ARE THE PROFESSIONAL ENGINEERING SERVICES THREATENED BY SUBSTITUTES?

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Substitutes pose a permanent threat on firms' products or services in any industry. As the extant literature on strategic analysis is abundant in examples of substitutes for goods and traditional services, the paper aims at analyzing in-depth the concept of substitutes in the case of engineering services industry which is a knowledge-based, project-based, and professional type one. The assessment of the threat of substitutes for these services has been supported by an empirical study among a number of managers of Romanian engineering companies. The paper ends up with a set of conclusions and an invitation to further debate and research.

Keywords: substitutes, professional services, engineering consulting and design services, industry, client.

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1. Introduction

The classic concepts in the strategic management theory have been developed and applied mainly to the production of material goods or traditional services firms almost overlooking the Professional Services Firms (PSFs) - the Industrial Engineering Consulting and Design Services Firms (IECDSFs) belong to - despite their distinctive characteristics (Scott, 1998; Sheehan, 2005; Malhotra & Morris, 2009; von Nordenflycht, 2010; Gand, 2010) which make them worth attention and in-depth study. Although the classic concepts may provide some strategic insights, managers of engineering services firms run the risk of applying misleading advice.

Out of the professional services firms category, the industrial engineering consulting and design services firms are among the least studied entities (Rimmer, 1991; Boxall & Steeneveld, 1999; Kreitl *et al.,* 2002; Ou & Chai, 2007; Kaiser & Ringlstetter, 2011) as far as their business management is concerned. Moreover, the strategy researchers have paid little attention to the competitive environment of these firms and their behaviour determined by the actions of the environmental competitive forces.

The IECDSFs serving different industrial sectors, among others of the same knowledge-based, project-based and professional type, are worthy of attention since they played and are still playing an important role in the industrial development and economic growth of countries in the world today (Kaiser & Ringlstetter, 2011), and it is assumed they will be playing a major role in the new „knowledge economy". They are considered to be one of the hallmarks of the knowledge-based economy (Bagdoniene *et al.,* 2007). That they have been unnoticed so far, is probably because their work is invisible for the general public, it is a very heterogeneous sector because they operate in a variety of fields, they are obscure, small and hidden in statistics as services or, in the best case, as professional services firms in general.

It is well known that substitutes generate one of the five competitive forces (as per Porter's five forces model) being a continual threat (Scott, 1998) on the firms' products or services in any industry (Porter, 2008). As the extant literature on strategic management and analysis is abundant in examples of substitutes for material goods and traditional services, the present paper aims at analyzing in-depth the threat of substitutes in case of industrial engineering consulting and design services sector which is a knowledge-based, project-based, and professional type one. The present paper tries to clarify the concept of substitutes while invites to further debates and research on this concept, in this particular case or similar cases.

The analysis in this paper is supported by the literature from Professional Services Firms (PSFs) field, by the extant literature on strategic analysis, also draws from author's own practicing experience of more than 20 years in the industrial consulting and engineering design services industry, both as a design engineer also as a general manager of an engineering company.

The analysis is descriptive and qualitative in nature, starts with a general overview of the engineering consulting and design industry and specific characteristics of IECDSFs (common with those of

PSFs), and then continues with a discussion regarding the substitutes in general, and in the particular case of professional engineering services of consulting and design. The paper ends up with a set of conclusions and directions for further research.

2. Engineering consulting and design services sector – a general overview

Engineering consulting and design services, as highly specialized activities, represent a key knowledge-intensive professional services sector that emerged during a later phase of global industrial development when a need for innovative solutions and improved design for construction projects, plants layout and technologies became evident. It has been seen as the key factor in the generation and definition of new technologies in advanced industrial economies, also as a key, risk-reduction factor in undertaking technology transfer from developed to developing economies.

Engineering consulting and design services include a wide range of activities, essentially intelectual, which are combined to optimize investment decisions in terms of choice, design and project management and implementation. The markets for engineering consulting and design services are therefore primarily related to the growth of industries (metals, mining, power, oil & gas, heavy machinery, cement, pulp & paper, chemical, rubber, etc.) and construction sector, and businesses in this sector tend to fluctuate with the cycles of growth and stagnation in production and constructions in major markets. Demand of industrial consulting and engineering design services is regularly characterized by uncertainty, unpredictibility, severe fluctuations, stagnation, or even discontinuity over time, depending on the economic cycles, growth and development of client industries and investment policies and plans of the potential customers belonging to various industrial sectors.

Industrial engineering consulting and design services are generally defined as highly specialized activities of intellectual nature, which identify, select, organize, process, convert and apply technical/ technological engineering knowledge and even create new knowledge for purposes of investments in production systems of client firms from industrial sectors. The outputs of these services do not feed the final consumption in an economy but represent intermediate inputs for other activities and processes of their client firms belonging to various industrial sectors. The outputs of these services are valuable intermediate inputs across a range of sectors of economy and thus directly shape the quality and efficiency of manufacturing and service firms' outputs (Løwendahl, 2005), also competitiveness and performance of these firms (Grimshaw & Miozzo, 2006).

The industrial engineering consulting and design services are required in conjunction with procurement, fabrication, construction, installation and commissioning activities to implement industrial investment projects that are usually undertaken to build new industrial facilities, increase the capacity or improve the productivity of industrial facilities, although safety and environmental based projects are also common.

The professional engineering services are characterized by certain methods/methodologies of work and often by a multidisciplinary approach (engineering, architecture, economics, finance, project management, ecology). The activities of engineering companies are intangible and "intellectual" to the extent that they involve highly qualified and skilled labour in terms of consulting, design and evaluation. The IECDSFs may provide any or all of a number of services, from consultancy to engineering, and these services can be categorized according to the stage of a project for which the services are provided. As such, there are services related to formulation of the project, research operations which explore various technologies available for a specific operation resulting in the choice of product design and technology, plant and equipment to be used, project evaluation, basic and detailed engineering and design, procurement of plant components, preparation of bid and contract documents, supervision of fabrication and construction, commissioning, testing and start-up of a new plant, training of personnel, services related to the operation and maintenance of an industrial facility.

The engineering consulting and design services industry is very heterogeneous but in this paper we focus on those engineering services firms which serve various industrial sectors (IECDSFs) such as metals, mining, power, heavy machinery, ship building, aircraft, oil & gas, cement, glass, rubber, pulp & paper, chemical, nuclear, manufacturing facilities, power transmission & distribution plants (Stroe, 2013).

As in this paper we are focusing on IECDSFs serving industrial production firms across various industrial sectors on investment projects, engineering consulting services may be particularly defined as activities involved in the identification and organization of technological knowledge, relating its possibilities and uses to the context of physical, technological, economic, social, and environmental requirements. Depending on the stage of a project for which the services are provided, engineering services can be grouped into three categories:

- Pre-investment (pre-project) services, rendered before the materialization of an investment, in order to identify, prepare and evaluate projects and select the appropriate technologies. These services are provided before the actual start of engineering design and fabrication and comprise techno-economic, pre-feasibility, project feasibility and evaluation studies (including market, location, technological, economic, commercial, financial and environmental aspects), preparation of terms of reference and invitations for tender;

- Project implementation services, rendered during the execution of the project. These services comprise project engineering (choice of appropriate technology and equipment, engineering surveys, drawings, plans, diagrams, bills of materials, specifications, tendering, bids evaluation and contracting, negotiation of financial, commercial, know-how agreements, information systems), supervision of project execution (procurement, fabrication, construction, erection, installation), and commissioning and start-up (including personnel training);
- Services for management and production, rendered during the operation stage of an investment which has already been materialized. These services comprise technical assistance and troubleshooting during operation/production, production planning and control, cost control and optimization, product design and development, process improvement, quality control and maintenance systems, sales and inventory systems, expansion programmes, personnel training, management information and control systems, etc.

Engineering design services, rendered mainly during the project implementation stage (project engineering), are particularly defined as activities involved in the conversion and application of knowledge in order to develop data, diagrams, drawings, models, simulation and calculation reports, product specifications, materials and fabrication specifications, wear and tear parts specifications, painting, packing, labeling, handling, and transport specifications, procurement specifications for special plant components and equipment, risk analysis reports, instructions for assembly, erection, installation, cold test, hot test, endurance test, commissioning, start-up, operation, maintenance, with the purpose of implementing new physical facilities for production activities, or of optimizing and maintaining the existing facilities.

As IECDSFs belong to the PSFs category which on its turn is a sub-group of the Knowledge-Intensive Firms (KIFs) or Know-How Companies group also of the Project-Based Organizations (PBOs), the mutual characteristics of these types of companies relevant for the present analysis are (Løwendahl, 2005; Alvesson, 1995, 2004; Scott, 1998; Kaiser & Ringlstetter, 2011):

- Their services are project-based and highly knowledge-intensive, delivered by professional workers with higher education, qualification and specialization, and frequently closely linked to technological knowledge development within the relevant area of expertise.
- Their services consist in creative, complex, and customized problem-solving and generally involve a high degree of customization in order to comply with the clients' unique problems or specifications. Hence, production processes cannot be easily industrialized, although some solutions can be standardized and used to different clients.
- Their services involve a high degree of discretionary effort and personal judgment by the experts delivering the services.
- Their services require substantial interaction with the client firm's staff. For the IECDSFs, the interaction with the client is most intense in the early definition stages of the project, whereas after the project proposal has been accepted and the contract awarded, the design process takes place largely within the IECDSFs offices.
- Their services are delivered within the constraints of technical norms, standards, regulations and clients' specifications.
- Selling professional services to potential clients is very different from the mass-marketing of consumer goods or services, as it involves both interaction with the client and a high degree of uncertainty, on demand side, in terms of what is actually going to be delivered.

The business of IECDSFs consists in creative, complex, and customized problem-solving activities for their customers. If the industrial production companies create value within a „value chain", the IECDSFs create value by solving their clients' problems through the application of knowledge within a „value shop". A value shop is an organization that creates value by solving the unique problems and satisfying the needs of its customers and not by producing physical outputs starting from physical inputs (Thompson, 1967; Stabell & Fjeldstad, 1998). A value shop sells its own competences and the customers buy solutions to their unique problems (Fjeldstad & Haanaes, 2001).

The five generic categories of primary value shop activities are problem finding & acquisition, problem solving, choice, execution, and control and evaluation (Stabell & Fjeldstad, 1998). Rather than being embodied in the process or product, knowledge resides in experts and it's application is customized based on clients' needs (Sheehan, 2005). The activities in these firms are performed by highly qualified professionals and the outcomes are provided by the mental efforts of the professional employees.

Whereas nowadays knowledge plays a role in all firms, it's role is distinctive in engineering consulting and design services firms (Sheehan, 2005). For IECDSFs both their inputs and outputs are intangible. For professional workers (engineers, designers, technical experts) knowledge is simultaneously an input, medium and output of their work (Newell *et al.,* 2002) and is characterized by a high degree of intangibility. Even though for IECDSFs the outputs are in form of written studies, specifications, calculation reports, instructions, and plotted drawings and plans, which all are tangible, storable and reusable, the intangibility of outputs refers in this case to the lack of customers' capability to physically feel and assess both the intangible intermediate outputs – because of the lack of specialized knowledge and information – and the physical final outputs to be materialized on the basis of IECDSFs intangible outputs. IECDSFs primarily create value through processes that require them to know more than their clients, either in terms of expertise or in terms of experience in similar problem-solving situations.

In current times the services that the IECDSFs aim to deliver are increasingly coming under pressure because of a continually changing environment. Because of the technological developments, collapsing boundaries of the industries, globalization and changing roles of competitors, blurred identity of the engineering consulting and design sector, commoditisation of design, and shifting patterns of customers' demand, the IECDSFs need to take notice of these changes and seek out viable strategies through which they are able to continue their endeavours to drive innovation and economic growth thus fulfilling their mission and the critical role that they play within the national context.

3. The concept and threat of substitutes – a general overview

As professor Porter posits „a substitute performs the same or a similar function as an industry's product but by a different means." (Porter, 2008:84). Johnson, Scholes and Whittington state that „substitutes are products or services that offer a similar benefit to an industry's products or services, but by a different process." (Johnson *et al.,* 2008:62).

Among industrials the source of most substitution is new technology. Technological substitution occurs as often in production technology as it does in end-products themselves (Scott, 1998). Keeping an eye on industry trends will help spot innovations that could affect the industry. A firm's capacity to keep up with technology is critical to the agility with which a firm responds in defending threat and capitalizing on opportunity. Porter asserts that, „...technological changes or competitive discontinuities in seemingly unrelated businesses can have major impact on industry profitability. Of course the substitution threat can also shift in favor of an industry, which bodes well for its future profitability and growth potential." (Porter, 2008:85). Porter gives the examples of videoconferencing which is a substitute for business travel, of plastic as a substitute for aluminum, and e-mail as a substitute for express mail. If we consider the traditional photo film industry which faced the emergence of digital photo devices, one can assert that the substitutes can pose a threat not only on industry's profitability but also on its very existence.

Managers often focus on their direct known competitors in their own industry and usually neglect the threat posed by substitutes. According to Porter, "sometimes, the threat of substitution is downstream or indirect, when a substitute replaces a buyer industry's product. ... Substitutes are always present, but they are easy to overlook because they may appear to be very different from the industry's product." (Porter, 2008:84). As one can see, in Porter's and other authors' examples available in the extant strategic management literature, the products or services presented as substitutes are found outside the industry of the original product/service, but serve the same or a similar purpose by performing the same or a similar function. Therefore, the competition engendered by the threats of substitutes comes from products/services outside the incumbents' industry and should not be confused with competitors' threats from within the industry. Thus, the extra-industry effects are the core of the substitution concept. The value of the substitute concept is to force the managers to look outside their own industry and consider more distant threats and constraints (Johnson *et al.,* 2008). Substitutes nearly always exist (Porter, 2008) and represent a continual threat (Scott, 1998) on the firms' products or services in any industry.

The threat of substitution is defined as the extent or degree to which different products and services, coming from different industries, can be used in place of an industry's existing products and services presently available on the market. The threat of substitution is affected by the ability of firms' customers to find a different way of doing what incumbent firms actually do for them. The threat of substitutes exists most dangerously when the price of a similar product in the marketplace goes down. As more substitutes become available, both the demand for and the price of the products becomes more elastic. As the price for substitutes goes down, the manufacturer of the original product or provider of original service is prevented from raising or forced to lower its price.

Several factors may exacerbate the threat of substitutes. The existence of products outside of the realm of the common product/service boundaries increases the propensity of customers to switch to alternatives. The potential factors that may lead to an increased threat of substitution are client propensity to substitute, relative price-performance of substitute, client switching costs, perceived level of product/service differentiation, number of substitute products/services available in the market, ease of substitution, substandard product/service, quality depreciation (Porter, 2008). In addition, Lynch suggests that the possible threat of obsolescence of the actual products or services may be a key issue to consider when trying to protect against substitutes (Lynch, 2000).

For example, the threat is higher if a product/service has no specific benefit compared to similar products/services. E-mail, the regular postal service and fax machines are all considered substitutes for each other, but each has its own specific benefit that keeps any of them from becoming obsolete and taking away of the market. Customers' ease in switching to substitutes also affects how serious their threat is. However, the threat of substitutes is greatest when price is the customer's primary motivation to purchase the product. The threat that substitute products pose to an industry's profitability depends on the relative price-to-performance ratios of the different types of products or services to which customers can turn to satisfy the same basic need. The threat of substitution is also affected by switching costs – that is, the costs in areas such as retraining, retooling and redesigning that are incurred when a customer switches to a different type of product or service.

The threat of substitutes also involves:

- Product-for-product (service-for-service) substitution (email for regular postal mail, fax); is based on the substitution of need;
- Generic substitution (videoconference systems suppliers compete with travel companies);
- Substitution by choosing not to buy; it relates to something that people can live without (e.g. cigarettes, alcohol, various luxury and sophisticated services).

A good way to reduce the threat of substitutes is to increase customer loyalty in any way possible. Producing a product with obvious benefits over the available substitutes and decent branding are helpful for an individual company. In some cases, an advertising campaign for an industry's product may be the best way to go. For example, if a firm supplies a unique software product that automates an important technological process, a client firm may substitute the software product by doing the process manually or by outsourcing it. Although some people might take the bus or buy a new car, there is no substitute for good mechanical skills and experience in an auto-repair shop. If substitution is easy and substitution is viable, then this weakens the power of producer/supplier.

4. The concept and threat of substitutes – the particular case of IECDSFs

When it comes to the industrial engineering consulting and design services firms, substitute products or services are not an easy concept to apply (Langford & Male, 2001). This is because the outputs of these firms do not feed the final consumption in an economy, represent inputs in other value chains, and have no direct application and immediate utility for the industrial client company. Moreover, IECDSFs do not have technology in the industrial sense of the word. Their work methods, techniques and frameworks can be easily copied (Scott, 1998).

The industrial engineering consulting and design services are required in conjunction with procurement, fabrication, construction, installation and commissioning activities to implement industrial investment projects. In the case of an industrial investment project intended to implement a new technological plant within an industrial production company, the outputs of an IECDSF represent inputs for other activities and processes performed by other firms (contractors) which fabricate, build and install that plant for the client (industrial company - owner of investment). The physical and functional system (the plant) has a major significance for the industrial client company because it will become a component of its value chain. That physical and functional system is seen by the client as the solution for its specific problem and satisfying its need. The outputs of the IECDSF, even if contain all the knowledge and informations embodied in the drawings and specifications related to the physical system, it has no direct application or immediate utility for the industrial client company (Figure 1).

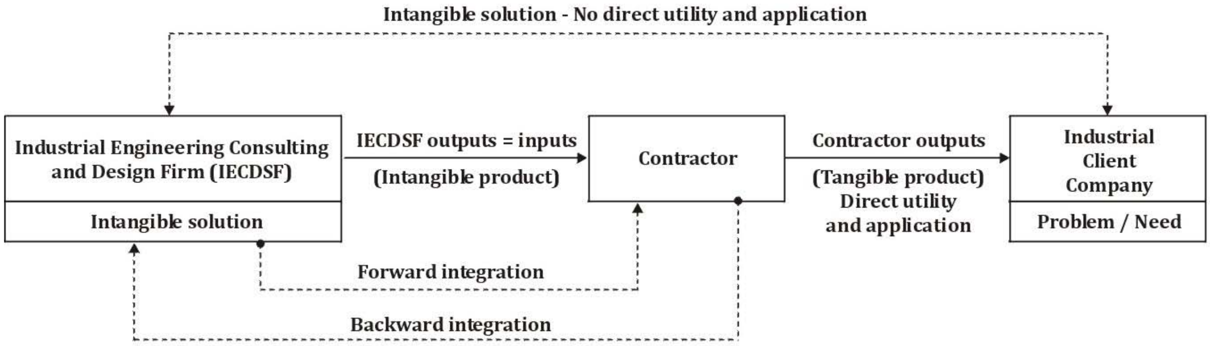

Figure 1 – Value chain in an industrial investment project

After having carried out a vast literature survey we did not find any paper, article or book containing analyses and generally accepted opinions of researchers and academics regarding the substitutes concept and existence or non-existence of threat of substitutes for the particular case of the industrial engineering consulting and design services. Obviously, there might be both *pros* and *cons*, depending on the perspective, background and degree of understanding of the concept and industry.

One exception can be mentioned here, namely that of Scott who, referring to PSFs in general, argues that „substitution does not occur through the appearance of a more advanced technique; it occurs through competitors making more compelling claims to a client than the incumbent firm. Substitution is simply a continual process of prizing away clients through superior reputation and talent." And, „all the PSF has to worry about is whether the quality of its service exceeds that offered by its immediate competitors. Substitution is the litmus test of a company losing competitiveness." (Scott, 1998:32). But, the statements of Scott seem to come in contradiction with the core of the substitutes concept in the strategic management literature, namely that the substitutes must come from outside the industry. Also, he considers as substitutes the services of the direct competitors from within the same industry which is not in compliance with the definitions generally accepted in the strategic management literature.

The critical issue in deciding what is, or, is not a substitute, in the common meaning, is that the substitute must come from outside the industry, undertake the same function and have direct application and the same utility for the client. Substitute products or services, important for defining market and industry boundaries, are predominantly a buyer issue, focusing on meeting a given need, provided that a seller can offer a similar product/service able to meet the functional requirements sought by the customer at the right price (Kay, 1993). When we think of the threat of substitutes, we can view that in the context of alternatives to the clients' existing specifications. Thus, we can ask ourselves: is the current environment creating the right circumstances for experimenting with new specifications? Ironically, that is likely to depend on the risk appetite of the client companies. Some companies will be risk averse and resist experimentation while others will welcome the potential for cost reduction and enhanced customer experience. The stakes are high - will that be thrashed out in the procurement strategy?

In the particular case of engineering consulting and design services, a potential industrial customer may expand the concept of service substitution by including the option of simply deselecting or not purchasing the service at all. An industrial client company can deselect the engineering consulting and design services when it can manage in-house this kind of services by its own technical department (project engineering department) following the „do it yourself" approach. Although one can understand why a technologically savvy client may think it is easily to be done, this approach might be a risky intention. Taking this argument into the future, a trend we can be assured of is the exponential evolution of technology. Therefore, those companies focusing purely on a specific specialist technology may find themselves at risk because of the threat of substitute technologies or obsolescence.

The majority of industrial production companies have retained only a few numbers of engineers and technologists within an in-house project engineering department to deal with a small base load of projects and to administer the efforts of external engineering consulting firms contracted to complete the majority of complex projects. This approach makes sense because project engineering requirements vary greatly over time, making it inefficient for the industrial companies to maintain sufficient in-house engineering departments and meet their highest demands through periods of low capital investment. There is a very small risk that a reverse trend could occur if large industrial companies decide to adopt a central in-house engineering approach to providing services for their facilities. Given current trends in the industry, however, this poses only a minor threat of substitution for engineering consulting and design services provided by independent IECDSFs.

Since we did not find any result of academic research on this matter, in order to get an idea on how this concept is actually understood and managed by practicioners in real life, we conducted a study by questioning 25 actual or former general managers of several Romanian engineering consulting and design companies which operate in various industrial sectors. As expected, the results show differences in the way managers understand the concept and take into consideration the threat of substitutes.

Thus, about 36% of the managers argue that there are no substitutes for the provision of engineering consulting and design services, therefore there is no threat of substitutes in this industry. They contend it is unlikely that clients will find an alternative expenditure for their funds that would meet their needs. This is a categorical statement which may be supported by the following exemplar contention: although the advanced PCs and CAD software programs are available and might be useful for a potential client (industrial company) to generate and visualize a new plant layout and plant's components in three dimensions, they are no substitute for the services of a competent engineering team.

The same is true even for an engineering design company for which the PCs and CAD softwares are only tools and cannot replace the knowledge, skills and expertise that resides in the professional engineers but only help knowledge processing. An engineering team takes into account a lot of aspects, variables, and constraints before and during the conception and design of the plant such as building, zoning and energy and environmental codes and regulations; soils and seismic issues; design in terms of space usage and flow, available and optimum fabrication technologies, suitable materials and heat treatments, technological performance indicators, energy usage, project budget, a.s.o. Thus, they say this concept does not apply *stricto senso* in the engineering consulting and design services industry due to the fact that each service is unique and rendered according to particular specifications in order to meet the customer's requirements, and the implication of human knowledge, skills, expertise and thinking is indispensable. Therefore, in their opinion, there is no threat of substitutes for the engineering consulting and design services *per se,* but one might consider substitution of services provided by an engineering services company by the services provided by another engineering services company, which is in contradiction with the definition.

On the other hand, the others 64% of the managers argue that the degree to which engineering consulting and design services can be substituted varies quite a bit, therefore there is a certain extent of threat of substitutes in this industry as explained below.

In general, an industry is defined by its end-product which represent a material, tangible object, with characteristics that allow the potential buyer to „feel" and assess the product before purchasing. The end-product has also direct and immediate utility for its purchaser. As stated before, in case of engineering consulting and design services industry the end-product is not tangible even if it is in form of feasibility studies, planning studies, technological solutions, plants layouts, technical specifications, conceptual/preliminary/detail designs, workshop drawings, calculations reports, diagrams, erection and installation drawings and instructions, operation and maintenance instructions, which are tangible and storable. Moreover, the end-product of these services (the service product) has no direct application and immediate utility for the purchaser because it represents an intermediate input for other activities and processes whose outputs are of direct application and immediate utility for their client firms.

The key issue in distinguishing what is a substitute, in the largely accepted meaning, is to identify the functional usage of the end-product for the buyer, once the decision to invest in new production systems has been made. The next stage is to determine the level of integration within the project delivery process sought by the client, and subsequently determine the alternative means of satisfying that function whilst taking into account the management of time, cost, quality, risk and safety through the correct strategic choice of procurement route. This will then determine the competitive arena or market for engineering consulting and design services firms. Market players are also very likely to be involved at all stages – even if clients are only refurbishing or upgrading an existing production system or plant rather than investing in a new plant or equipment.

For example, let us take the case of a steel making company which plans to increase its production capacity. Supposing that upstream facilities (blast furnaces) are able to supply an increased amount of molten iron, increasing the existing steel production capacity implies construction of a new converter and a new continuous casting machine. Once the decision to invest in new production systems has been made, the steel company deals with an external engineering consulting and design company to supply the know-how and engineering design for the construction and implementation of the new production capacities. But, the work of the IECDSF results in knowledge embodied in drawings and technical/technological specifications. These outputs represent an intangible solution for the client's problem (need) and have no direct utility and application for the client. Consequently, the client then hand over the drawings and specifications issued by the IECDSF to a contractor who will take the responsibility for procurement, fabrication, construction, installation and commissioning of the new production systems.

As often an industry's product or service is used together with others produced by different industries, seemingly there is a relationship of complementarity of the IECDSF's services and contractor's services. Since complementors are products which are valuable together but worthless when separated, we consider it would be more correct to call it quasi-complementarity, because in our case the two products are valuable together, but only the drawings and specifications are worthless when taken separately. The client does not need the intangible solution to its problem embodied in drawings and specifications and the contractor does not know to fabricate or build the physical system the client requires without the inputs coming from the IECDSF. The result of the IECDSF services (the objective of the conception stage of the overall project) represents a target for the contractor and client (the objective of the implementation stage of the overall project) (Vaattovaara, 1999) who has to materialize the intangible solution provided by the IECDSF and transform it into the physical and functional state that performs the desired function and satisfies the client's need. Thus, it can be stated that a demand for engineering consulting and design services automatically generates demand for fabrication, construction and installation services. The reciprocal statement is valid as well.

The others 64% of the questioned managers contend that in the current times an increasing threat for IECDSFs is local and/or international turnkey contractors, which either have in-house engineering capabilities or own an engineering design subsidiary, by taking a proactive role in identifying projects and executing them on a turnkey basis including financing, project management, engineering consulting and design, procurement, construction, fabrication, installation, and commissioning. This is because clients seek for integrated solutions and find of more significant value the „one-stop shopping" option also because they are aware that can save costs by using one firm. If these contractors do not have in-house engineering capabilities they might procure the required engineering services from independent IECDSFs. Eventually, some of these contractors will probably end up integrating backwards by creating in-house design units or by forming strategic alliances with more than one IECDSF.

In such alliances the IECDSF does not enjoy all the professional privileges as it does when operating as an independent entity. The fact that contractors are encroaching on the engineering services market may be seen as a substitution issue since the engineering services are being substituted by contracting services that encompass the services originally provided by independent IECDSFs. In this case, the substitutes come from a different industry and perform more than the same function and has more utility for the client than the services substituted.

Porter contends that "if an industry does not distance itself from substitutes through product performance, marketing, or other means, it will suffer in terms of profitability – and often growth potential." (Porter, 2008:84). Thus, an actual trend in the engineering consulting and design industry, increasingly pursued by both major industrial customers who seek for integrated solutions and single point responsibility and IECDSFs, is for the IECDSFs to bid and get involved in *"design & build"* contracts, meaning a quasi-forward integration, thus trying to counteract the big contractors' backwards integration trends. This is possible only for large integrated engineering companies who are able to provide a vast set of services related to project definition and implementation. We call it quasi-forward integration because the IECDSF acts as a project manager and takes the responsibility for the entire project implementation from concept to commissioning and start-up, but the physical works such as land preparation, fabrication, construction, installation, commissioning are carried out by specialized sub-contracting companies on behalf of the IECDSFs and not by themselves.

Vertical integration provides the opportunity for IECDSFs and contractors to extract more margin from the value chain. It also provides clients with added value in the form of increased risk reduction and lower transaction costs associated with bidding, negotiating, and contract administration after the detailed engineering phase of the project.

5. Conclusions and directions for further research

Are industrial engineering consulting and design services threatened by substitutes? This is a problematic question to answer as long as in-depth studies have not been conducted and there is no unified opinion among academics and researchers.

As seen before, even among practicioners there is a lack of consensus. Some of them assert that there is no threat of substitutes for the engineering consulting and design services *per se,* but admit that services provided by one engineering company can be substituted by the services provided by a competitor company as long as the end-result will have the same utility for the client, which is in contradiction with the definition. On the other hand, some argue that the degree to which industrial engineering consulting and design services can be substituted varies quite a bit, therefore there is a certain extent of threat of substitutes in this industry. The fact that contractors are encroaching on the engineering services market may be seen as a substitution issue since the engineering services are being substituted by contracting services that encompass the services originally provided by independent IECDSFs. In this case, the substitutes come from a different industry and perform more than the same function and has more utility for the client than the services substituted.

In our opinion, as long as engineering consulting and design services are highly knowledge-intensive, specialized and customized ones, they can almost never be substituted. Due to backward or forward integration strategic decisions they will always be found within various industrial value chains even if they will not be furnished by independent engineering and design organizations but encompassed within other companies' activities. Thus, this concept does not really apply *stricto senso* in the engineering consulting and design services industry due to the fact that each service is unique and rendered according to particular specifications in order to meet the customer's requirements. But, while practically there is no substitute for the value of services an engineer can provide, not yet at least, it is a force that needs reckoning with.

Further research can be initiated by considering IECDSFs from other countries as well as by questioning the industrial clients on their opinion regarding the necessity to have external engineering consulting and design services providers. Also, another path of research might be the concept and threat of substitutes for other technical, knowledge-based and professional engineering services, such as R&D, testing and technical analyses services, forensic engineering services, fire engineering services, safety engineering, or even other professional non-technical services such as accounting, management consulting, financial.

References

1. *Alvesson, M. (1995), Management of Knowledge-Intensive Companies, Berlin/New York: de Gruyter.*
2. *Alvesson, M. (2004), Knowledge Work and Knowledge-Intensive Firms, New York: Oxford University Press,.*
3. *Bagdoniene, L., Kunigeliene, D. and Jakstaite, R. (2007), "Relationship Marketing as Factor for Competitiveness of Knowledge-Intensive Business Services' Providers", in Proceedings of the Service Competitiveness and Cohesion-Balancing Dynamics in the Knowledge Society Conference, Reser 2007: XVIIth International Conference of RESER, Tampere, Finland, pp. 103-120.*
4. *Boxall, P. and Steeneveld, M. (1999), "Human Resource Strategy and Competitive Advantage: A Longitudinal Study of Engineering Consultancies", Journal of Management Studies, 36(4), pp. 443-463.*
5. *Fjeldstad, Ø.D. and Haanaes, K. (2001), "Strategy Tradeoffs in the Knowledge and Network Economy", Business Strategy Review, 12(1), pp. 1-10.*
6. *Gand, S. (2010), "Analyzing and comparing Professional Service Firms over services, time and space. Proposition of a foundation framework", 26th Colloquium of European Group for Organizational Studies EGOS 2010, July 1-3, Lisbon, Portugal.*
7. *Grimshaw, D. and Miozzo, M. (2006), "Knowledge intensive business services: understanding organizational forms and the role of country institutions", in Miozzo, M. and Grimshaw, D. (eds.), Knowledge Intensive Business Services: Organizational forms and national institutions, Northampton: Edgar Elgar Publishing, pp. 1-25.*
8. *Johnson, G., Scholes, K. and Whittington, R. (2008), Exploring Corporate Strategy, 8th Edition, Harlow: Pearson Education Limited.*
9. *Kaiser, S. and Ringlstetter, M. (2011), Strategic Management of Professional Service Firms, New York: Springer-Verlag.*
10. *Kay, J. (1993), Foundations of Corporate Success, Oxford: Oxford University Press.*
11. *Kreitl, G., Urschitz, G. and Oberndorfer, W.J. (2002), "Corporate growth of engineering consulting firms: a European review", Construction Management and Economics, 20(5), pp. 437-448.*
12. *Langford, D. and Male, S. (2001), Strategic Management in Construction, 2nd Edition, Oxford: Blackwell Science.*
13. *Løwendahl, B.R. (2005), Strategic Management of Professional Service Firms, 3rd Edition, Copenhagen: Copenhagen Business School Press.*
14. *Lynch, R. (2000), Corporate Strategy, 2nd Edition, Harlow: Financial Times/Prentice Hall.*
15. *Malhotra, N. and Morris, T. (2009), "Heterogeneity in professional service firms", Journal of Management Studies, 46(6), pp. 895-922.*
16. *Newell, S., Robertson, M., Scarbrough, H. and Swan, J. (2002), Managing Knowledge Work, London: Palgrave.*
17. *Ou, W.-M. and Chai, K.-W. (2007), "Use of Leadership and Differentiation Strategies by Professional Service Firms: A Case Study", International Journal of Management, 24(3), pp. 477-488.*
18. *Porter, M. (2008), "The five competitive forces that shape strategy", Harvard Business Review, pp. 79-93.*
19. *Rimmer, P. (1991), "The global intelligence corps and world cities: engineering consultancies on the move" in Daniels, P. (ed.), Services and Metropolitan Development, London: Routledge.*
20. *Scott, M. (1998), The Intellect Industry: Profiting and Learning from Professional Service Firms, Chichester: John Wiley & Sons.*
21. *Sheehan, N.T. (2005), "Why old tools won't work in the 'new' knowledge economy", Journal of Business Strategy, 26(4), pp. 53-60.*

22. *Stabell, C.B. and Fjeldstad, Ø.D. (1998), "Configuring Value for Competitive Advantage: On Chains, Shops, and Networks", Strategic Management Journal, 19(5), pp. 413-437.*
23. *Stroe, G.S. (2013), "Structural analysis of engineering consulting and design industry", Management & Marketing, 8(1), pp. 41-62.*
24. *Thompson, J.D. (1967), Organizations in Action, New York: McGraw Hill.*
25. *Vaattovaara, M. (1999), "Transforming services into products in a system engineering company", Doctoral Dissertation, Industrial Management and Work and Organizational Psychology, Helsinki University of Technology.*
26. *von Nordenflycht, A. (2010), "What is a Professional Service Firm? Toward a Theory and Taxonomy of Knowledge-Intensive Firms", Academy of Management Review, 35(1), pp. 155-174.*