AN EXTENDED INDUSTRY ANALYSIS OF THE WATER FACILITIES DESIGN INDUSTRY IN BRITISH COLUMBIA

by

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Abstract

This paper presents an extended industry analysis of British Columbia's water facilities design industry. The paper analyzes the industry using two models to determine the competitive position, profitability, linkages and competitive scopes of typical engineering consulting firms with water facilities design practices in British Columbia. Strategies to be pursued are then recommended based on these analyses.

The extended industry analysis is first conducted using the Five Forces model. This model determines the overall competitive position and profitability of typical engineering consulting firms with water facilities design practices in the industry. The Value Chain model is then used to identify linkages and competitive scopes that exist within the larger water facilities industry.

Through the analyses conducted with the two models, sources of competitive advantage or key success factors are identified and critical ones are recommended for implementation.

Keywords: Water, Design, Engineering, Facilities

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Glossary

KSF	Key Success Factor
RFP	Request for Proposal
QBS	Quality Based Selection
P.Eng.	Professional Engineer
B2B	Business to Business
APEGBC	Association of Professional Engineers and Geoscientists of British Columbia
ASTTBC	Applied Science Technologists and Technicians of British Columbia
AIA	American Institute of Architects
CADD	Computer Aided Design and Drafting
BIM	Building Information Management
GIS	Geographic Information Systems
3D	Three Dimensional

1: Introduction

1.1 Purpose and Scope

The purpose of this paper is to complete an extended industry analysis of the water facilities design industry in British Columbia.

Public infrastructure is comprised of the physical assets and facilities necessary for a community to function. Such infrastructure includes roads, bridges, schools, hospitals, power distribution systems, water works and wastewater works. Water works and wastewater works include water supply and treatment works, water transmission and distribution works, wastewater collection works and wastewater treatment and disposal works. For reasons to be discussed later in this chapter, these works are classified either as linear (water transmission and distribution works and wastewater collection works) or facilities (water supply and treatment works and wastewater treatment and disposal works). Henceforth, water supply and treatment works and wastewater treatment and disposal works will be referred to collectively as water facilities.

Engineering consulting firms are groups of engineering professionals that offer their advice to clients and charge a fee for such advice. This advice comes in the form of design services provided to build, upgrade and rehabilitate buildings and infrastructure. The engineering consulting industry that provides design services to build, upgrade and rehabilitate water facilities in British Columbia will be the focus of this paper.

Through the extended analysis of the water facilities design industry in British Columbia, sources of competitive advantage or key success factors (KSFs) will be identified that can help engineering consulting firms practising water facilities design formulate more effective strategies.

1.2 Water Facilities Design Industry in British Columbia

1.2.1 Industry History

A cursory review of the early history of many modern industries and the different types of organizations within them shows that as these organizations grew and became more complex, the need for specialized professional services offering independent advice grew. Typically, professional legal, accounting and engineering design services were required when such organizations did not want or could not justify full-time lawyers, accountants and engineers on staff (McKenna, 1995).

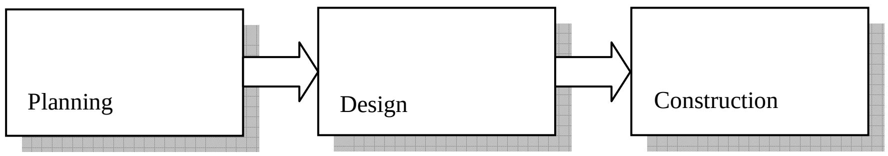
In the public sector, as the understanding of the link between public health and public water supplies grew in the late 1800s and early 1900s, the need for drinking water treatment works, wastewater treatment works and the engineering design services required to build them grew. To satisfy this need for design services, public sector agencies responsible for the delivery of drinking water and the disposal of wastewater turned to engineering consulting firms specializing in water facilities for the design of such facilities.

1.2.2 Industry Definition

To ensure the extended industry analysis undertaken in this paper produces meaningful results and provides a basis from which effective strategies can be formulated (Porter, 2008), the following discussion serves to define the water facilities design industry in British Columbia.

The vast majority of infrastructure in Canada is owned and operated by public sector agencies. Such agencies include crown corporations, federal and provincial government agencies and regional and local municipalities. At a high level, the supply chain to build, upgrade or rehabilitate each major class of infrastructure (transportation, drainage, parks, recreational, cultural and water infrastructure) is very similar. To build, upgrade or rehabilitate its infrastructure, each agency undertakes the activities of planning, design and construction (see Figure 1.1 below):

Figure 1-1 Infrastructure Supply Chain



The delivery of projects in this supply chain begins with the agency planning the project. The agency will then retain an engineering consulting firm to design the project. Once the retained firm completes the design drawings and specifications for the project, the agency uses the drawings and specifications to compile a tender package. This package is used to solicit bids from several general contractors to construct the project. Once all bids are received, the agency selects the general contractor with the lowest bid to enter into a contract to construct the project. The water facilities design work undertaken in the middle box of Figure 1.1. and the interaction between the agency and the engineering consulting firm providing design services to the agency is the subject of the extended industry analysis in this paper.

The agencies responsible for water infrastructure in Canada are primarily local municipalities. With access to only 8% of all tax revenues, these municipalities build and maintain over 80% of the water infrastructure in Canada (Mirza, 2007). Engineering consulting firms can provide services to these municipalities in all stages of the water infrastructure supply chain. However, for the purpose of industry definition, differentiating between water infrastructure planning, design and construction services is appropriate as the technical skills and capabilities required by planners, engineering design professionals and general contractors differ. In addition, the financial requirements for design and construction differ by an order of magnitude (depending of the type of infrastructure, engineering design fees are typically 5% to 15% of the capital expenditure requirements for construction). It is for these reasons that drawing boundaries around the water infrastructure design industry is appropriate.

Furthermore, water infrastructure in Canada is commonly categorized into linear and facility assets. Linear assets are distributed throughout the area serviced by the water infrastructure and include transmission mains, water distribution mains, sanitary collection sewers, services, manholes, chambers and related appurtenances such as valves, hydrants, etc. Facility assets include those parts of the water infrastructure that are located at points geographically and include treatment plants, reservoirs and pumping stations. Differentiating between the linear and facility assets of the water infrastructure design industry and henceforth, analyzing the design of these assets as separate and distinct industries is appropriate since:

- the design industries servicing these two assets are largely populated by distinct sets of rivals (i.e. most design firms usually compete in one industry or the other),
- the technical skills and qualifications required for each differ significantly (i.e. the design of linear assets requires more of a civil engineering background whereas the design of facility assets requires more of a multidisciplinary engineering background), and
- the construction methods for each are significantly different (i.e. the construction of linear assets is far more equipment intensive than the construction of facility assets), requiring different types of field knowledge and experience.

Given the different bases of competition in these asset classifications (i.e. skills, qualifications, knowledge and experience), drawing boundaries around the design of facility assets within the water infrastructure design industry for the purpose of extended industry analysis is appropriate.

1.2.3 Industry Size

A first order approximation of the present value of the water facilities design industry in British Columbia is calculated as follows:

- In 2007, the water infrastructure deficit (i.e. the total funds required to upgrade and rehabilitate existing water infrastructure such that it meets minimum service levels) was estimated to be $31B across Canada (Mirza, 2007),

- From 2007, water infrastructure upgrade and rehabilitation works across Canada are assumed (conservatively) to have kept pace with the deterioration of the same water infrastructure (i.e. the present day water infrastructure deficit is equal to the 2007 water infrastructure deficit),

- The water infrastructure deficit for British Columbia is proportional to the fraction of Canada's population residing in British Columbia ("Population by Year, by Province and Territory", n.d.):

  $$\text{Deficit}_{BC} = \text{Deficit}_{Canada}(\text{Population}_{BC\text{-}2011}/\text{Population}_{Canada\text{-}2011})$$

  $$= \$31B(4{,}573{,}300/34{,}482{,}800) = \$4.11B$$

- In 2007, the present value of new needs for water infrastructure was estimated to be $56.6B across Canada (Mirza, 2007); conservatively, it is assumed to be the same at present,

- The present value of new needs for water infrastructure in British Columbia is proportional to the fraction of Canada's population residing in British Columbia ("Population by Year, by Province and Territory", n.d.):

  $$\text{New Needs}_{BC} = \text{New Needs}_{Canada}(\text{Population}_{BC\text{-}2011}/\text{Population}_{Canada\text{-}2011})$$

  $$= \$56.6B(4{,}573{,}300/34{,}482{,}800) = \$7.51B$$

- The present value of engineering design required to execute the above noted water infrastructure construction is approximately 1.5% of the water infrastructure life cycle costs and the value of water infrastructure construction is approximately 16.5% of the life cycle costs (Consulting Engineers of British Columbia, 2006):

  $$\text{Present Value}_{\text{Engineering Consulting}} = (1.5\%/(1.5\% + 16.5\%))(\$4.11\text{B} + \$7.51\text{B}) = \$968\text{M}$$

- Assuming a 50/50 split between linear and facility assets, the present value of water facilities design work is approximately \$968M/2 = \$484M

It should be noted that estimating the size of the water facilities design industry based on budgetary allocations from municipal, provincial and federal levels is inappropriate as water infrastructure has been chronically underfunded over many decades, leading to Canada's present water infrastructure deficit (Mirza, 2007). The first order estimation described above is more of a representative reflection of the quantum of work required and the opportunities available.

1.3 Industry Situation and Overview of Strategies

1.3.1 Prevailing Industry Features

Two features of the water facilities design industry significantly influence its structure: tendering in the public sector and acquisitions in the engineering consulting sector. To appreciate the competitive dynamics within the industry, understand the strategies employed within it and provide a basis from which meaningful KSFs can be identified, these features are discussed below.

1.3.1.1 Tendering in the Public Sector

In the public sector, products and services are almost always procured through a public tendering process. The policies and procedures that embody the public tendering process are designed to ensure transparency and value. Such policies and procedures involve describing the requirements for the product or service in detail, formalizing this description in a tender and inviting sealed bids from prospective suppliers or contractors. Once all bids are received, the supplier or contractor that submits the lowest bid is awarded the contract (Federation of Canadian Municipalities, 2006).

For professional services in general, and water facilities design services in particular, the above noted low-cost approach is inappropriate. As previously discussed, the design undertaken by engineering professionals amounts to approximately 1.5% of a project's total life cycle costs, yet the quality of such design directly affects the remaining 98.5% of the project's overall life cycle costs (i.e. construction, operations and maintenance costs). When such design is done well, quality and performance is increased and overall life cycle costs are decreased. The proponents of quality based selection (QBS) maintain that the quality and performance of infrastructure, as manifest in infrastructure life cycle costs, is a direct consequence of the design undertaken early in the life cycle (Consulting Engineers of British Columbia, 2006).

With an appreciation of the above reasoning supporting QBS, municipalities require firms to submit cost-competitive proposals for design services (through requirements stipulated in Requests for Proposals (RFPs) for such services) that contain aspects of differentiation characterizing QBS methods. This mix of proposal requirements (i.e. low cost AND differentiation) resulting from the combination of the public tendering process and QBS presents a strategic fit dilemma for engineering consultants seeking to position themselves. This strategic fit dilemma is explored further in Section 1.3.2. – Overview of Strategic Positioning in the Industry.

1.3.1.2 Acquisitions

Within the last five to fifteen years, the engineering consulting industry in general, and the water facilities design industry in British Columbia in particular, has been and continues to undergo a period of consolidation. With large multi-industry engineering consulting firms becoming larger through the acquisition of small and medium sized firms specializing in water facilities design, the number of competing water facilities designers in British Columbia is becoming smaller.

Municipalities seeking to retain water facilities designers are attracted to the larger range of expertise and economies of scope offered by these larger multi-industry engineering consulting firms (Canadian Consulting Engineer, 2010). Regardless of this attraction, the strategic fit dilemma remains as municipalities continue to mix low cost and differentiation requirements in RFPs for water facilities design services.

1.3.2 Overview of Strategic Positioning in Industry

Firms in an industry become “stuck in the middle” because of their unwillingness to make choices between low cost and differentiation strategies (Porter, 1998). However, the overall strategic fit dilemma that typical water facilities designers face is not by choice: the industry imposes a requirement for a strategy that is a mix of low cost and differentiation strategies. The industry imposes this requirement through a mix of low cost and differentiation selection criteria in RFPs for water facilities design services (see Section 1.3.1.1. Tendering in the Public Sector). The conservative nature of the engineering profession and the highly skilled, independent-minded individuals that comprise this profession also serves to exacerbate this mix when the firms employing these individuals compete for design work through the public tendering process. The public tendering process and the resulting commoditization of design services leads to low cost strategies. However, the high level of skill required in the engineering design profession, the autonomy required by individual designers, and the low capital requirements and decentralization that characterize engineering consulting firms, creates a strong predisposition towards differentiation strategies. This predisposition is further reinforced as engineering consulting firms become larger through the industry trend of acquisition.

To address this strategic fit dilemma, a KSF for an engineering consulting firm competing in British Columbia's water facilities design industry would be to have the capability to offer a significantly differentiated design service at a considerably lower cost. This KSF of a low-cost, differentiated service will be discussed further in the following chapter.

The above noted dilemma is summarized in the strategic fit grid below:

Table 1.1 Strategic Fit Grid for a Typical Water Facilities Design Firm

	Cost Based **Low Cost, Adequate Quality**											**Differentiation** **High Quality, Adequate Cost**
	Source	1	2	3	4	5	6	7	8	9	10	
Service Strategy	Rapid Follower		**X**									Innovative
R&D Expenses	Low	**X**										High
Structure	Centralized								**X**			Decentralized
Decision Making	Less Autonomy									**X**		Autonomy
Production, Service	Economies of Scale									**X**		Economies of Scope, Flexible
Labour	Mass Production										**X**	Highly Skilled, Flexible
Marketing	Comparative, Push		**X**									Pioneering, Pull
Risk Profile	Low Risk	**X**										High Risk
Capital Structure	Leveraged (Debt)										**X**	Conservative (Equity)

The positions along key dimensions of strategy shown above that are typically adopted (intentionally or otherwise) by engineering consultants competing in the water facilities design industry are discussed below.

1.3.2.1 Service Strategy

As discussed in Section 1.3.1.1 – Tendering in the Public Sector, tenders are compiled by describing the products or services in detail. Municipalities compiling RFPs for water facilities design services spend considerable amounts of time and effort detailing the background and requirements for the design services being procured. Given the highly prescriptive RFPs that result, the opportunities for engineering consultants to inject creativity and innovation into their proposals in response to these RFPs (and design services should they be awarded the work) are largely limited.

As such, water facilities designers are usually unable to differentiate their service offering significantly through creativity and innovation. With respect to the strategic dimension of service, typical engineering consultant firms are largely left to follow.

1.3.2.2 Research and Development Expenses

Typical engineering consulting firms budget 20 – 30% of available staff time for business development, research and development and professional development (Bastien, Cherniavsky, Murji, Pilarinos and Jackson, 2011). Considering the significant effort required to submit proposals and the requirements for the continuing education of engineering professionals, little budget is left for research and development.

1.3.2.3 Structure

As discussed in Section 1.3.1.2 – Acquisitions, large engineering consulting firms are getting larger and the number of small and medium sized firms is decreasing in the water facilities design industry in British Columbia. However, the local relationships developed over many years between engineering professionals and the staff of municipalities remain after acquisition. These relationships maintain the differentiation available through personal reputation and familiarity on a one-to-one level. With respect to the strategic dimension of structure, typical engineering consulting firms should be considered decentralized.

1.3.2.4 Decision Making

Due to the local relationships discussed in the previous section and the resulting decentralized structure reinforced by these relationships, decision making also tends to be decentralized. This results in a high level of autonomy for the branch offices of engineering consulting firms.

1.3.2.5 Production and Service

As discussed in Section 1.3.1.2 – Acquisitions, municipalities are attracted to the economies of scope offered by large engineering consulting firms. The desirability of this trait requires that large firms take advantage of their own economies of scope as much as they can when positioning themselves along the strategic dimension of production and service.

1.3.2.6 Labour

Given the high level of skills, qualifications, knowledge and experience possessed by the engineering professionals on staff, engineering consultants seek to differentiate their water facilities design service offerings along the labour dimension of strategy.

1.3.2.7 Marketing

The public tendering process used by municipalities is comparative by definition. Proposals are compared to each other to determine which firm will be awarded the work. Typical water facilities designers are comparative and therefore, cost based along the marketing dimension of strategy.

1.3.2.8 Risk Profile

As individuals, engineering professionals are risk averse by training. So it is not surprising that groups of these individuals, such as those found managing and executing design services awarded to water facilities designers, are also risk averse. Such risk aversion puts the typical water facilities designer on the low risk end of the risk profile dimension.

1.3.2.9 Capital Structure

In general, engineering consultants have low capital expenditure requirements (Bastien et al., 2011). Such requirements put water facilities designers at the conservative end of the capital structure strategic dimension.

1.3.2.10 Strategic Fit Summary

The positions discussed above are typical of engineering consulting firms in the water facilities design industry in British Columbia. Overall, these positions result in firms being "stuck in the middle". However, attractive profits can be earned if the structure of the industry is highly favourable (Porter, 1998). In the larger infrastructure engineering consulting industry, this seems to be the case. Presently, engineering consulting firms in Canada are quite profitable. This profitably is demonstrated by the four publicly traded Canadian engineering consulting firms that have outperformed the market consistently over the last five years (Bastien et al. 2011). However, the policies, processes and professional attributes entrenched in municipalities, engineering consulting firms and the engineering profession that lead to the mix of low cost and differentiation strategies described above may exert downward pressure on this profitability in the future. Since the impact of this pressure on profitability is in the future and uncertain, the changes in strategy that will be required are anticipatory. Strategic changes that are anticipatory result from management looking ahead, anticipating change in the industry and making what is felt to be the necessary strategic adjustments (Crossan, Rouse, Fry and Killing, 2009).

1.4 Chapter Summary

An extended industry analysis of the water facilities design industry in British Columbia will be undertaken in this paper. In doing so, this paper will identify KSFs that can help engineering consulting firms practising within this industry to formulate more effective strategies.

This paper will begin this extended industry analysis using Porter's Five Forces model. Determinants comprising each of these forces will be defined and then assessed within the context of the industry. These assessments will be used to assess the strength of each of the five forces and as a result, the overall competitiveness and profitability within the industry. The five force analysis will then be followed by an industry level analysis using Porter's Value Chain model. This value chain analysis will be undertaken to identify linkages and competitive scopes that exist within the larger water facilities industry.

Through the five force and value chain analysis processes, KSFs will be identified as they present themselves. In the final section of this paper, these KSFs will be summarized and the critical KSFs identified. Recommendations towards the formulation of more effective strategies within the water facilities design industry in British Columbia will then be provided based on the critical KSFs.

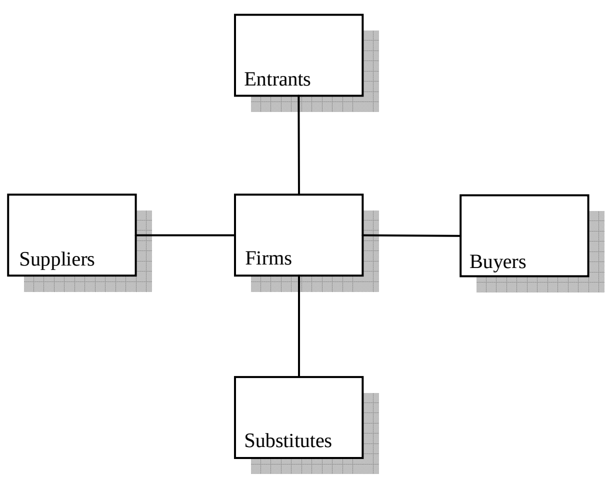
2: Industry Analysis using the Five Forces

2.1 General

Industry analysis is important to anyone or any firm interested in the profitability of an industry. More specifically, the decision to invest in an industry will be determined by how profitable the industry is perceived and what it will take to be profitable in that industry. Industry analysis provides the information for this investment decision and the actions and attributes that will be required to be profitable (Crossan et al., 2009).

As discussed in Chapter 1, the extended industry analysis provided in this paper will start using Porter's Five Force model. Porter asserts that to understand competition and profitability within a given industry, the industry's structure must be analyzed in terms of the forces between the groups shown in Figure 2.1 below.

Figure 2-1 Porter's Five Forces Model



The strongest of these forces determines not only the nature of the competition and profitability within the industry, but also where attention should be paid when strategies are formulated (Porter, 2008). The forces between the groups shown in Figure 2.1 above are indicated in Table 2.1 below:

Table 2.1 Forces in Porter's Five Force Model

Force	**Groups Involved**
Bargaining Power	Between Buyers and Firms
Bargaining Power	Between Suppliers and Firms
Threat of Entry	Between Entrants and Firms
Threat of Substitutes	Between Substitutes and Firms
Degree of Rivalry	Amongst Firms

The players in the water facilities design industry in British Columbia that are within these groups are provided in Table 2.2. below:

Table 2.2 Players in Water Facilities Design Industry in British Columbia

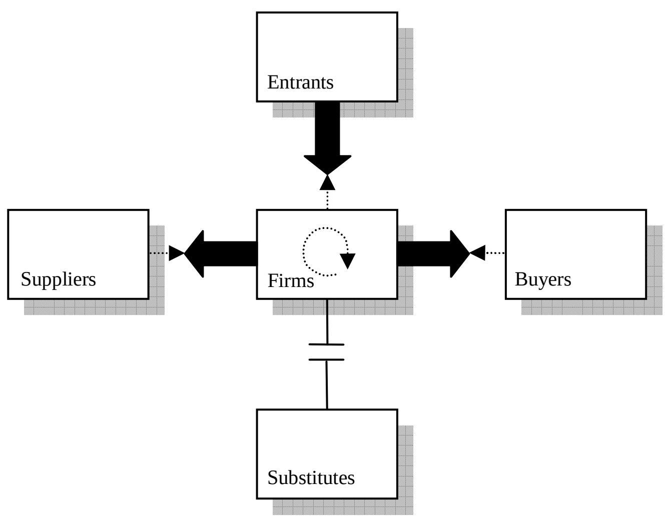
Group	**Player(s)**
Buyers	Municipalities
Suppliers	Engineering Professionals
Entrants	Multi-Industry Engineering Consultants; Foreign Engineering Consultants with Water Facilities Design Practices
Substitutes	Not Applicable
Firms	Engineering Consultants with Water Facilities Design Practices

Based on an analysis of the force determinants constituting each of the five forces and the resulting strengths of the five forces, a profitable structure is indicated at present for the water facilities design industry in British Columbia. The relative magnitudes of the five forces are summarized in Table 2.3 and Figure 2.2 below:

Table 2.3 Summary of Five Forces for Water Facilities Design Industry in British Columbia

Force	**Force Strength**	**Resultant Forces**	**Force Strength**
Bargaining Power	Firms - Strong		Buyers - Weak
Bargaining Power	Suppliers - Weak		Firms - Strong
Threat of Entry	Threat - Strong		Barrier - Weak
Threat of Substitutes		Not Applicable	
Degree of Rivalry	Amongst Firms - Weak		

Figure 2-2 Graphical Summary of Five Forces for Water Facilities Design Industry in British Columbia



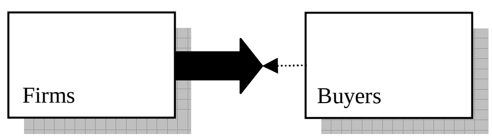
The following sections will define and analyze each of the force determinants constituting the five forces. Through the process of defining and analyzing the determinants in the context of the water facilities design industry, KSFs will be identified as they arise.

2.2 Bargaining Power of Buyers: Weak

2.2.1 Definition and Strength

Ghemawat defines the bargaining power of buyers as a power exerted by the buyers of a given industry's product or service that induces the firms supplying the product or service to lower their prices and/or raise the quality of their offering (Ghemawat, 2010). As indicated in the previous chapter, the buyers of design services for water facilities are local municipalities and the firms are engineering consultants with water facilities design practices. As shown in Figure 2.3, the relative strength of these buyers in comparison to the firms is weak:

Figure 2-3 Bargaining Power Forces between Buyers and Firms



This assessment of strength is based on evaluations of the determinant strengths of this force (Porter, 1998). These evaluations are summarized in Table 2.4 below and discussed in the following sections.

Table 2.4 Summary of Determinant Strengths for Bargaining Power between Buyers and Firms

Determinant	**Strength of Firm**	**Determinant Forces**	**Strength of Buyer**
Relative Concentration	Strong		Weak
Buyer Volume	Strong		Weak
Relative Switching Costs	Weak		Strong
Buyer Information	Strong		Weak
Ability to Backward Integrate	Strong		Weak
Substitute Products	Strong		Weak
Pull Through		Not Applicable	
Price/Total Purchases		Not Applicable	
Product Differences	Strong		Weak
Brand Identity		Not Applicable	
Impact on Quality/Performance	Strong		Weak
Buyer Profits	Weak		Strong
Decision Makers’ Incentives		Not Applicable	

2.2.2 Determinants of Buyer Power

2.2.2.1 Relative Concentration (Buyer Concentration vs. Firm Concentration)

Concentration within a given sector is a measure indicating the extent to which a few large firms dominate the sector (Baye, 2010). When comparing the relative strengths of buyers and firms on the basis of concentration, buyers will have greater bargaining power if there is a significantly smaller number of buyers when compared to the number of firms in the industry in question. Conversely, firms will have greater bargaining power if there is a significantly smaller number of firms when compared to number of buyers of products or services from that same industry (Porter, 1979).

On the basis of concentration, the bargaining power of local municipalities is weak. In British Columbia, the number of engineering consultants providing water facilities design services is far exceeded by the number of local municipalities responsible for water facilities. The acquisition trend in the industry described in Chapter 1 serves to further increase the strength of water facilities designers through continuing increases in firm concentration. The strong financial performance of publicly traded engineering consulting firms with significant water facilities design practices (Bastien et al., 2011) provides strong evidence that this strategy of acquisition in the water facilities design industry is a successful one. As a KSF, continuing increases in firm concentration serve to decrease the degree of rivalry in the industry. By removing smaller firms that tend to submit lower cost proposals and decreasing the number of firms (and the number of choices) that are available to buyers, profitability is increased.

2.2.2.2 Buyer Volume

Buyer volume can be defined as the product of the quantity of products or services obtained in a given purchase and the frequency of such purchases. When the volume of a buyer's purchases from a firm are small in comparison to the volume of the firm's business, then the buyer will not have much power to bargain on the price and/or quality of these purchases. When the volume is large in comparison to the volume of the firm's business, then buyer has much more power to bargain with the firm.

Based on buyer volume, the bargaining power of local municipalities is weak. With the exception of large local municipalities (e.g. Metro Vancouver), the nature of new water facilities construction and the upgrade and rehabilitation of existing water facilities is such that local municipalities do not undertake such work often. Therefore, the water facilities design services provided by engineering consulting firms are not required frequently. Furthermore, the bulk of the work undertaken by large Canadian engineering consulting firms with significant water facilities design practices comes from a large amount of assignments that are typically small in both size and scope (Bastien et al., 2011). Given the infrequent requirement for water facilities design services by the vast majority of local municipalities in British Columbia and the relatively small size and scope of such consulting assignments when compared to the total volume of work undertaken by the same consultants, buyer volumes for any one municipality are relatively small. These relatively small buyer volumes result in little bargaining power for municipalities on a volume basis.

Similar to the manner discussed in the previous section in which increases in firm concentration provide a KSF to firms in the industry, decreases in the volume of a firm's work from any one buyer through acquisition acts as a KSF by further decreasing the power of buyers.

2.2.2.3 Relative Switching Costs (Buyer's Cost vs. Firm's Costs)

When a buyer stops purchasing a product or service from a given firm and begins to purchase it from a different firm, the buyer may incur costs resulting from the switch. These costs are referred to as switching costs. If a buyer incurs little or none of these costs, then the buyer is not at a disadvantage if the contemplated switch is made: his bargaining power is not weakened (Porter, 2008).

Through the contractual transfer of switching costs to the successful consultant in the award of water facilities design work, the bargaining power of local municipalities is strong. A consequence of the public tendering process described in Chapter 1 is that if an engineering consultant is awarded a consulting assignment but is not awarded the following consulting assignment, the municipality must switch consultants. However, the commercial terms and conditions of the Agreement are written by the municipality and presented as a Form of Agreement during the tendering process to all prospective consultants. These terms and conditions are written such that the awarded consultant must adapt to the municipality's systems, processes and procedures. In effect, the municipality avoids the switching costs of adapting to any consultant’s systems, processes or procedures by contractually having the successful consultant adapt to the municipality’s systems, processes and procedures.

Having to assume these switching costs, it is in the engineering consultant’s interest to thoroughly understand a given municipality’s systems, processes and procedures. Through this understanding and the hastening of related learning curve effects, the switching costs borne by the engineering consultants on subsequent work with the same municipality are successively reduced. The KSF of improved management systems to improve consultant profitability includes the pursuit of such an understanding. Improved management systems allow the consultant to pursue the most effective and efficient means to interact with the municipality, including but not limited to:

- Resolving technical matters,
- Negotiating and processing changes in scopes of work,
- Obtaining interdepartmental approvals, and
- Expediting payment.

2.2.2.4 Buyer Information

When a buyer has more information about the firm’s industry, then the buyer has more bargaining power (Porter, 1998).

Given the appropriateness of the levels of engineering knowledge and experience retained in house by municipalities when compared to the frequency, quantum and complexity of water facilities design services required, the bargaining strength of municipalities based on their knowledge of the water facilities design services is weak. The capabilities of local municipalities to understand (and therefore, have more information about) water facilities engineering technology varies from municipality to municipality. This variation is largely due to the frequency and complexity of the water facilities work that different municipalities undertake. When a municipality undertakes water facilities work frequently and/or is undertaking several large and complex water facility projects that will take a number of years, experienced and knowledgeable water facilities engineers are hired directly by the municipality in order to acquire buyer information. Conversely, a municipality that undertakes water facilities work infrequently and/or undertakes a large and complex water facilities project once every decade cannot justify retaining a large number of experienced and knowledgeable water facilities engineers on staff. Such municipalities have less buyer information and therefore, less bargaining power when it is necessary to award and execute water facilities design work.

Metro Vancouver is the most visible example of a large municipality in British Columbia that undertakes water facilities work frequently and undertakes large and complex water facilities work every year. Metro Vancouver maintains a relatively large contingent of engineering and technical support staff in house in civil, structural, geotechnical, mechanical, power, instrumentation, control and treatment process disciplines. Such engineering and technical support staff plan, procure and execute water facilities work as well as operate and maintain capital assets (Metro Vancouver, 2012). The knowledge and experience of Metro Vancouver's engineering and technical support staff is utilized in the tendering process for water facilities design services and as such, provides Metro Vancouver with buyer information.

However, the engineering knowledge and experience retained directly by Metro Vancouver is an exception rather than a rule for municipalities in British Columbia. The majority of local municipalities throughout British Columbia responsible for the construction of new water facilities and the upgrade, rehabilitation, operation and maintenance of existing water facilities tend to keep less specialized engineering and technical support staff in house. These municipalities tend to keep fewer, more generalist engineering and technical support staff in house. However, given the frequency, quantum and complexity of water facilities work undertaken by these municipalities, the buyer information provided to these municipalities by such staff when procuring water facility design work is appropriate.

2.2.2.5 Ability to Backward Integrate

If a buyer is capable of producing the product or providing the service offered by a firm and the buyer deems the firm to be too profitable, then there is a credible threat to integrate backward (Porter, 2008).

The threat of backward integration by municipalities and the corresponding bargaining strength this threat offers is weak. Depending on the size and complexity of a given water facilities design assignment, the knowledge and experience of the engineering and technical support staff described in the previous section can be used to undertake engineering design, thus becoming a credible threat for backward integration. However, the threat is not credible since 1) there is a provincial statutory requirement for the drawings and specifications embodying this design work to be stamped and sealed by licensed Professional Engineers and 2) local municipalities do not carry errors and omissions insurance for design work undertaken by Professional Engineers.

2.2.2.6 Substitute Products

Substitute products or services come from outside of the firm's industry and can be used by the buyer instead of the firm's product or service (Porter, 2008).

Considering the criticality of water facilities, the bargaining strength of municipalities on the basis of having credible, sustainable substitutes is weak. From a technological and environmental perspective, there are presently no substitutes for water facilities and the design services required to design and build them anywhere in the developed world. However, from a funding perspective, there are an infinite number of substitutes when the funding priorities of local municipalities are considered. Municipalities must contend with increasing responsibilities, decreasing revenues and infrastructure that struggles to keep up with demand while continuing to deteriorate. As discussed in Chapter 1, local municipalities have access to only 8% of all tax revenues, yet they are responsible for over 80% of Canada's water infrastructure (including water facilities) (Mirza, 2007). The estimated cost of fixing this infrastructure is referred to as the infrastructure deficit. The Canadian water infrastructure deficit in 2007 was estimated to be approximately $31 billion and rising (Mirza, 2007). As such, other funding priorities (e.g. health care, education) and other infrastructure needs (e.g. transportation, recreation facilities and cultural programs) can be considered real substitutes for water facilities work and the concomitant water facilities design work required for such facilities. However, such substitution cannot continue indefinitely in the long term, given the criticality of water facilities to our public health and our local environment.

2.2.2.7 Pull Through

For pull through to exist, intermediaries between the buyer and the firm must exist and there must be some discernable brand identity (Porter, 1998).

Pull through is not a factor in the water facilities design industry as the vast majority of end users (ratepayers, taxpayers and other citizens) are unaware and uninterested in the providers of such infrastructure, whether they are engineers, architects, contractors or equipment suppliers. In effect, the lack of pull through gives no additional bargaining power to either the firm or the buyer.

2.2.2.8 Price/Total Purchases

When the product or service purchased by a buyer is a sizeable portion of the cost of the buyer's own offering, the buyer is likely to negotiate with the firm more vigorously for price reductions, creating more bargaining strength on the buyer's side. If the product or service is not a sizeable portion of its costs, then the buyer will not be that concerned with the firm's price for its product or service, shifting bargaining strength to the firm in the process (Porter, 2008).

The bargaining strength determinant of Price/Total Purchases does not come into play in the water facility design industry as the public tendering process nullifies it. Local municipalities budget annually to provide a vast number of services ranging from social programs to recreational facilities to many types of infrastructure not including water facilities. When compared to these other funding priorities, the price of water facility engineering consulting services is a small portion of a municipality's annual budget. Considering such proportionality alone, firms are conferred bargaining strength. However, the competitive bidding process serves to keep this strength in check, pitting firms against each other.

2.2.2.9 Product Differences

If a firm's product or service is seen by a buyer as differentiated from other firms and the basis or bases of such differentiation is/are seen as valuable by the buyer, then the firm will have bargaining power. However, if the firm's product or service is seen to be the relatively the same as other firms by the buyer, the buyer will be in a position of strength when bargaining (Porter, 2008).

Taking into account the mix of low cost and differentiation selection criteria imposed by municipalities in RFPs for water facilities design services, the bargaining strength of municipalities is considered weak. As discussed in Chapter 1, Section 1.3.2 – Overview of Strategic Positioning in Industry, the prescriptive scopes of work contained within RFPs for water facilities design services serve to commoditize the design services required and thus, drive prices down. However, such commoditization is partially offset by QBS criteria used in the same RFPs such as proven performance, experience of similar projects, local knowledge and managerial ability. Such QBS criteria provides engineering consultants the opportunity to differentiate and therefore, drive prices up.

Unfortunately, the resulting mix of cost-oriented and differentiation-oriented selection criteria is not consistent from project to project. Furthermore, when RFPs are written with well-crafted exclusion and privilege clauses, municipalities legally reserve the right to accept any submitted proposal, regardless of the weighting of cost-oriented and differentiation-oriented selection criteria stated in the RFP (Fasken Martineau, 2007).

The inconsistency of the buyer's weighting of low cost and differentiation criteria suggests simultaneously appealing to both cost-oriented and differentiation-oriented selection criteria found in RFPs in order to increases the likelihood of award. The capability to offer a significantly differentiated design service at a considerably lower cost would become a KSF when submitting proposals in response to such RFPs.

2.2.2.10 Brand Identity

When a firm's product or service impacts the brand identity of the buyer who uses this product or service, then the firm has bargaining power over the buyer with respect to brand identity (Porter, 1998).

As alluded to in Section 2.2.2.7 – Pull Through, the vast majority of end users are unaware and uninterested in the providers of infrastructure project and services, whether they are engineers, architects, contractors or equipment suppliers. As such, impact on the buyer's brand identity is not applicable: no additional bargaining power goes to either the firm or the buyer.

2.2.2.11 Impact on Quality/Performance

When the quality of a buyer's product or service is influenced significantly by the quality of the firm's product or service, then the firm will have bargaining power over the buyer as the buyer will be less price sensitive. Conversely, when the quality of the firm's product or service has little effect on the buyer's product or service, the buyer will become more price sensitive and the firm will have less power (Porter, 2008).

The bargaining power of water facilities designers is considered strong with respect the impact they have on the quality and performance of water facilities owned by municipalities. As discussed in Chapter 1, the proponents of QBS maintain that the quality and performance of infrastructure is a direct consequence of the engineering undertaken early in the infrastructure life cycle (Consulting Engineers of British Columbia, 2006, p. 3):

"The cost of a consulting engineer represents only approximately 1.5% of the total "life-cycle" cost of a project - that is, the cost from the conceptual stage through construction, maintenance and renovation, including both capital and operating costs. The costs of construction, operations and maintenance are the direct consequence of decisions taken during the engineering planning and design stages of a project. The more resources that are put into the front-end decisions, the better will be the quality of the finished product, and the lower will be its life cycle cost because many uncertainties will have been resolved".

Although municipalities impose a mix of low cost and differentiation selection criteria in RFPs for water facilities design services, most understand the value of life cycle costing and the downstream impact that high quality design services can have (Federation of Canadian Municipalities, 2006).

2.2.2.12 Buyer Profits

When a buyer is running a profitable enterprise, he will generally pay less attention to the price a firm charges him for the required product or service. If the buyer is not profitable, then he will seek to negotiate with the firm supplying the required product or service in order to drive price of the product or service down. Not being profitable, the buyer exerts bargaining power when negotiating with the firm (Porter, 2008).

By definition, the municipalities that own and operate water facilities in British Columbia are public sector agencies and are therefore, not-for-profit agencies. Taking into account the financial similarities of a non-profit agency and an unprofitable private sector agency and bearing in mind the increasing public pressure to reduce government spending, the bargaining power of municipalities is considered strong.

2.2.2.13 Decision Makers' Incentives

When a buyer receives an incentive from a firm, the firm is attempting to motivate the buyer to purchase its product or service on bases other than those upon which other firms in the firm's industry compete (Porter, 1998).

The bargaining power of a firm based on providing incentives to decision makers in the buyer's organization is no longer a determinant of significance. Traditionally, in many infrastructure and construction related industries, incentives in such forms as gifts at Christmas, hockey game tickets and general entertainment were used by a firm to influence the decision process of a buyer. With the increasing professionalism of the purchasing profession and stricter policies within municipalities regarding the receipt of such incentives, the force of this determinant has been virtually eliminated.

2.2.3 Summary of Determinant Strengths including Identified KSFs

Table 2.5 below repeats Table 2.4 and includes the KSFs identified in the determinant analyses in Section 2.2.2 – Determinants of Buyer Power.

Table 2.5 Summary of Determinant Strengths for Bargaining Power between Buyers and Firms including Identified KSFs

Determinant	Strength of Firm	Determinant Forces	Strength of Buyer	KSF
Relative Concentration	Strong	→	Weak	Increasing Firm Concentration
Buyer Volume	Strong	→	Weak	Decreasing Fraction of Buyer's Volume
Relative Switching Costs	Weak	←	Strong	Reducing Transferred Switching Costs through Improved Management Systems
Buyer Information	Strong	→	Weak	None Identified
Ability to Backward Integrate	Strong	→	Weak	None Identified
Substitute Products	Strong	→	Weak	None Identified
Pull Through		Not Applicable		None Identified
Price/Total Purchases		Not Applicable		None Identified
Product Differences	Strong	→	Weak	Providing significantly differentiated design service at considerably lower cost
Brand Identity		Not Applicable		None Identified
Impact on Quality/Performance	Strong	→	Weak	None Identified
Buyer Profits	Weak	←	Strong	None Identified
Decision Makers' Incentives		Not Applicable		None Identified

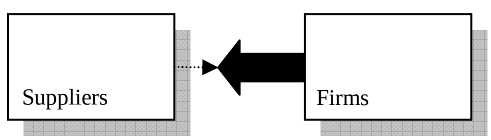
2.3 Bargaining Power of Suppliers: Weak

2.3.1 Definition and Strength

Porter defines the bargaining power of suppliers as a power exerted by the suppliers of given industry's product or service by "charging higher prices, limiting quality or service, or shifting cost to industry participants" (Porter, 2008, p.6).

As indicated in Chapter 1, the most significant suppliers to the water facilities design industry are the individual professionals who together, comprise the bulk of the project staff of the consulting firms providing such services. Most engineering consultants practising water facilities design in British Columbia retain on staff a licensed architect and in some cases, a registered land surveyor. However, the vast majority of the project staff at these firms are comprised of engineering professionals, namely licensed Professional Engineers and the technologists and technicians who support them. As shown in Figure 2.4, the relative strength of these suppliers in comparison to water facilities design firms is weak.

Figure 2-4 Bargaining Power Forces between Firms and Suppliers



This assessment of strength is based on evaluations of the determinant strengths of this force (Porter, 1998). These evaluations are summarized in Table 2.6 below and discussed in the following sections.

Table 2.6 Summary of Determinant Strengths for Bargaining Power between Firms and Suppliers

Determinant	Strength of Supplier	Determinant Forces	Strength of Firm
Differentiation of Inputs	Weak		Strong
Relative Switching Costs	Weak		Strong
Presence of Substitute Inputs	Strong		Weak
Supplier Concentration	Weak		Strong
Importance of Volume to Supplier		Not Applicable	
Cost Relative to Total Purchases	Weak		Strong
Impact of Inputs	Weak		Strong
Threat of Forward Integration	Weak		Strong

2.3.2 Determinants of Supplier Power

2.3.2.1 Differentiation of Inputs

A supplier whose service is differentiated to the extent that such differentiation is valued by the industry that it supplies and/or is difficult to find is said to have bargaining power over the firms in the industry (Porter, 2008).

Given the variations in knowledge, experience, qualifications, reputation and client relationships and considering demographic trends, the bargaining power of individual engineering professionals over water facilities design firms is considered weak. Engineering professionals supply water facilities design firms with the knowledge, experience, qualifications, reputation and client relationships necessary to win and execute engineering consulting assignments. Without such professionals, winning and executing such work becomes impossible. The ability to attract and retain such professionals is vital to the success of engineering consultants (Bastien et al., 2011). However, as individuals, these engineering professionals exert varying degrees of bargaining power over the water facilities design firms that employ them. These variations are due to variations in the knowledge, experience and reputation of the individual engineering professionals and the client relationships that they bring with them. A Professional Engineer (P.Eng.) licensed in British Columbia and trained at an accredited Canadian engineering school with twenty plus years of local experience on successful projects will possess more bargaining power than a foreign trained, unlicensed Engineer with only five years of engineering experience on projects outside of Canada.

Variations in bargaining power can also be attributed to local demographic trends. In British Columbia, moderate to significant supply pressures for qualified engineers are expected at least until 2018 (Randstad Engineering, 2010). Moderate supply pressure is defined as “difficulty in recruiting qualified engineering staff with more than five years of Canadian experience, with industry or technology-specific skills, and with appropriate non-technical skills” (Randstad Engineering, 2010, p.5). Significant supply pressure is defined as “difficulty across the board in recruiting qualified engineering staff in the local and regional labour market” (Randstad Engineering, 2010, p.5).

2.3.2.2 Switching Costs of Suppliers and Firms in Industry

When a firm stops purchasing a product or service from a given supplier and begins to purchase it from a different supplier, the firm may incur costs resulting from the switch. These costs are referred to as switching costs. If a firm incurs little or none of these costs, then the firm is not at a disadvantage if the contemplated switch is made and his bargaining power is not weakened (Porter, 2008).

Within the context of switching costs for engineering consultants with water facilities design practices when engineering professionals leave their firm, the engineering professional’s bargaining power is considered weak. For engineering professionals (the suppliers that execute design services) and the engineering consultants that they work for, the majority of switching costs arise when engineering professionals leave the engineering consultants and replacements must be attracted and hired. While an engineering consultant with a large backlog of work may feel pressure to attract and hire replacements when engineering professionals leave, the engineering consultants cannot be exorbitant in their offers of compensation when hiring replacement engineering professionals. If exorbitant offers by the consultant become commonplace, then the consultant will begin to lose its competitiveness and/or profitability in the water facilities design industry beyond the typical six to nine month backlog (Bastien et al., 2011).

2.3.2.3 Presence of Substitute Inputs

Substitute inputs to the firm's industry come from outside of the firm's industry and can be used by the firm instead of the supplier's product or service. When it is difficult to substitute the supplier's product or service, the supplier is said to have bargaining power over the firm (Porter, 2008).

Within the context of the determinant of substitution, the bargaining power of engineering professionals on staff is strong. There are very few substitutes for the design services that are supplied by engineering professionals on staff to the water facilities design industry that can be used consistently and credibly. Two such substitutions undertaken by water facilities design firms are 1) subcontracting limited engineering services out to key equipment suppliers, and 2) subcontracting engineering services out to faculty at academic institutions.

Design services provided by equipment suppliers for water facilities works are utilized infrequently by design firms looking to reduce costs on low margin assignments or looking to transfer professional liability risks to select equipment suppliers. Although the equipment supplier will provide stamped and sealed drawings and specifications to the firm, the subsequent tendering process for construction that follows the design activity in the supply chain will be less competitive. The equipment supplier will have no competition and all general contractors bidding on the works will be forced to use the equipment supplier's equipment. Furthermore, continued subcontracting of select design services to equipment suppliers by the water facilities designer could result in a diminished professional reputation. By subcontracting design services, the municipality may feel "short changed" on the design services procured. The designer also risks the municipality working directly with some of the equipment suppliers on the next project.

Design services can also be subcontracted out to engineering professors at post-secondary academic institutions when the water facilities design firm does not have the specialized expertise to undertake a specific and sophisticated technical analysis. However, such practices are usually limited to the schematic phase of design (see Chapter 3, Section 3.2.2.1 – Schematic Design). In this phase of design, stamping and sealing design drawings and specifications, professional liability insurance and errors and omissions insurance for Professional Engineers and Engineers of Record is not required. Similar to the practice of subcontracting select design services out to equipment suppliers as described above, the consultant may also suffer a diminished professional reputation, with the municipality opting to work with the engineering professor directly on the next project.

Given that the two substitutes discussed above are used infrequently and that they both have the potential to diminish the professional engineering credibility of the engineering consultant, the firm is generally unwilling to substitute engineering services provided by engineering professionals on staff..

With respect to this determinant, a potential KSF to keep the costs of engineering professionals in check is to utilize less Professional Engineers and more Technologists and Technicians where appropriate. Although the drawings and specifications that are issued for construction legally require the stamps and seals of Professional Engineers, many of the actual design calculations and analyses do not need to be carried out by the same Professional Engineers. Technologists and technicians can undertake the design calculations and analyses with the Professional Engineers reviewing them before signing off on them. In doing so, the average rents engineering professionals extract as a group will tend to decrease.

2.3.2.4 Supplier Concentration

When comparing the relative strengths of suppliers and firms on the basis of concentration, suppliers will have greater bargaining power if there is a significantly smaller number of suppliers when compared to the number of firms in the industry in question. Conversely, firms will have greater bargaining power if there is a significantly smaller number of firms when compared to number of suppliers of products or services from that same industry (Porter, 1979).

Given the numbers for engineering professionals and engineering consultants with water facilities design practices in British Columbia, supplier concentration is relatively weak in comparison to firm concentration. With respect to concentration, engineering professionals have very little bargaining power when negotiating with water facilities design firms. The water facilities design industry is comprised of engineering professionals from civil, structural, geotechnical, electrical, mechanical, and environmental disciplines. The total number of licensed Professional Engineers (P.Eng.) and registered technologists and technicians that fall within these disciplines in British Columbia far exceeds the number of engineering consulting firms with water facilities design practices.

2.3.2.5 Importance of Volume to Supplier

When a supplier cannot easily scale back production and demand for the supplier’s product or service is low in comparison to the product or service being supplied, a firm buying high volumes of the supplier’s product or service has more bargaining power than the supplier.

When the firm buys small volumes, the firm has less bargaining power than the supplier (Porter, 1998).

This determinant of bargaining power between supplier and firm is not applicable in the water facilities design industry. To varying degrees, engineering professionals “supply” knowledge, experience, qualifications, reputation and client relationships to water facilities design firms. However, for the individual engineering professional, the volume of this supply is not scalable.

2.3.2.6 Cost Relative to Total Purchases in the Industry

When the product or service purchased by a firm is a sizeable portion of the cost of the firm’s own offering, the firm is likely to negotiate with the supplier more vigorously for price reductions, creating more bargaining strength on the firm’s side. If the product or service is not a sizeable portion of its costs, then the firm will not be that concerned with the supplier’s price for its product or service, shifting bargaining strength to the supplier in the process (Porter, 2008).

Within the context of supplier’s cost as a portion of the firm’s product or service and the supplier’s bargaining power that results, the individual engineering professional has very little bargaining power when negotiating with the firm. For professional consulting firms in general, the payroll costs of staff represents a significant portion of the firm’s cost structure. However, the payroll cost of an individual is relatively small for any medium to large sized engineering consulting firm.

2.3.2.7 Impact of Inputs on Cost or Differentiation

If the value of a firm’s product or service is largely due to a constituent product or service provided by the supplier, then the supplier will have more power when bargaining with the firm than if the supplier's product or service played an inconsequential role in the firm's product or service (Porter, 1998).

The bargaining power of engineering professionals in the context of the determinant of impact of inputs is considered weak on average. In the submission of proposals to provide design services to municipalities, water facilities design firms attempt to differentiate themselves from their competitors by emphasizing the calibre of key engineering professionals to be assigned to the project. Such differentiation is based on assigning the most knowledgeable and experienced engineering professionals on staff to undertake or manage the design services to which they are best suited. In terms of impacts of the firm's inputs, the firm attempts to demonstrate its value in the submission of its proposal by emphasizing the value of its engineering professionals. Although price still plays a large role in the tendering process (as described in Chapter 1), when the front-running lower priced proposals are near equal in price, such differentiation can determine which firm is awarded the assignment.

Through repeated success in submitting proposals, subsequent award of assignments and successful execution of the required design services, the key personnel described above build bargaining power to eventually negotiate with the firm. This power can be used to negotiate salary increases, bonuses and share purchases. However, the engineering professionals who complete the bulk of the work, who are less influential in a municipality's award decisions and who play less of a role in affecting the success of a project's execution have less bargaining power when negotiating with the firm.

2.3.2.8 Threat of Forward Integration by Suppliers

When a supplier can threaten to become a competitor of the firm, the supplier has bargaining power through the threat of forward integration (Porter, 1998).

Considering the threat of forward integration, the bargaining power of engineering professionals is weak. In any professional services industry, the threat of a professional employee striking out on his own and becoming a competitor of his former employer is always present. For engineering professionals, the threat of forming a firm that can compete with the scale of water facilities design practices and the large engineering consulting firms within which they reside is very small.

2.3.3 Summary of Determinants of Strength including Identified KSFs

Table 2.7 below repeats Table 2.6 and includes the KSFs identified in the determinant analyses in Section 2.3.2 – Determinants of Supplier Power.

Table 2.7 Summary of Determinant Strengths for Bargaining Power between Firms and Suppliers including Identified KSFs

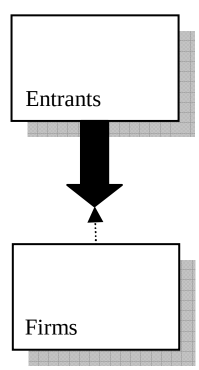
Determinant	**Strength of Supplier**	**Determinant Forces**	**Strength of Firm**	**KSF**
Differentiation of Inputs	Weak	←	Strong	None Identified
Relative Switching Costs	Weak	←	Strong	None Identified
Presence of Substitute Inputs	Strong	→	Weak	Reducing Costs through Increasing Utilization of Technologists and Technicians
Supplier Concentration	Weak	←	Strong	None Identified
Importance of Volume to Supplier		Not Applicable		None Identified
Cost Relative to Total Purchases	Weak	←	Strong	None Identified
Impact of Inputs	Weak	←	Strong	None Identified
Threat of Forward Integration	Weak	←	Strong	None Identified

2.4 Threat of Entry: Strong

2.4.1 Definition and Strength

If an industry is profitable, firms outside the industry may want to join and compete to extract rents from that industry. The threat of entry by such firms is a force that moderates the profitability of the industry. Such threats are limited by the barriers to entering the industry that make it economically difficult to reproduce the positioning of existing competitors (Ghemawat, 2010). As discussed in Chapter 1, the major threats of entry into the water facilities design industry in British Columbia come from multi-industry consulting engineering firms and foreign engineering consulting firms with water facilities design practices. As shown in Figure 2.5, the threat of entry that these firms pose to the water facilities design industry in British Columbia is strong.

Figure 2-5 Threat of Entry and Barriers to Entry Forces



This assessment of threat strength is based on evaluations of the determinant strengths of this force (Porter, 1998). These evaluations are summarized in Table 2.8 below and discussed in the following sections.

Table 2.8 Summary of Determinant Strengths for Threat of Entry and Barrier to Entry

Determinant	Strength of Threat	Determinant Forces	Strength of Barrier
Economies of Scale	Weak		Strong
Proprietary Product Differences	Strong		Weak
Brand Identity	Strong		Weak
Switching Costs		Not Applicable	
Capital Requirements	Strong		Weak
Access to Distribution		Not Applicable	
Absolute Cost Advantages	Strong		Weak
Government Policy	Weak		Strong
Expected Retaliation	Strong		Weak

2.4.2 Determinants of Threat of Entry

2.4.2.1 Economies of Scale

When existing competitors within an industry dominate an industry due to their concentration, volume of work undertaken or other advantages derived from their large size, then it will be harder for firms interested in entering the industry to enter if they need to replicate or come close to the same scale when entering or to accept less of a margin for a period of time after they enter (Porter, 2008).

Given the growing prevalence of large firms in the water facilities design industry and given recent successful entries to the industry, the strength of the economies of scale entry barrier is considered strong, resulting in a weak threat of entry. Engineering consulting firms are considered to be small when they have less than 25 people on staff and medium sized when they have 25 to 200 people on staff (Canadian Consulting Engineer, 2010). As indicated in Chapter 1, such small and medium sized firms are being acquired by larger firms. Municipalities are attracted to large engineering consulting firms with water facilities design practices because of the following:

- their vast store of diverse qualifications and experience,
- their ability to source highly specialized engineering professionals from a large geographic base when required, and
- their ability to offer various efficiencies through economies of scale (Canadian Consulting Engineer, 2010).

These attributes make it difficult for any firm to enter the industry unless they have the same attributes. The relevance of diversity, geographies and efficiencies derived from economies of scale and scope is evident if the entrants to British Columbia's water facilities design industry are considered over the last five to ten years. Firms entering the water facilities design industry have done so either by entering as a large multi-industry firm on their own (e.g. Hatch Mott McDonald) or as a large foreign firm with their own water facilities design practices acquiring smaller local firms (e.g. American firm Tetra Tech acquiring EBA and New Zealand's Opus acquiring Dayton and Knight).

The success of the above noted entrants and the trend of acquisition in the industry suggests that a KSF in the water facilities design industry is size. As will be discussed at the end of this chapter, the KSF of size acts as a barrier to entry and is related to the previously identified KSF of firm concentration.

2.4.2.2 Proprietary Product Differences

Tangible product differences that customers value create entry barriers in that they force new entrants to incur costs in an attempt to overcome customers' affinities for these differences and draw these customers to their offerings (Porter, 1979).

The strength of proprietary product differences as an entry barrier is considered weak in the water facilities design industry, thus creating a strong threat for entry. As previously discussed in Section 2.2.3.2, a great deal of work is put into developing very prescriptive scopes of work by the engineering staff of municipalities that effectively commoditize the design services required (Federation of Canadian Municipalities, 2006). Such commoditization serves to encourage entry.

To maintain profitability in the water facilities design industry, improved management systems provide a KSF by building a barrier to entry. This barrier is built through a difference in service that will be valued by the customer outside the commoditized technical facets of the design work. With the engineering consultant free to differentiate in non-technical areas, improved management systems allow the consultant to differentiate in a non-technical area and build an entry barrier that threatening entrants must overcome.

2.4.2.3 Brand Identity

Similar to the proprietary product differences, brand identity valued by customers creates entry barriers that force new entrants to incur costs in an attempt to overcome customers' affinities for the brand and draw customer to their offerings (Porter, 1979).

The strength of brand identity as an entry barrier is considered weak in the water facilities design industry, thus resulting in a strong threat of entry. In the water facilities design industry, the tendering process employed by municipalities seeks to negate brand preferences, as previously discussed. Through the weighting and scoring in non-price categories employed in the same tendering process, municipalities moderate this negation of brand preference by exercising preference for engineering consulting firms that are known to have leading water facilities design practices.

The KSF of improved management systems provides an opportunity to develop brand identity with municipality staff through improved service. By differentiating its offering beyond the largely commoditized technical aspects of water facilities design assignments, an entry barrier is created.

2.4.2.4 Switching Costs

In the context of entry barriers, switching costs arise when a buyer must incur additional costs if it purchases the required product or services from the entering firm. If the buyer deems these costs to be significant, then they become an entry barrier for the firm contemplating entry (Porter, 2008).

As a barrier to entry, the strength of switching costs is immaterial. Similar to the discussion in Section 2.2.2.3 – Buyer's Switching Costs Relative to the Firm's Switching Costs, municipalities avoid the switching costs of adapting to any consultant's systems, processes or procedures by contractually having the successful consultant adapt to the municipality's systems, processes and procedures. Through the contractual transfer of switching costs to the successful consultant in the award of water facilities design assignments, switching costs become immaterial, whether they are existing rivals or entrants that are new to the industry.

2.4.2.5 Capital Requirements

To enter some industries, capital investment is required in the start-up stages. Such investment constitutes an entry barrier if significant capital is required (Porter, 2008).

The strength of capital requirements as an entry barrier is considered weak in the water facilities design industry, leading to a strong threat of entry based on this determinant alone. In the water facilities design industry, start up capital is relatively small when compared to other industries since a professional fee-for-service is being sold. As noted in Section 2.2.2.2 – Buyer Volume, capital expenditure requirements for professional consulting firms in general (and water facilities design firms in particular) are low (Bastien et al., 2011).

2.4.2.6 Access to Distribution

Some industries require firms to have distribution channels to distribute their product or service to their buyers. For the firm contemplating entry, new channels will have to be developed or existing ones will have to be secured. The costs required for these channels can be significant to the point of being a barrier to entry (Porter, 2008).

In the water facilities design industry, engineering consultants interact directly with municipalities. Since the nature of this industry is "business-to-business" (B2B), "Access to Distribution" is neither a threat nor a barrier to entry.

2.4.2.7 Absolute Cost Advantages

Absolute cost advantages for firms incumbent in a particular industry refer to advantages not derived from the size of the firm and can include "proprietary technology, preferential access to the best raw material sources, pre-emption of the most favourable geographic locations, established brand identities, or cumulative experience that has allowed incumbents to learn how to produce more efficiently" (Porter, 2008, p.4).

The strength of the cumulative experience of a design firm's team and in general, absolute cost advantages, are weak as a barrier to entry into the water facilities design industry, thus constituting a strong threat of entry. Of the advantages noted above, only cumulative experience and its effect on production efficiency is applicable to the water facilities design industry. To be successful in the award of design work, water facilities design firms typically tout the advantages of having a team of engineering professionals on staff that have a track record of being a cohesive, productive, efficient and effective unit. In promoting their professionals as a team and as individuals that are more than capable of executing the work synergistically, the consultants promote the cumulative experience of the team.

Municipalities recognize the cumulative experience of a team to an extent. However, typical scoring distributions do not give much weight to such cumulative experience. The KSF of staff retention can increase the significance of this cumulative experience, providing an avenue to improving cost advantages. By creating and nurturing teams of engineering professionals that municipalities value, a barrier to entry is built outside the commoditized technical aspects of the work that new entrants must rise above to enter and compete successfully in the industry.

2.4.2.8 Government Policy

As a barrier to entry, government policy can prevent firms from entering an industry by requiring permits and/or licenses to practice in the industry (Porter, 2008).

Similar to other provinces in Canada, there are licensing requirements to practise engineering in British Columbia. Given:

- the experience and education requirements for individuals to be licensed as a Professional Engineer with the APEGBC or as a registered technologist or technician with the ASTTBC, and
- the multidisciplinary requirements that necessitate water facilities design firms to have licensed engineering professionals on staff from a variety of disciplines (i.e. civil, structural, geotechnical, mechanical, power, instrumentation and control and process),

licensing to undertake professional engineering services acts as a strong barrier to entry in the water facilities design industry, thus resulting in a relatively weak threat of entry.

It should be noted that municipal governments do not set standards for the water facilities design industry. These standards (e.g. drinking water standards and wastewater effluent criteria) are set at the provincial and health authority level. Such standards constitute design criteria that an entrant must factor into design calculations and analyses when providing design services. As such, no threat or barrier to entry is created through standards set by these levels of government.

2.4.2.9 Expected Retaliation

If a prospective entrant to an industry believes that firms presently in the industry will retaliate to minimize or at least limit the profitability of the entrant once in the industry, the firm might reconsider entry depending on their expectations of the success of this retaliation. This expectation acts as a barrier to entering the industry (Porter, 2008).

The expectation of retaliation and the effectiveness of this expectation as a barrier to entry is weak, thus creating a strong threat of entry on the basis of expected retaliation alone. In the water facilities design industry, the tendering process minimizes the threat of retaliation. This process limits the ability of firms to read each other’s signals. The only results of the tendering process visible to rival firms through the process are the final total prices submitted by all rivals to win the work. Since the prices submitted are generally not subject to negotiation, there is no opportunity to make adjustments once the proposals or bids are submitted. Therefore, given the limited signals available in the tendering process and the uniqueness of water facilities design assignments (i.e. no two assignments are the same), it is difficult for rival firms to discern the strategy of other rivals on any given assignment or succession of assignments.

2.4.3 Summary of Determinants of Strength including Identified KSFs

Table 2.9 below repeats Table 2.8 and includes the KSFs identified in the determinant analyses in Section 2.4.2 – Determinants of Threat of Entry.

Table 2.9 Summary of Determinant Strengths for Threat of Entry and Barrier to Entry including Identified KSFs

Determinant	Strength of Threat	Determinant Forces	Strength of Barrier	KSF
Economies of Scale	Weak		Strong	Increasing Firm Size
Proprietary Product Differences	Strong		Weak	Building Differentiation through Improved Management Systems
Brand Identity	Strong		Weak	Creating Brand Identity through Improved Management Systems
Switching Costs		Not Applicable		None Identified
Capital Requirements	Strong		Weak	None Identified
Access to Distribution		Not Applicable		None Identified
Absolute Cost Advantages	Strong		Weak	Improving Cost Advantage through Staff Retention
Government Policy	Weak		Strong	None Identified
Expected Retaliation	Strong		Weak	None Identified

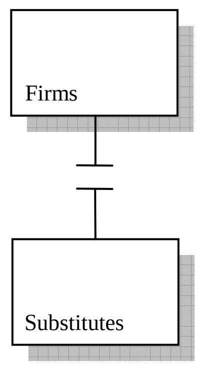
2.5 Threat of Substitutes: Not Applicable

2.5.1 Definition and Strength

When a product or service provided by others outside the industry can satisfy the same basic buyer need as a product or service provided by a firm competing in the industry, the product or service from outside the industry poses a threat as a substitute, threatening the profitability of the industry in the process (Ghemawat, 2010).

As previously discussed in Section 2.3.2.3 – Presence of Substitute Inputs, there are very few inputs that can substitute for the design services that engineering professionals provide to the engineering consulting firms employing them. Since the sum of the services provided by individual engineering professionals constitutes the service provided by a water facilities design firm, there are therefore no credible substitutes for the design services provided by water facilities design firms. Therefore, as shown in Figure 2.6, the threat of substitutes is not a consideration.

Figure 2-6 Threat of Substitutes Forces



As such, an assessment of the determinants of the threat of substitution (namely, the relative price performance of substitutes, switching costs and the buyers' propensity to substitute) will not be undertaken.

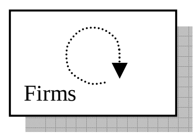
2.6 Degree of Rivalry: Weak

2.6.1 Definition and Strength

As the degree of rivalry between existing competitors in an industry increases, industry profitability decreases. This degree of rivalry is determined by both the intensity of the competition between rival firms and the basis on which the rival firms compete (Porter, 2008).

At the beginning of this chapter, the rival firms in the water facilities design industry were identified as engineering consultants with water facilities design practices. As previously discussed in Chapter 1, Section 1.3.1.2 – Acquisitions, the water facilities design industry in British Columbia continues to consolidate, with large firms becoming larger through the acquisition of small and medium sized firms. Prior to this period of acquisition, there were small and medium sized firms whose sole area of practice was water facilities design. Through acquisitions, these firms have almost disappeared from the industry with the vast majority of water facilities design practices residing in large multi-industry engineering consulting firms. The rival firms that compete within the water facilities design industry are now almost exclusively large multi-industry engineering consulting firms. As shown in Figure 2.7, the relative degree of rivalry between these firms is weak.

Figure 2-7 Degree of Rivalry among Firms



This assessment of the degree of rivalry is based on evaluations of the determinant strengths of this force (Porter, 1998). These evaluations are summarized in Table 2.10 below and discussed in the following sections.

Table 2.10 Summary of Determinant Strengths for Degree of Rivalry

Determinant	**Degree of Rivalry**	**Determinant Forces**
Industry Growth	Weak	
Fixed Costs	Weak	
Intermittent Overcapacity	Weak	
Product Differences	Medium	
Brand Identity	Medium	
Switching Costs	Not Applicable	
Concentration and Balance	Weak	
Informational Complexity	Weak	
Diversity of Competitors	Weak	
Corporate Stakes	Weak	
Exit Barriers	Weak	

2.6.2 Determinants of Rivalry

2.6.2.1 Industry Growth

When an industry is growing, firms within the industry feel less of a need to battle with each other for market share as there are enough profits to be had by all. When an industry matures or is in decline, one firm's growth and profitability is often gained at the expense of another, creating greater rivalry amongst competing firms (Porter, 1998).

Rivalry on the basis of industry growth is considered weak. As is evident from the growth of the water infrastructure deficit (Mirza, 2007), there is great potential for growth in the water facilities design industry. In fact, many large engineering consultants are entering the water facilities design industry in anticipation of the design work that needs to be done to reduce the growing deficit.

2.6.2.2 Fixed Costs

When fixed costs are a large percentage of the total costs for all firms in an industry, each firm must sell large volumes of their products or services to pay for these fixed costs, increasing rivalry in the process. Conversely, when fixed costs are a small percentage, firms can reduce their production and sales efforts when there is less demand, reducing the potential for rivalry (Porter, 1998).

Given the low capital expenditure requirements of engineering consulting firms (Bastien et al., 2011), rivalry on the basis of fixed costs is considered weak.

2.6.2.3 Intermittent Overcapacity

When firms in an industry are periodically subjected to short periods of time where demand is less than supply, intermittent overcapacity exists. During these periods of overcapacity, rival firms tend to compete more vigorously (Porter, 1998).

Given work backlogs, the strength of intermittent overcapacity to increase rivalry in the water facilities design industry is considered weak. Typically, engineering consulting firms practising in the water facilities design industry seek to maintain a six to nine month backlog of work (Bastien et al., 2011). In doing so, the demand for the work to be completed by the firm's engineering professionals is always greater than the supply of work for that firm.

2.6.2.4 Product Differences

If buyers of an industry's products or service believe that there is very little difference between the offerings of different firms in the industry, then rivalry between firms in the industry tends to increase (Porter, 1998).

As discussed in Section 2.2.2.11 – Impact on Quality/Performance, most municipalities understand the downstream impact high quality design services have on the water facilities that are constructed. Based on this understanding, municipalities look for differences in the offerings of water facilities designers in the RFP process used to select engineering consultants. However, with a mix of low cost and differentiation selection criteria in RFPs for water facilities design services, the ability of water facilities design firms to offer a differentiated service is somewhat muted by the public tendering process. Given this mix of low cost and differentiation, the rivalry among water facilities design firms created by perceived differences in design services is considered medium.

As indicated in Section 2.2.2.9 – Product Differences, the above noted mix of selection criteria suggests a KSF that would appeal to both cost-oriented and differentiation-oriented selection criteria for water facilities design work.

2.6.2.5 Brand Identity

When buyers have strong preferences for the brands of firms, then the potential for rivalry amongst competing firms is minimized (Porter, 1998).

The rivalry between competing firms resulting from the brand preferences of industry buyers is considered medium. As previously discussed in Section 2.4.2.3 – Brand Identity, the tendering process employed by municipalities seeks to negate brand preferences in the water facilities design industry (Federation of Canadian Municipalities, 2006). However, through the weighting and scoring in non-price categories employed in the same tendering process, municipalities can exercise limited preference for firms that are known to have leading water facilities design practices.

As indicated in the previous subsection, the above noted mix of selection criteria suggests a KSF that would appeal to both cost-oriented and differentiation-oriented selection criteria for water facilities design work.

2.6.2.6 Switching Costs

Rivalry between competing firms tends to increase when the switching costs for buyers decrease, making it easier for buyers to change firms (Porter, 1998).

Avoiding switching costs makes it easier to change engineering consultants. However, since switching will always occur as a result of the tendering process, the degree of rivalry is unaffected. As discussed in Section 2.2.2.3 – Buyers Switching Costs Relative to Firms Switching Costs, municipalities avoid the switching costs of adapting to the water facilities engineering consultant's systems, processes or procedures by contractually obligating the successful consultant adapt to the municipality's systems, processes and procedures through the terms and conditions of the contract.

2.6.2.7 Concentration and Balance

If the industry has only a relatively small number of firms who are comfortable with their share of the market, the rivalry between competitors tends to be less intense. When there are a large number of firms and not enough profit in the industry, rivalry becomes more intense as competitors fight for a share of the market (Porter, 1998).

The increasing concentration of firms in the industry serves to weaken the rivalry that occurs between firms. As discussed in Section 2.2.2.1 – Relative Concentration (Buyer

Concentration vs. Firm Concentration) the number of engineering consultants in British Columbia providing water facilities engineering consulting services is far exceeded by the number of local municipalities responsible for water facilities. When this imbalance is considered with the acquisition trend in the engineering consulting industry described in Chapter 1, it is evident that the increasing concentration of firms in the industry serves to weaken rivalry. It should be noted that if increases in firm concentration continue to progress such that the industry becomes a functioning oligopoly, then rivalry may either continue to weaken or become fiercely competitive. The outcome will depend upon the choices made by the firms left standing in the resulting oligopoly.

As discussed in Section 2.2.2.1 – Relative Concentration (Buyer Concentration vs. Firm Concentration), firm concentration is becoming a KSF in the water facilities design industry. As a KSF, continuing increases in firm concentration serve to decrease the degree of rivalry in the industry.

2.6.2.8 Informational Complexity

When a firm’s product or service is easy to understand, differentiation is more difficult, resulting in more vigorous rivalry between competing firms (Porter, 1998).

Given the disparity in knowledge and experience between municipalities and consultants, rivalry between competitors on the basis of informational complexity is weak. Owing to the highly technical nature of water facilities design and the specialized engineering professionals that typically undertake such work, it is very difficult for municipalities to understand how to undertake such work. Engineering staff at municipalities understand the design services that are required in general terms. However, considering the relatively basic knowledge and experience of municipal staff with an engineering background (Federation of Canadian Municipalities, 2006), engineering professionals employed by municipalities are relatively lay in comparison to their engineering counterparts in water facilities design firms.

2.6.2.9 Diversity of Competitors

When a firm competes in multiple industries, it is less likely to be highly competitive with other rivals in any one industry since its risks are minimized through diversification across several industries. If the firm competes in only one industry, it cannot benefit from such diversification and will tend to compete more vigorously with rival firms in the industry (Porter, 1998).

On the basis of diversity, the rivalry between large engineering consulting firms participating in multiple industries is considered weak. As discussed in Section 2.6.1 – Definition and Strength, rivals within the water facilities design industry are now almost exclusively large multi-industry engineering consulting firms. Since these firms have engineering practices in other infrastructure industries, they are not beholden to any one industry, including the water facilities design industry.

The continuing trend of acquisition by multi-industry engineering consulting firms in the water facilities design industry and their success (Bastien et al., 2011) suggests that industry diversity is a KSF. Such industry diversity leads to less of a competitive industry environment through less risk, creating more of a profitable environment for all firms.

2.6.2.10 Corporate Stakes

Although a firm may be diversified if it competes in multiple industries, it may depend on one industry for a significant majority of its revenue. If so, the firm's stakes in that industry are said to be high. If other firms have similarly high stakes in the same industry, then rivalry between these competing firms will be high (Porter, 1998).

The rivalry between competing firms based on corporate stakes is considered relatively weak. As discussed in the previous section, most of the large engineering consulting firms with water facilities design practices have practices in other infrastructure industries. As the other practices are not insignificant for these large firms, it can't be said that they have high stakes in the water facilities design industry. However, the water facilities design practices in these firms are significant enough to be far from trivial.

2.6.2.11 Exit Barriers

If it will cost a firm too much to exit an industry, then they will tend to tolerate marginal profits or losses for extended periods of time. When a number of firms start to tolerate such marginal profits or losses, rivalry between them increases (Porter, 1998).

Rivalry based on exit barriers is considered weak. Given the low capital expenditure requirements necessary to participate in the engineering consulting industry (Bastien et al., 2011), it is relatively easy for engineering consulting firms to exit the water facilities design industry.

2.6.3 Summary of Determinants of Strength including Identified KSFs

Table 2.11 below repeats Table 2.10 and includes the KSFs identified in the determinant analyses in Section 2.6.2 – Determinants of Rivalry.

Table 2.11 Summary of Determinant Strengths of Degree of Rivalry including Identified KSFs

Determinant	Degree of Rivalry	Determinant Forces	KSF
Industry Growth	Weak		None Identified
Fixed Costs	Weak		None Identified
Intermittent Overcapacity	Weak		None Identified
Product Differences	Medium		Providing significantly differentiated design service at considerably lower cost
Brand Identity	Medium		Providing significantly differentiated design service at considerably lower cost
Switching Costs	Not Applicable		None Identified
Concentration and Balance	Weak		Increasing Firm Concentration
Informational Complexity	Weak		None Identified
Diversity of Competitors	Weak		Increasing Industry Diversity
Corporate Stakes	Weak		None Identified
Exit Barriers	Weak		None Identified

2.7 Summary of Key Success Factors

The five force analysis undertaken in this chapter indicates and confirms the attractiveness and profitability of the water facilities design industry in British Columbia. Through the preceding analysis of the five force determinants, it is evident that engineering consultants with water facilities design practices in British Columbia exert bargaining power over both their clients (i.e. local municipalities) and their suppliers (i.e. engineering professionals). When this power is coupled with the lack of real substitutes for water facilities design and the relative weakness of the competition in the industry, it is clear why the industry is both profitable and therefore, attractive. It is so attractive that the strong threat of entry indicated in this chapter has moved from threat to actual entry in recent years, through both Canadian and International multi-industry engineering consulting firms acquiring local firms to gain entry into British Columbia's water facilities design industry.

Through the five force analysis undertaken in this chapter, KSFs were also identified. The KSFs identified are summarized in Table 2.12 below:

Table 2.12 Summary of Identified KSFs from Five Force Analysis

KSF	Related Force	Related Determinant
Increasing Firm Concentration	Firm – Buyer	Relative Concentration
Decreasing Fraction of Buyer's Volume	Firm – Buyer	Buyer Volume
Improving Management Systems	Firm – Buyer	Relative Switching Costs
Differentiating Service and Lowering Costs	Firm – Buyer	Product Differences
Increasing Utilization of Technologists and Technicians	Firm - Supplier	Presence of Substitute Inputs
Increasing Firm Size	Threat of Entry	Economies of Scale
Improving Management Systems	Threat of Entry	Proprietary Product Differences
Improving Management Systems	Threat of Entry	Brand Identity
Retaining Staff	Threat of Entry	Absolute Cost Advantages
Differentiating Service and Lowering Costs	Degree of Rivalry	Product Differences
Differentiating Service and Lowering Costs	Degree of Rivalry	Brand Identity
Increasing Firm Concentration	Degree of Rivalry	Concentration and Balance
Increasing Industry Diversity	Degree of Rivalry	Diversity of Competitors

The next chapter in this paper will identify KSFs derived from a value chain analysis of the larger water facilities industry within which the water facilities design industry is located. In the final chapter of this paper, these KSFs will be assessed along with the KSFs summarized in

Table 2.11 above to provide insight on how profitability can be maintained and sustainable competitive advantage gained in British Columbia’s water facilities design industry.

3: Industry Analysis using the Value Chain

3.1 General

To extend the industry analysis completed in Chapter 2 using the Porter’s five force framework, Porter’s value chain analysis will be undertaken in this chapter. As discussed in Chapter 1, this value chain analysis will be carried out to identify the linkages and competitive scopes that exist within the larger water facilities industry within which the water facilities design industry resides.

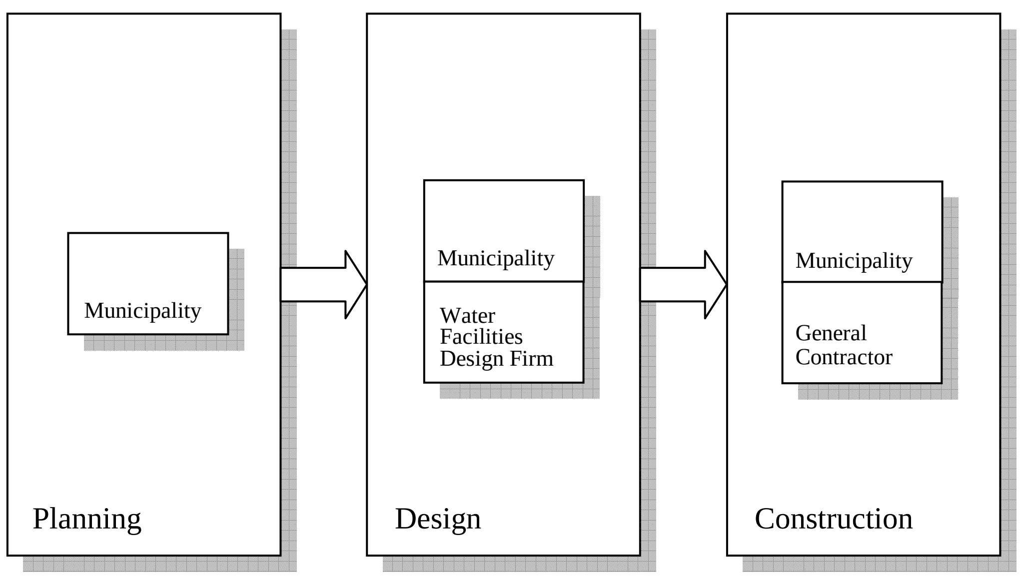
A value chain is a group of interconnected activities that add value to an evolving product or service. Porter (1998) defines the conceptualization of the value chain as a means by which a firm can be deconstructed into constituent strategic activities within the firm so that sources of cost and differentiation can be identified and examined in a systematic and analytic fashion. It is through cheaper or better performance of these activities that a firm achieves competitive advantage in its industry. When an industry is dissected into activities undertaken by individual firms that add value to a product or service, the resulting industry-level value chain is referred to as a value system (Porter, 1998). Strictly speaking (i.e. in accordance with Porter’s terminology), a value system analysis will be undertaken in this chapter. For the purposes of this paper, value system analysis will be referred to henceforth as value chain analysis of the industry.

Value chain analysis of the water facilities industry in British Columbia will begin in this chapter by first describing the supply chain activities shown in Figure 1.1 in more detail and with more industry specificity. Such detail and specificity is required to examine the linkages between activities that lead to value creation in the value chain. Finally, dimensions of competitive scope within the value chain will be considered. Through these discussions and considerations of linkages and competitive scope, KSFs will be identified as they arise.

3.2 Value Chain in the Water Facilities Industry

The activities of planning, design and construction are connected in the water facilities industry no differently than the same activities in other infrastructure industries shown in Figure 1.1 – Infrastructure Supply Chain. To facilitate the discussions in following sections on activity details and the linkages between them, the players participating in the water facilities industry are shown below in Figure 3.1.

Figure 3-1 Water Facilities Industry Value Chain including Players



3.3 Value Activities in the Water Facilities Industry

3.3.1 Planning

When a municipality is considering a water facilities project, some form of feasibility analysis is usually undertaken. This analysis begins by collecting data from historical records, previous related projects and analyses, site visits, sampling records and existing topographic and hydrographic surveys. Within the context of the municipality's objectives, a feasibility report is then drafted based on analyses of this collected data, providing findings and recommendations related to present and anticipated service levels and risks. Such reports are not limited to the engineering feasibility of the project under consideration. Economic, environmental and social aspects are also considered (Merritt, Loftin and Ricketts, 1996).

If the municipality chooses to move forward based on the findings and recommendations of the feasibility report, then conceptual design is carried out to concretely define the project at a high level. In the water facilities industry, conceptual design for the construction, rehabilitation or upgrade of water facilities usually involves:

- confirmation of data analyzed in the feasibility stage (e.g. retrieving soils from boreholes to confirm existing subsurface and geotechnical conditions),
- stipulation and general arrangement of the treatment processes to be implemented, improved and/or decommissioned, and
- master plans for layout of sites and facilities.

When the project is sufficiently defined as a whole or in stages, budgets can be developed in order to secure funding and if necessary, obtain comments from regional, provincial and federal regulatory agencies having jurisdiction. With conceptual design, budgets and comments in hand, the council for the municipality can then determine whether or not the municipality should allocate funding and proceed with the water facilities project.

3.3.2 Design

Once the council for the municipality has approved the project and the funding to design, build and operate the facility, an engineering consultant with a water facilities design practice can be retained and design can begin. The design process is an iterative one with increasing levels of detail that allow the municipality to review the design work, visualize the facilities being designed and if necessary, request modifications or additions as required (Merritt et al., 1996). Many names are used indiscriminately in the infrastructure industry for the stages of design that comprise the design process as a whole. While not formally accepted as a standard, the design phases named and defined by the American Institute of Architects (AIA) as “Schematic Design”, “Design Development” and “Construction Documents” are relatively commonplace. These phases of design will be discussed below in the context of water facilities design.

3.3.2.1 Schematic Design

Schematic design is the first phase in the design process where the engineering consultant determines and finalizes the functional goals and requirements of the water facility design concept previously established in the planning stage. The engineering consultant typically develops schematic drawings and documents to a level of detail that is sufficient to convey the spatial relationships, scale and form of the facility for the review of the municipality (American Institute of Architects, 2007). In the water facilities design industry, these schematic drawings typically include:

- Flow diagrams,
- Preliminary building floor plans and elevations,
- Preliminary external works plans (e.g. access roads, site drainage, external lighting),
- Preliminary equipment lists and layouts for process, mechanical and electrical equipment,
- Structural concepts with preliminary dimensions and general arrangements,
- Process narratives,
- Preliminary electrical single line diagram, and
- Control system architecture

Typically, a water facilities design firm seeks the municipality's endorsement of the schematic design indicated in the above drawings and documents before proceeding to the next phase. The budget for the facility is also refined in this phase to a construction cost estimate. This estimate provides both the engineering consultant and the municipality with a financial benchmark to manage design work in subsequent design phases.

3.3.2.2 Design Development

Design development is the second phase in the design process where the engineering consultant takes the schematic drawings and documents from the previous design phase and details them further. Civil, architectural and structural drawings are taken to near completion in order to provide a solid physical basis from which to layout and coordinate process, mechanical and electrical equipment and their interconnecting pipes, cables, conduits and ducts (American Institute of Architects, 2007). In the water facilities design industry, the design development phase of design produces the following drawings and documents:

- Detailed process and instrumentation diagrams (derived from flow diagrams),
- Complete building floor plans and elevations, including sections,
- Detailed structural plans, including sections,
- Complete external works plans,
- Detailed equipment lists and layouts for process, mechanical and electrical equipment,
- Detailed piping, cabling, conduits and duct layouts,
- Process control narratives (derived from the process narratives),
- Detailed electrical single line diagram,
- Detailed instrument loop diagrams (derived from control system architecture)
- Detailed block input/output wiring diagrams, and
- Preliminary specifications for all materials and equipment.

Similar to the schematic phase of design, a water facilities engineering consultant seeks the municipality's endorsement of the design development package indicated in the above drawings and documents before proceeding to the next phase. The construction cost estimate is checked to ensure the project remains within funding limits (based on funds allocated by the council of the municipality).

3.3.2.3 Construction Documents

Construction documents is the third and final phase in the design process where the engineering consultant takes the design development drawings and documents from the previous design phase and completes them. These drawings and documents are sufficiently detailed that they are used as the basis of tender documents for construction (American Institute of Architects, 2007). In the water facilities design industry, the construction documents phase of design produces the following complete drawings and documents:

- Process and instrumentation diagrams,
- Building floor plans and elevations, including sections,
- Structural plans, including sections,
- External works plans,
- Equipment lists and layouts for process, mechanical and electrical equipment,
- Piping, cabling, conduits and duct layouts,
- Process control narratives,
- Electrical single line diagram,
- Instrument loop diagrams.
- Detailed block input/output wiring diagrams, and
- Specifications for all materials and equipment.

Once the construction documents package of drawings and specifications is reviewed and approved by the municipality, the package is sent to the municipality's purchasing department. The construction documents package is then combined with the appropriate commercial terms and conditions to form a contract for tendering and subsequent award.

3.3.3 Construction

Once the project is awarded to a general contractor, the contract between the municipality and the contractor that describes the scope of work must be administered. The general goal of contract administration is to review the contractor’s work as the contractor constructs the project to ensure it conforms with the requirements of the contract and the construction documents contained therein (American Institute of Architects, 2007). Depending on the nature, magnitude and complexity of the water facilities work, administration of the contract usually requires the municipality to:

- provide either part-time or full-time resident inspection of the works,
- issue clarifying sketches or drawings,
- confirm interpretations of specifications,
- review submittals required by the contract (e.g. shop drawings, method statements, material characteristics),
- review and approve payment requests by the contractor depending upon the progress of the work, and
- review, approve and administer changes to the scope of work resulting from unanticipated conditions (e.g. unforeseen soils conditions, differing locations and dimensions of existing underground infrastructure),

to ensure conformance with the design concept embodied in the construction documents of the contract (Merritt et al., 1996).

Unlike other types of municipal infrastructure that are relatively static systems (e.g. water mains, sewers, roads and bridges), water facilities are operating, dynamic systems with moving mechanical and electrical equipment that must work together in a coordinated fashion. The process control narrative that is included in the construction documents describes that manner in which the mechanical and electrical equipment should operate, both in isolation and as part of coordinated subsystems comprising the complete water facility. Commissioning is the final part of water facility construction and consists of the start up and sustained operation of individual pieces of equipment and the coordinated operation of the same equipment as part of the functional subsystems of the water facility. The municipality ensures that the water facility is commissioned in accordance with the process control narrative in order to certify that the facility operates in accordance with the design intent.

3.4 Linkages in Water Facilities Industry Value Chain

3.4.1 Definition of Linkages

As indicated in Section 3.3 above, the activities of planning, design and construction connect to form the water facilities industry value chain in British Columbia. Similar to other industry value chains, the activities in the chain are not only connected insofar as the output of one provides input to another. From the perspective of analyzing competitive advantage, the manner in which some of the activities are performed can affect the cost or performance of others. Porter refers to these value based connections as linkages. KSFs can be found in such linkages through the optimization and coordination of activities. Within the context of value chain analysis at the industry level, these linkages are referred to as vertical linkages (Porter, 1998).

As discussed in Chapter 2, Section 2.2.2.11 – Impact on Quality/Performance, proponents of QBS maintain that the quality and performance of infrastructure is a direct consequence of the engineering undertaken early in the infrastructure life cycle. In effect, proponents of QBS are asserting that there is value to be found in the vertical linkages that connect planning to construction (via design) and design to construction. These vertical linkages are discussed in the following sections.

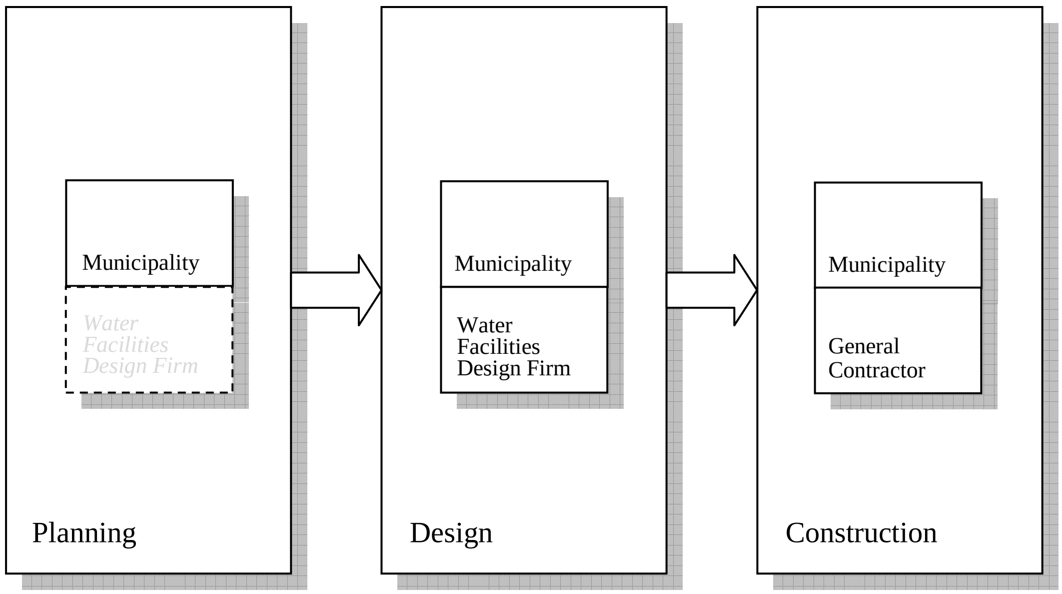
3.4.2 Planning – Construction Linkage via Design

The feasibility analysis and conceptual design undertaken by the municipality in the planning stage can be completed in a more informed and thorough fashion with the help of an engineering consulting firm with a water facilities design practice. In fact, for large and/or complex water facilities projects, municipalities often retain such engineering consultants to help with planning work. However, when municipalities retain an engineering consultant for such planning assistance, it is often done through the RFP process prior to and separately from the water facilities design work. This practice frequently results in two water facilities design firms working on the same project: one during the planning stage and one during the design stage.

Given that the RFP for the water facilities design work is issued following the completion of the planning work, the municipality risks a diminished or incomplete transfer of knowledge from the planning stage to the design stage by not bundling planning and design work into one RFP. Consider a water facilities design firm retained to assist with planning: it will most likely be interested in undertaking the water facilities design work for the same project. To have a competitive advantage in the RFP process for the project's design work, this firm engaged in planning will attempt to discreetly withhold information from the municipality. If a different water facilities design firm ends up being awarded the design work, this withheld information is lost. Within the context of the QBS previously discussed, such diminished or incomplete knowledge transfer can lead to poorer design quality and result in poorer quality and/or more expensive construction.

A KSF for a water facilities design firm would consist of developing reputable planning capabilities, positioning itself as a value added participant in the planning process (see Figure 3.2 below),

Figure 3-2 Positioning Water Facilities Design Firm in Planning Stage



and then selling municipalities on the value of the vertical linkage between planning and construction via design as described above, prior to the issuance of a separate RFP for planning. By encouraging the bundling of planning and design work together in one assignment and by positioning to offer superior planning services (in comparison to rival design firms), a firm can increases its revenues and margins while the municipality decreases costs and improves performance downstream in construction.

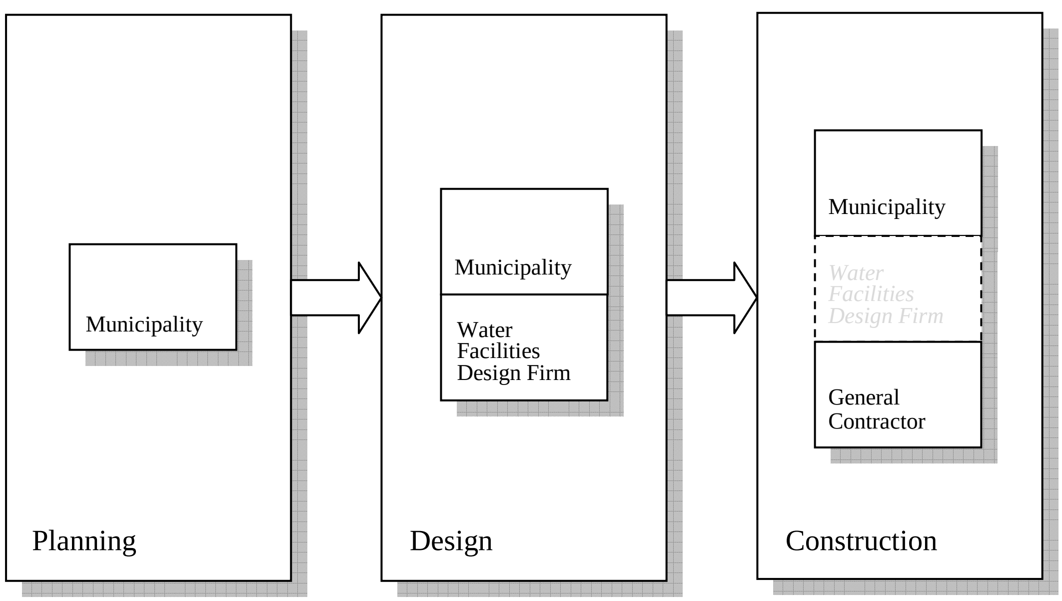
3.4.3 Design – Construction Linkage

For water facilities work in British Columbia, an engineering consultant usually administers the contract, acting as the municipality's representative. However, the retained engineering consultant may or may not be the water facilities design firm that designed the project. Often, the municipality chooses not to hire a engineering consultant, preferring to use municipality staff to administer the contract.

Similar to the diminished or incomplete transfer of knowledge discussed in the previous section, tacit design knowledge not made explicit in the contract document cannot be effectively utilized if the contract administrator is not the designer of the project. Without such project-specific design knowledge readily available as the contract is administered and as the general contractor plans and executes construction, the potential for delays, cost increases and poorer quality in the completed water facility increases.

A KSF for a water facilities design firm would be to develop solid contract administration capabilities and then sell the municipality on the value of bundling the contract administration services with the design services requested via the RFP process. The KSF would stem from persuading the municipality to realize the coordination value of the vertical linkage between design and construction and being positioned with superior contract administration capabilities (when compared to other water facilities design firms) as shown in Figure 3.3.

Figure 3-3 Positioning Water Facilities Design Firm in Construction Stage



3.5 Competitive Scope in Water Facilities Industry Value Chain

3.5.1 Dimensions of Scope

Competitive scope is a term used to define the different dimensions in which a firm can compete (Porter, 1998). The segment, vertical, geographic and industry scopes that result from these different dimensions that a firm in the water facilities design industry in British Columbia can potentially compete are discussed below.

3.5.2 Segment Scope

In theory, firms in British Columbia's water facilities design industry can choose segments of the industry in which to focus their efforts and gain competitive advantage. Such choices would define the firm's segment scope (Porter, 1998). However, as can be seen from the highly integrated nature of design drawings, design specifications and other design documents listed in Section 3.3.2.1 – Schematic Design, Section 3.3.2.2 – Design Development and Section 3.3.2.3 – Construction Documents, such segmentation is not realistic. The individual deliverables indicated in these lists are connected and coordinated across technical disciplines (civil, structural, geotechnical, electrical, mechanical, and environmental) and in time (i.e. in the three different phases of design) and are therefore, not easily segmented. If segmentation of such deliverables is imagined for a moment, then it is evident that these segmented deliverables provide little value to the municipality. For example, if segmentation of mechanical design for water facilities is imagined, then the municipality will then need to know if the mechanical equipment specified in the mechanical design is:

- drained properly (a civil engineering concern),
- connected to a sufficient supply of seal water (a civil engineering concern),

- housed within at stable structure (a structural engineering concern),
- supported by a foundation with sufficient strength (a geotechnical engineering concern),
- connected to an adequate supply of power (an electrical engineering concern), and
- operating within regulatory emission requirements (an environmental engineering concern).

While the above list is far from exhaustive, it is evident that water facilities design work provides value to the customer through the connection, integration and coordination of individual pieces of equipment, systems and subsystems across different engineering disciplines. As such, differentiating based on varying segment scopes is not applicable to the water facilities design industry.

3.5.3 Vertical Scope

The vertical scope of a firm refers to the vertical linkages discussed in Section 3.4 – Linkages in the Water Facilities Industry Value Chain on an activity level and whether or not the firm chooses to perform select activities in-house (Porter, 1998). The vertical scope adopted by a firm is defined by the activities it chooses to outsource to the industry value chain and the activities it chooses to integrate into its own activities from the industry value chain.

In the water facilities industry, engineering consultants ensure that their vertical scope choices do not result in the need to expend significant amounts of capital. As noted in Section 1.3.2.9 – Capital Structure, water facilities design firms have low capital expenditure requirements. The low amount of fixed capital required by such firms make them an attractive investment (Bastien et al., 2011). To remain an attractive investment, water facilities designers cannot expand their vertical scope such that significant capital expenditures are required. This requirement precludes integrating almost all downstream construction activities, as they are capital intensive. Commissioning, as discussed in Section 3.3.3 – Construction, is one of the construction activities that is an exception to this rule. Similar to design activities, commissioning is a knowledge based activity and as such, requires very little capital expenditure. As a KSF, "Insourcing" commissioning into their vertical scope offers engineering consulting firms with water facilities design practices a means by which to differentiate their offering and increase their competitive advantage.

The KSF of providing planning services discussed in Section 3.4.2 – Planning – Construction via Design Linkage offers another means through which water facilities design firms can capture value in the industry value chain. As another knowledge-based activity, expanding the firm's vertical scope upstream in the value chain through the provision of planning services satisfies the low capital expenditure requirements discussed above.

3.5.4 Geographic Scope

When a firm's value activities are shared or coordinated across geographic regions to provide products or services to different geographic regions within which the firm operates, the firm is said to have geographic scope. Such scope is a source of competitive advantage when it serves to lower costs and/or increase differentiation (Porter, 1998).

In Section 1.3.1.2 – Acquisitions, the trend of larger multi-industry engineering consulting firms acquiring small and medium size firms specializing in water facilities design was introduced. As a rule, these engineering consulting firms have practices that have international and Canadian regional geographic scope through offices located across Canada, in the United States and internationally. Given the knowledge-based nature of the water facilities design industry and the present state of information and communication technology, engineering professionals are no longer required to physically occupy the same office location in order to work on a project's design team. With physical distance no longer a limitation, the large multi-industry engineering consulting firms have a larger pool from which to draw from (in comparison to small and medium size local firms) and differentiate their design services, especially when the services of very specialized engineering professionals are required. For example, odour control in wastewater treatment facilities is becoming more of a design concern as urban densities increase, the public becomes more vocal and technological means develop to control such odours. With facility level odour control technology becoming widespread only in recent years, engineering professionals with the appropriate knowledge and experience to design such systems are uncommon. A small or medium size local water facilities design practice would most likely not have such a specialized engineering professional on staff. However, a large multi-industry engineering consulting firm would most likely have such an individual on staff. Even if this individual is located in the south-eastern United States, he can still provide his knowledge and expertise to a water facilities design team based in Vancouver.

As a KSF, geographic scope permits large multi-industry engineering consulting firms to differentiate their services in any one location. As a product of the trend of acquisition, the KSF of geographic scope is linked to the KSF of firm size discussed in Section 2.4.2.1 – Economies of Scale.

3.5.5 Industry Scope

Similar to geographic scope, when a firm's value activities are shared or coordinated across industries to provide products or services to different industries within which the firm operates, the firm is said to have industry scope. Such scope is a source of competitive advantage when it serves to lower costs and/or increase differentiation (Porter, 1998).

The trend of larger multi-industry engineering consulting firms acquiring small and medium size firms introduced in Section 1.3.1.2 – Acquisitions also provides the larger firms with more of an ability to pool engineering professionals from different disciplines. Considering that many engineering disciplines provide knowledge and expertise that can be applied in many different industries, the multi-disciplinary engineering consulting firm is more readily able to balance workloads with this pool and therefore, deliver water facilities design services on time. For example, an engineering consulting firm with a water facilities design practice and a mining design practice would have a pool of electrical engineers on staff that would be larger in comparison to the pool of electrical engineers in any one firm with only one of these practices. However, this pool would be smaller than the combined pool of electrical engineers resulting from the sum of the individual water facilities design and mining design firms. In effect, this pool provides the large multi-disciplinary consulting firm with a staffing economies of scale. With electrical engineering design not being materially different, whether the pumps in a water facility or the crushers in a mine are being supplied with power, the services of the electrical engineers can be shuttled in the larger firm from one industry project to another more readily than if they were employed by separate industry design firms.

This sharing of resources across industries provides a KSF via differentiation in water facilities design service execution. As a product of the trend of acquisition, the KSF of industry scope is the same as the KSF of industry diversity discussed in Section 2.6.2.9 – Diversity of Competitors

3.6 Summary of Key Success Factors

The industry value chain analysis undertaken in this chapter extends the five force analysis undertaken in Chapter 2 by moving beyond the design activities carried out by water facilities design firms to discover opportunities on the industry value chain level. The opportunities discussed in this chapter are identified as KSFs for water facilities design firms to consider. The KSFs identified in this chapter are summarized below in Table 3.1.

Table 3.1 Summary of Identified KSFs from Value Chain Analysis

KSF	**Related Activity Linkage**	**Related Competitive Scope**
Positioning to provide Planning and Design Service Combination	Planning - Construction via Design	
Positioning to provide Design and Contract Administration Service Combination	Design - Construction	
Utilizing Geographic Breadth		Geographic Scope
Utilizing Multi-Industry Breadth		Industry Scope

The first two KSFs indicated in Table 3.1 recognize the value the can be found upstream and downstream in the supply chain by examining the creation of value simultaneously within AND beyond the boundaries of the firm's activities through vertical linkages. If municipalities recognize not only the existence of such value but also its magnitude, they may be willing to pay for this value by modifying their procurement procedures and bundling services in RFPs (as suggested by these two KSFs) in order to acquire the value.

Derived through value chain analysis, the last two KSFs indicated in Table 3.1 were also derived through five force analysis in the previous chapter. Both of these KSFs become viable as a consequence of the recent trend of acquisition in the engineering consulting industry introduced in Chapter 1.

KSFs derived in both Chapters 2 and 3 will be compared in the following final chapter of this paper to provide a path forward for water facilities design firms to formulate more effective strategies.

4: Conclusion

Through the extended analysis of the water facilities design industry in British Columbia completed in this paper, KSFs have been identified that can help engineering consulting firms practising water facilities design formulate more effective strategies. These KSFs have been derived from a number of different perspectives, namely the different relationships between players in the five force model, the linkages between activities in the industry value chain model and the competitive scopes adopted by firms in the industry value chain. Based on their frequency of appearance in the extended industry analysis, the KSFs are ranked and tabulated in Table 4.1 below.

Table 4.1 Ranking of Identified KSFs

Rank	KSF	Frequency
1	Differentiating Service and Lowering Costs	3
1	Improving Management Systems	3
2	Increasing Firm Concentration	2
3	Decreasing Fraction of Buyer’s Volume	1
3	Increasing Utilization of Technologists and Technicians	1
3	Increasing Firm Size	1
3	Retaining Staff	1
3	Increasing Industry Diversity	1
3	Positioning to provide Planning and Design Service Combination	1
3	Positioning to provide Design and Contract Administration Service Combination	1
3	Utilizing Geographic Breadth	1
3	Utilizing Multi-Industry Breadth	1

A closer look at the KSFs indicated in Table 4.1 reveals that a number of them can be grouped under one KSF, since a number of them are not mutually exclusive. More specifically, if

“Acquisition” is viewed as a KSF, then the KSFs of “Increasing Firm Concentration”, “Decreasing Fraction of Buyer’s Volume”, “Increasing Firm Size”, ‘Increasing Industry Diversity”, “Utilizing Geographic Breadth” and “Utilizing Multi-Industry Breadth” become a consequence of implementing the KSF of “Acquisition”. Similarly, if the KSF of “Improving Management Systems” is seen as a means of implementing the KSF of “Differentiating Service and Lowering Costs”, then the KSF of “Differentiating Service and Lowering Costs” can be seen as a combination of the two KSFs. Table 4.2 below revises Table 4.1 by grouping KSFs in this manner.

Table 4.2 Revised Ranking of Identified KSFs through Grouping

Rank	**KSF**	**Frequency**
1	Acquisition	7
1	Differentiating Service and Lowering Costs	6
2	Increasing Utilization of Technologists and Technicians	1
3	Retaining Staff	1
3	Positioning to provide Planning and Design Service Combination	1
3	Positioning to provide Design and Contract Administration Service Combination	1

As can be seen in Table 4.2, the KSFs of “Acquisition” and “Differentiating Service and Lowering Costs” are the most critical KSFs based on frequency. Given the criticality of these two KSFs, they offer the most effective means by which engineering consultants with water facilities design practices in British Columbia can maintain profitability and gain sustainable competitive advantage.

Implementation of the “Acquisition” KSF is relatively straightforward as it is readily observable in the water facilities design industry today. Through acquisition, large multi-industry engineering consulting firms are increasing their already formidable bargaining power over municipalities by increasing their concentration and decreasing the leverage municipalities have by virtue of the volume of revenue they represent to the firm. By increasing their concentration through the acquisition of small and medium size firms, acquiring firms are also decreasing rivalry in the industry through a reduction in the number of competing firms. Finally, the resulting increases is size, geographic and industry diversity serve to create a barrier to entry, obliging firms considering entry to "go big or go home".

Although there are almost no firms left in British Columbia that can claim to be small or medium size water facilities design practices, the trend of acquisition will most likely continue in other jurisdictions (Bastien et al., 2011), thus further affecting bargaining strength, buyer leverage and barriers to entry. As such, implementation of the KSF of acquisition is clear:

- for large firms getting larger, continue, and
- for small and medium size firms, solicit an acquiring firm with the best offer in terms of price and conditions of purchase.

Implementation of the KSF of "Differentiating Service and Lower Cost" is easier said than done. Aside from advances in information and computing technology, the practice of water facilities design has remained relatively stagnant over the last twenty plus years. While engineering design technology has benefitted from advances in information and computing technology similar to other industries, these advances are widely available to all engineering consultants, thus negating any potential for advantage through either differentiation or lower cost. For example, with respect to efficiency and effectiveness, the most significant advances in engineering design technology over the last twenty plus years have been made through computer aided design and drafting (CADD) technology. Significant improvements in drawing production, drawing consistency, interdisciplinary design coordination, building information management (BIM), geographic information systems (GIS) and three-dimensional (3D) visualization are all attributable to CADD technology. However, CADD technology is widely available to all water facilities design firms. Instead of becoming a source of differentiation or lower cost, the utilization of CADD technology has become a prerequisite to competing in the engineering consulting industry in general and the water facilities industry in particular.

Improving management systems for design services provides a means of differentiation that builds upon existing design activities whilst improving the likelihood of performance of design services within budget, thereby lowering final costs. The KSF of improved management systems provides the potential for differentiation and lowering costs through more efficient and effective:

- resolution of technical problems,
- negotiation and processing of changes in scopes of work,
- approvals processing for departments inside and outside of the municipality, and
- payment processing.

Although improving management systems for design services does not represent a quantum leap in competitive advantage, it does represent a sustainable one in accordance with Porter's conditions for sustainable differentiation (Porter, 1998) in that:

- such systems will create sources of uniqueness that engineering professionals, naturally prone to seeking technical solutions, will not be inclined to emulate,
- the above points of efficiency and effectiveness represent multiple sources of differentiation which are harder to imitate than a single source, and
- performance of these same points will lead to a sustainable cost advantage.

Implementation of the critical KSFs of “Acquisition” and “Improved Management Systems” presented in this paper represent strategic moves recommended to engineering consultants competing in British Columbia’s water facilities design industry that are anticipatory in nature. As such, the need for their implementation is not immediate: acquisition may result in either a future oligopolistic industry in which prices are effectively set by the remaining engineering consultants or a highly competitive future oligopoly characterized by low cost competition. At this time, the outcome is uncertain. However, it is suggested that without the implementation of the critical KSFs recommended in this paper, water facilities design firms risk remaining “stuck in the middle” of an industry that may not be as profitable sometime in the future.

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