Designing Effective Contracts within the Buyer-Seller Context: A DEMATEL and ANP study

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Abstract

This study examines the factors that contribute to effective contract design within the context of buyer-seller relationship. Research streams on contract factors, supply chain factors, environmental factors, and competitive factors were reviewed to arrive at 18 contract factors. A hybrid model of Decision-Making Trial and Evaluation Laboratory (DEMATEL) and Analytic Hierarchy Process (ANP) analysed empirical data collected from 17 experts to weight the importance of contract factors. It was found that most important factors are, in order of significance: policies, supplier technology, force majeure, formality, relationship learning, buyer power, legal actions, liquidated damages, supplier power and partnership.
Keywords: Contract, Contract Design, buyer-seller relationship, DEMATEL, ANP, decision making.

Introduction

The volume of work on contracts is enormous in the economics and operations management literatures (Tirole, 1988; Tsay et al. 1999; Cachon, 2003; Krishnan et al. 2004; Liu and Etinkaya, 2009). Despite the established role of contracts in economies and markets, there is a substantial gap in our knowledge of the factors underling the design of effective contracts within the context of buyer-seller relationships. This gap stems from the widely accepted thesis that contracts cannot be complete and in many times are "excessively" incomplete (Bernheim and Whinston, 1998; Williamson, 1975, 1996).

The contribution of this study is to synthesise the research streams in order to arrive at an optimal contract design. Moving beyond the transactional power of a contract and the repercussions of its incompleteness, the contract design may have a dual effect on buyer-seller relationships: an incomplete contract may stimulate opportunism which can alter the governing equilibrium (Mesquita and Brush 2008). On the other hand, a contract may contain incentives that promote ethical choices that foster trust and enhance long-term collaborations (Merkert and Hensher, 2013). Using the strategy lenses, a contract needs not be complete in transactional terms, yet it needs to contain clauses that promote an effective buyer-seller relationship. In this way, companies can use contracts as a mechanism to maintain their competitive

advantage that resides within relationships maintained with external organisations (Dyer and Singh, 1998; Kale, Singh and Perlmutter, 2000). Nevertheless, it is typical in supply contract design, the more powerful party to assume the leadership position (Liu and Etinkaya, 2009).

Literature Review

In order to examine what factors contribute to an effective contract design, four research streams were reviewed (contract factors, supply chain factors, environmental factors, competitive factors) and 18 factors were identified).

Contract Factors

Ranjan and Lee (2007) examined contracts in the context of global trade and found that contract enforcement directly affects trade volume and product differentiation. Hart (2011) argued that contract design needs to deal with imbalance in bargaining power between contractors. Weber and Mayer (2011) pointed out that contract may induce certain behaviours thus indirectly affect supplier performance and groups contracts in two categories: (i) promotional contracts that endorse trust and take a partnership approach and (ii) prevention contracts that dictate high conformance to avoid contract default. Wilkinson-Ryan's (2010) suggested that a contract with a Liquidated Damages (LD) clause is more likely to default than one without it since firms will try to comply with moral and social norms to meet their obligations.

Ryall and Sampson (2009) reviewed the key terms from 52 technology development contracts in telecommunication companies and found great variance on contract purposes and relational governance. Experienced firms were more likely to include detailed terms and conditions and implement penalty clauses, as well as place more emphasis and reliance on contractual tools such as LDs to ensure contractual adherence following firsthand experience of defaulting partners rather than solely relying on relational governance. Poppo and Zenger (2002) suggested that relational governance was often incorporated into formal contracts and concluded that the two were complementary.

Supply Chain Factors

Within a buyer-seller context, agency theory provides a useful lens to examine governance mechanisms and their role in ensuring appropriate supplier behaviour Vlachos et al., 2008). Incentive contracts are popular in corporate governance to motivate managers and align their interests with those of shareholders (Holmstrom, 1982). The literature around this theory focuses on different ways that contracts incentivise agents and means to resolve the issues that arise when contracts are incomplete (Hart and Moore, 1990). Baiman et al. (2001) applied agency theory in a buyer-supplier relationship to examine contracting issues with respect to internal and external failures. Research has focused primarily on understanding how governance tools of the principal might serve to minimize agent opportunism since the lower the opportunism is the stronger supply chain relationships can develop (Pardalos et al. 2004; Kashyap et al., 2012).

Merkert and Hensher (2013) surveyed of European and Australian regional airlines and found that air and bus contracts were particularly unclear and incomplete in two key contract issues, namely incentives to improve performance/grow patronage and change events. Merkert and Hensher (2013) suggested that incentives in contracts should go beyond minimum service levels and should be clearly defined in the contracts. Pillai and Sharma (2003) noted that, in principle, most partnerships should be founded on trust, commitment and information exchange. Trust is the product of the common history and incremental investments in a supplier-buyer relationship and reflects the extent commitments are sustained (Vlachos and Bourlakis, 2006).

Contextual Factors

There are two primary contextual factors: impossibility of performance and commercial impracticability due to factors beyond the control of the trading parties. Force majeure generally refers to circumstances that are beyond the control and without the fault or negligence of the non-performing party (Allen, 2005). Contracts will often contain a force majeure clause to protect the supplier being reprimanded if they cannot meet their contractual obligations as a result of such an event (Buffalow, 2011). A Force Majeure clause in a contract is intended to excuse a party from not performing its contractual obligations due to unforeseen events such as natural disasters, and war. Tanenbaum (2006) pointed out that a force majeure clause can actually increase the risk of default because it is seen as accepted that a force majeure event is likely to occur at some point in the transaction relationship, providing disincentive for the supplier to adequately prepare and mitigate disruptions. Tanenbaum (2006) suggested combining force majeure clauses with disaster recovery and business continuity provisions to ensure the supplier anticipates force majeure events and continues to provide some level of service.

Competitive Factors

Porter identified five forces that determine the attractiveness of an industry: buyer power, supplier power, the competitive threat posed by current rivals, the availability of substitutes, and the threat of new entrants (Porter, 1980). Based on the five forces model, firms could develop strategies to alter the firm's position in the industry vis-à-vis competitors, suppliers, and buyers (Porter, 2008). Therefore, the contracts that firms design need to reflect their competitive position from which it could best defend against these competitive forces or influence them to its advantage. Without written incentives in a formal contract to oblige suppliers not exploiting their power there is always the possibility of losing competitive advantage. The same stands true for customers who always have the option to switch suppliers to minimise their price and risks.

Methodology

This study employs Decision-Making Trial and Evaluation Laboratory (DEMATEL) to investigate interdependences between contract, governance and competitive factors and then incorporates Analytical Network Process (ANP) to evaluate the magnitudes among factors and their dependences when designing contracts. This section, at first,

presents the application of DEMATEL for network relationships, and second, applies ANP to obtain the relative weights respective to each factor. Finally, it presents data collection according to the chosen methodology.

Application of DEMATEL for network relationship

The DEMATEL technique was initiated for a Science and Human Affairs Program by the Battelle Memorial Institute of Geneva between 1972 and 1976. It was established to solve complex problems. It can elevate the understanding of the issues, groups of interaction factors, criteria and provide a feasible solution by building a hierarchically relevant network system. This technique has been applied for solving complex decision making in a wide spectrum of management challenges, such as the choice of knowledge management strategy and the selection management systems of SMEs (Tsai and Chou, 2009).

There are four steps in the DEMATEL method as described by Wu (2008): **Step 1**: **Generate the direct-relation matrix**. The comparison scale among the criteria has four levels: 0 (no influence), 1 (low influence), 2 (high influence), and 3 (very high influence). Experts are given pairs of factors and make wise comparisons in terms of influence and direction between criteria. The expert evaluations are the initial data obtained as the direct-relation matrix that is a n×n matrix A, in which aij is denoted as the degree to which the criterion i affects the criterion j. **Step 2**: **Normalise the direct-relation matrix**. The normalisation of the direct-relation matrix A produces the normalized direct-relation matrix X obtained through formulas. **Step 3**: **Compute the total-relation matrix**. Having calculated the normalized direct-relation matrix X, the total relation matrix T can be acquired. **Step 4**: **Set a threshold value and obtain the impact-relation map**. Based on the matrix T, each aspect tij of matrix T provides information about how aspect i influences aspect j. A threshold value (P) of 30% was set to remove invalid effects from consideration in matrix T.

The sum of rows and the sum of columns are respectively denoted as vector D and vector R. The horizontal axis vector (D+R) named as ‘‘Prominence’’ is calculated as the sum of D and R. Prominence signifies the importance of each factor. The vertical axis (D-R) named as “Relation” is calculated by subtracting D from R. Relation classifies factors into two groups: a cause group and an effect group. When a factor has positive in the vertical D-R axis, then it belongs to the cause group, otherwise it belongs to the effect group. Therefore, the causal diagram can be acquired by mapping the dataset of the (D + R, D - R) as a dispersion graph, providing valuable insight for decision making.

Weight measurements by integrating DEMATEL and ANP

The purpose of the Analytic Hierarchy Process (ANP) approach is to solve problems involving interdependence and feedback among criteria or alternative solutions. ANP is the general form of the AHP, which has been used in multi-criteria decision-making (MCDM) in order to consider non-hierarchical structures. The ANP handles dependence within a criterion (inner dependence) and among different criteria (outer

dependence). According to Lee et al., (2011), DEMATEL method is not going to be used only to calculate the level of impacts among different groups of factors, but the normalised total-influence matrix will be incorporated into un-weighted supermatrix W in the ANP to calculate the level of interdependences of different factors.

Although key interdependences of clusters can be obtained via DEMATEL, the ANP algorithm determines interdependences between clusters. The total-influence matrix acquired by DEMATEL is similar to the concept of ANP, which confirms the importance and influence of criteria through questionnaires. The ANP algorithm runs in four steps: **Step 1**: Construct the structure of the network and establish its objectives. Then, the network is decomposed into network hierarchical structure. **Step 2**: Calculate the unweighted supermatrix W. Since DEMATEL produced the total-influence matrix, the unweighted supermatrix W can be calculated by normalizing the sum of influence for each criterion in each hierarchy under the criteria of total-influence matrix. **Step 3:** Obtain the weighted supermatrix by normalizing the sum of impact for each hierarchy and each dimension in the dimensions total-influence matrix**. Step 4**: Obtain the limited supermatrix, by multiple productions of the weighted supermatrix until the vector values in the limited supermatrix become stable. The vectors of the limited supermatrix represent the relative weights of each factor in relation to the defined objective. Sorting the limited supermatrix W according to the relative weights of each factor gives insights on the significance and contribution of each factor as well as each cluster to the objective of network.

Data Collection

Experts were selected from a leading international manufacturing company with headquarters in France. The company enjoys multi-billion dollars annual revenues and relies upon contractual partners totalling about 1,800 suppliers over 30 countries. Experts hold the positions of Contract Managers, Quality and Supply Chain Professionals, Procurement Leaders and Finance Managers. A total of 17 experts took part in this study. Most experts were senior managers with over ten years of experience only three of them had between two and ten years of procurement experience. Interviews took place on early 2012 by experienced, trained researcher. Other procurement employees were also interviewed in order to derive at an appropriate threshold value in DEMATEL analysis.

Findings

This section presents the results of the analysis of the experts' preferences on the factors that contribute to creating a strong contract.

Analytical technique relationship by DEMATEL

This study applies DEMATEL to construct the structure in contract decision making and analyze the interdependent relationships of eighteen factors (Agreement of formal contract, Relationship Learning, Liquidated Damages, Undertaking of legal action, Trust, Incentives, Long-term relationships, Partnership approach, Supplier take-over intention, Re-organization of the supplier, Force majeure, Change in policies and

procedures, Supplier's technology, Supplier power, Buyer power, Threat of Rivals, Threat of new entrant, Threat of Substitution).

The prominences and relations between techniques are reflected by the sums of influences and provided in Table 1, which shows greater d coefficient of Buyer power as 4.22 than 4.11of Formality and Supplier power with 3.95, which indicates that Buyer power and Formality are the most important issues to consider in writing strong contracts. This finding support the hypothesis that the company needs to write a contract in a formal way than sets clear the negotiating power of buyer (the reporting company itself) and then the power of supplier (contractor).

Table 1 The sum of influences of factors

Factors	D	R	D+R	D-R
Formality	4.11	4.44	8.54	-0.33
Relationship Learning	3.44	4.30	7.74	-0.86
Liquidated Damages	2.40	3.69	6.09	-1.29
Legal action	2.90	3.38	6.28	-0.47
Trust	3.43	4.13	7.55	-0.70
Incentives	2.08	2.98	5.06	-0.90
Long-Term	3.54	4.48	8.03	-0.94
Partnership	3.61	4.36	7.96	-0.75
Supplier take-over	2.61	0.88	3.49	1.73
reorganisation	1.30	0.53	1.83	0.77
Force majeure	0.67	0	0.67	0.67
Change in policies	2.11	1.26	3.37	0.85
Supplier technology	0.86	1.27	2.13	-0.41
Supplier power	3.95	3.04	6.99	0.91
Buyer power	4.22	3.41	7.64	0.81
Rivals	2.41	2.05	4.46	0.36
New entrant	2.62	1.99	4.61	0.63
Substitution	2.52	2.60	5.12	-0.07

However, findings are different with the r coefficient. Factors could be classified into groups: the first one with significant high coefficients and the second one with low r coefficients. In the first group, there are factors that define the type of the contract such as the long-term (4.48), formality (4.44), partnership (4.36), the Relationship Learning (4.3), and finally trust (4.13). In order to put the factors in a perspective, the Influence Relationship Map depicts the dispersion graph of prominence (D+R) and relation (D-R) (Figure 1).

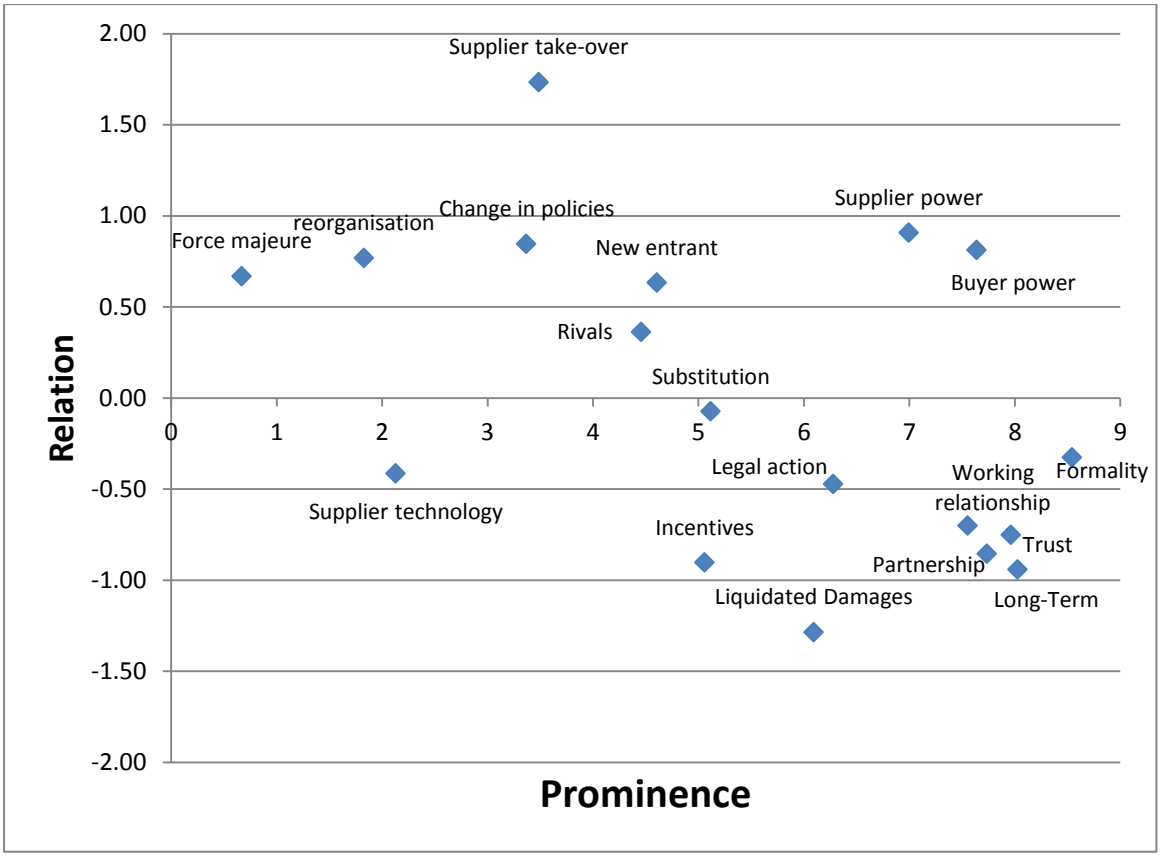

Figure 1 Influence Relationship Map

Prominence reveals how much importance the criterion has and Relation divides criteria into a cause group (positive relation) and an effect group (negative relation). Figure 1 makes clear that buyer and supplier powers are cause factors and the long-term, formality, partnership, the Relationship Learning, and trust are effect factors. Interestingly, supplier take-over is the highest cause factor yet its relation is lower than the effect group factors.

Weight calculation by incorporating DEMATEL with ANP

The influence relationship map obtained through DEMATEL can provide us with an understanding of the entire structure. Table 2 shows the priorities of the factors. Among the eighteen factors, three environmental factors are the most important ones: Policies (weight 0.39361), Supplier's Technology (weight 0.30705), and Force Majeure (weight 0.29934), in order of importance. Relative to other factors, experts perceive three supplier factors to be least important: Take-Over (weight 0.15836), Incentives (weight 0. 15148), and Reorganisation (weight 0. 13079).

Conclusions

While the use of contracts is ubiquitous in buyer-seller transactions, the design of effective contracts has been debated in various research streams. In transaction cost economics, contracts protect trading partners from opportunism (Williamson, 1975, 1985, 1996). In agency theory, contracts interact with governance mechanisms, define

and get defined from agent behavior (" (Bergen et al.1992; Holmstrom, 1982). Competitive factors are part of effectively-designed contracts since property rights cannot apply to control a relationship; therefore contracts govern relationships and form networks (Porter, 1980). Further, specific clauses in contracts can be written in ambiguous ways and either foster or forge trust, mitigate or encourage opportunism thus facilitate or inhibit trust development respectively (Weber and Mayer, 2011). Therefore, there is no effective way to design contracts patently.

Table 2 Priorities

Rank	Factor	Group	Normalized By	Limiting
1	Policies	Environmental Factors	0.39361	0.098403
2	Supplier's	Environmental Factors	0.30705	0.076762
3	Force Majeure	Environmental Factors	0.29934	0.074835
4	Agreement Of	Contract Factors	0.28346	0.070866
5	Relationship	Contract Factors	0.25768	0.064419
6	Buyer Power	Competitive Factors	0.23896	0.059739
7	Legal Action	Contract Factors	0.2366	0.059151
8	Liquidated	Contract Factors	0.22226	0.055564
9	Supplier Power	Competitive Factors	0.22158	0.055394
10	Partnership	Supplier Management	0.18828	0.047071
11	Trust	Supplier Management	0.18663	0.046658
12	Threat Of New	Competitive Factors	0.18617	0.046543
13	Long Term	Supplier Management	0.18445	0.046112
14	Threat Of	Competitive Factors	0.18019	0.045048
15	Threat Of Rivals	Competitive Factors	0.1731	0.043276
16	Take-Over	Supplier Management	0.15836	0.039591
17	Incentives	Supplier Management	0.15148	0.037869
18	Reorganisation	Supplier Management	0.13079	0.032698

This study adopts the methods of DEMATEL and ANP to analyse the interdependences between factors that affect the design of an effective contract. By integrating the dynamic influence relationship obtained by DEMATEL with ANP, levels of direct and interactive impacts for factors are quantified and ranked, and the outcomes are robust to actual performances.

The contract factors obtained through the proposed approach are objective for the following reasons. First, the results are generated by a group of experts with at least 10 years of experience in contract design within the buyer-seller context. Second, the analytical process weights the contract factors in a way than minimises any loss of information as it would be the case with data analysis methods like factor analysis or structural equation modelling. Managers are equipped with a strong analytical technique than minimizes theoretical limitations and takes into account all information available for decision making using criteria that provide the most effective direction towards contract design.

The proposed method also simplifies the existing models and raise efficiency without affecting the key outcomes. The empirical results provide evidences of significant interdependent and self-feedback relationships among 18 factors grouped in four categories. The weights of factors are numerically obtained and demonstrate that the most important factors are, in order of significance: policies, supplier

technology, force majeure, formality, relationship learning, buyer power, legal actions, liquidated damages, supplier power and partnership. The less significant factors were: re-organisation, incentives, take-over, thread of rivals, thread of substitution, long term Threat of New Entrant and trust.

The finding consolidated from mathematical theories and judgments of experts is essentially useful to companies that see a dual role of contracts, that is protect from opportunism and an opportunity for developing the buyer-seller relationship. This study suggests that, instead of protecting opportunism, companies design contracts to promote cooperation and partnership within a buyer-seller relationship. Contracts can become a tool to develop a partnership by giving trading partners a shield for their transaction and a tool to align their performance with their partnership objectives. Contracts need to deal with competitive issues such as buyer and seller power and by doing so, they protect from opportunism. Trust and incentives were ranked low in order of significance. Regarding incentives, there is a difficulty to obtain the optimum incentive equilibrium, which may disqualify incentives as an opportunism protection mechanism. Regarding trust, companies seem to prefer quantified ways to build a relationship and the concept of trust may be blatant to trust.

There are several limitations in this study. Information from experts working in different companies, in the public sector, in small and medium companies would provide a stronger test of our model and will be the subject of future research. A recommendation for future research would also be to maintain the current design and compare results from different sources. i.e. large companies vs. small companies, buyers vs. sellers, product –vs. service offered. The second empirical limitation is that the sample of experts was drawn solely from the large manufacturing company in Europe. Cultural issues as well law in different counties i.e. in Asia and USA may moderate the contract design factors and produce different results. Therefore, future research should examine the contract factors in other contexts and countries which could produce a basis for cross-validation of the model.

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