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The impact of information technology on supplier selection decisions

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Abstract

New information technologies used to support electronic commerce transactions have the potential to trigger significant changes in supplier relationships by reducing transaction costs. This work identifies the transaction costs of supplier relationships and examines how these costs are likely to be reduced by new developments in information technology. A model is presented and discussed with respect to technologies reducing the evaluation costs of finding new suppliers and the costs of establishing business relationships with them.

Transaction costs in supplier relationships

Technologies supporting electronic commerce are likely to influence the relationships between an organization and its suppliers (Gebauer 1996; Segev et al. 1998; Steinfield et al. 1995) . In a supplier relationship goods or services are passed from a supplier to the customer, who makes payments (Zenz 1994). The costs incurred by activities of transferring and securing these titles using markets, i.e. by a transaction, are also referred to as transaction costs (Coase 1937).

The activities taking place in transactions can be divided into phases according to their functions and their approximate order, as shown in Figure 1 (Schmid 1993). The phases are the evaluation phase in which information about potential suppliers and their products is collected and contracts are negotiated and the transaction phase in which the goods are exchanged and payments are done.
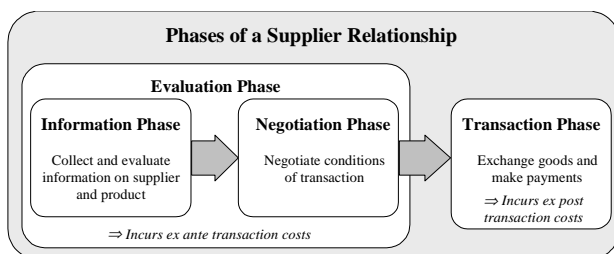

Figure 1: Phases of a supplier relationship

During the evaluation phase ex ante transaction costs are incurred which consist of:
- contact costs of finding a potential transaction partner and to establish a first contact;
- costs of gathering further information on the potential transaction partner;
- negotiation costs incurred by negotiations, contractual arrangements and agreements between partners; and
- decision costs when deciding whether to continue searching or to accept an offer.

Whereas during the transaction phase ex post transaction costs are incurred consisting of:
- costs of signing the contract;
- initialization costs incurred by necessary organizational and/or technical adaptions when establishing a relationship to a new supplier;
- costs of exchanging goods and payments;
- adjustment costs, incurred by supervising agreements, (un)planned changes of the original provisions of the contract, and the costs of modifications; and
- decision costs when deciding whether to prolong a contract or to change to an alternative supplier.

Technologies supporting supplier relationships

Technologies supporting supplier relations are likely to contribute to a reduction of transaction costs. A reduction of ex ante transaction costs enables a more intensive search for suppliers. Technologies reducing ex post transaction costs may make it easier to change suppliers. Two examples of recent standards in information technology will illustrate these effects:

A standard with the potential to reduce ex ante transaction costs is the Web Interface Definition Language which has been developed by webMethods (webMethods 1998). The goal of this approach is to enable automation of interactions with HTML/XML documents and forms, providing a general method of representing request/response interactions over standard web protocols. The provider of a Web-based service, e.g. a supplier offering products over a catalog which is accessible by forms, can provide a formal description of the input and output parameters of this service. This description can then be used by search engines to retrieve more precise results. Hence, lower ex ante transaction costs can be realized. This leads to potentially better prices for the purchased goods or services due to a more intensive search.

A standard with the potential to reduce ex post transaction costs is Open Buying on the Internet (OBI) which has been developed by a consortium of 71 companies and is currently available in release 1.1 (OBI Consortium 1998). The goal of this approach is to support the purchase of non-strategic, indirect materials by large, distributed requisitioner populations. The benefit of OBI lies in an accelerated and more efficient order processing and in an automated information flow between seller and buyer.

Thus, this technology may lead to lower information processing costs in the execution of supplier relations. Moreover, once many potential suppliers support this standard it will be cheaper to add new or substitute existing suppliers since the costs of establishing relationships to new transaction partners decrease, too.

Model of supplier selection decisions

In this section a model is introduced which represents the decisions made in a purchasing organization its suppliers and which will help to analyze the influence of information technology on these decisions.

The purchasing organization faces the decision whether to maintain business with the current supplier for a given good or service, or whether to change transaction partner, i.e. selecting a supplier from the set of possible transaction partners and establishing business with him or her. It is assumed that a supplier can neither influence the customer's decision, apart from the price offered, nor refuse the conclusion of an agreement once a customer decided to make a contract with him or her. The model is derived on basis of the following further assumptions:

- the decision maker is risk neutral and acts rationally;
- only one type of good will be considered;
- the probability distribution function of the suppliers' prices is known;
- the goods of different suppliers are distinguished only with regard to the price; and
- only one decision will be considered, not a number of decisions over a period of time.

The costs of keeping the current transaction partner, C_{keep}, consist of the current price paid for the good p_k. This price is multiplied by x which is the amount of the good that the purchasing organization buys from its supplier in the considered period.

$$C_{keep} = p_k x \qquad (1)$$

The costs of changing from the current supplier to an alternative transaction partner, C_{change}, consist of the expected ante transaction costs $TAC_{ex\ ante}$ and ex post transaction costs TAC_{ex_post}. Additionally, the expected acquisition costs AC must be considered, i.e. the costs for purchasing the goods from the new supplier.

$$C_{change} = AC + TAC_{ex\ ante} + TAC_{ex\ post} \qquad (2)$$

Subsequently , the terms of Equation (2) will be described in more detail.

Search costs to find a possible transaction partner and costs of negotiating a contract comprise a major portion of the ex ante transaction costs. A stop price p^* must be calculated, which serves as a criterion for stopping the search for a supplier. That is, an offer is accepted and the search is stopped as soon as a supplier is found, who offers the specific good for a maximum price of p^*. The left-hand-side of equation (3) represents the expected return of the next search step, which is the difference of the expected price improvement and the evaluation costs per unit of good purchased, c/x. Search will be carried out, until the expected return equals zero. The stop price is calculated by solving equation (3) to p^* (Hey 1981).

$$p^* F(p^*) - \int_{-\infty}^{p^*} qf(q)dq - \frac{c}{x} = 0 \qquad (3)$$

Once the price p^* is known, the expected number of search steps $\frac{1}{F(p^*)}$ needed to find p^* can be calculated. The total expected ex ante transaction costs $TAC_{ex\ ante}$ are equal to the expected number of search steps multiplied by the marginal evaluation costs c.

$$TAC_{ex\ ante} = \frac{c}{F(p^*)} \qquad (4)$$

If the good is purchased from a supplier, then the acquisition costs AC will depend upon the price demanded by the transaction partner. This price is the result of the search and negotiation process described above. The search continues until a price $p \le p^*$ is found. Thus, with the probability $1-F(p^*)$ the expected price going into the acquisition costs will be p^* and with the probability $F(p^*)$ lower than p^*.

$$AC = x \left[\int_{-\infty}^{p^*} pf(p)dp + p^*(1 - F(p^*)) \right] \qquad (5)$$

Ex post transaction costs $TAC_{ex\ post}$ to be paid as soon as a good is purchased from an alternative supplier. These costs consist of expenses for necessary technical or organizational changes due to establishing a relation to a new transaction partner.

The decision-maker chooses to change his or her supplier if the costs of changing from the current supplier to an alternative transaction partner are smaller than the costs of keeping the current transaction partner.

Model discussion

The decision-maker will be indifferent if, for the given assumptions, both alternatives have the same expected costs, i.e. when the following holds:

$$C_{keep} = C_{change} \qquad (6)$$

Solving (6) to p_k leads to indifference curve (7).

$$p_k^* = \frac{AC + TAC_{ex\ ante} + TAC_{ex\ post}}{x} \qquad (7)$$

The indifference curve can be used to analyze how changes in the ex ante and ex post transaction costs influence the decision on transaction partner selection. Whenever a price provided by the current supplier is lower than p_k^* a change of transaction partner is profitable. A first analysis of the model leads to the following results.

Decreasing evaluation costs c and decreasing ex post transaction costs $TAC_{ex\ post}$ respectively, lead to an even greater advantage in changing supplier, see Figures 2 and 3. This has consequences for both transaction parties of a supplier relationship. For the purchasing organization the danger of locking-in to a certain supplier is reduced. Since the current supplier can be substituted more easily there are incentives for the supplier to behave in the interest of his or her customer. For suppliers this means a chance and a danger at the same time. Newcomers in a market will be able to win new customers more easily once they use technologies which make them easier to be evaluated by potential customers. However, once a business relationship has been established the danger of being substituted by an alternative supplier leads to a more intensive competition between suppliers.
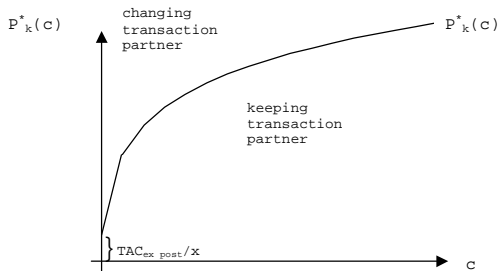

Figure 2: Indifference curve p_k^* as a function of the evaluation costs c
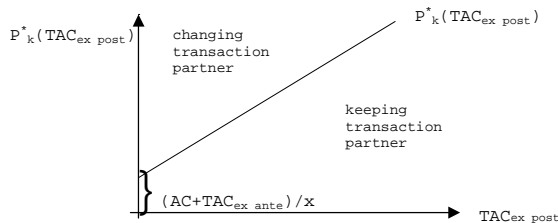

Figure 3: Indifference curve p_k^* as a function of the ex post transaction costs $TAC_{ex\ post}$

While $p_k^*(c)$ is concave, varying $TAC_{ex\ post}$ leads to a linear change in p_k^*. This means that for high marginal evaluation costs, the impact of a reduction in c may be less than the impact of changing $TAC_{ex\ post}$. But given the concavity of $p_k^*(c)$ and linearity of $p_k^*(TAC_{ex\ post})$, the effect of decreasing evaluation costs will possibly be greater than that of the ex post transaction costs. For a purchasing organization this means that the relative profitability of investments in technologies supporting the evaluation of transaction partners compared with investments in tech-

nology supporting the execution of a transaction increases with decreasing evaluation costs.

Conclusion

The use of information technology to support the trade of goods or services changes the relationship between organizations and their suppliers. We presented a model which predicts supplier relationships to loosen up due to the use of information technology. This result may help to explain the move to electronic markets for the exchange of goods observable in some cases. Moreover, we briefly discussed how reductions of transaction costs may effect the profitability of investments in technologies used in different transaction phases. Hence, the model can be used to quantify the benefit of using information technology in supplier relationships. In this way it provides a methodical basis for technology adoption decisions.

However, it becomes clear that the present basic model can only be a starting point for further research. In model extensions implementation costs in certain technologies must be considered as well as the diffusion of these technologies among potential suppliers. This extended analysis is currently under work.

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