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Dr. Custos, Dr. Opponent, Ladies and Gentlemen,

Cooperation between companies is often illustrated with metaphors from team sports. A successful sports team – take football for example – needs to be built on high-quality players. The players are selected for each particular position – goal keeper, defenders, midfield, and forward. Hence, the individual player's level of competences determines whether the player can be included in the team, and furthermore, on which position.

In football, it is the team that wins or loses. Therefore, the players' incentives should always encourage playing for the team and the players must understand that instead of always attempting to score themselves, sometimes it is beneficial to pass the ball to a better-positioned team-mate.

Value networks differ from sports teams in that the players are companies who aim at business benefits by the means of network collaboration. Value network as a term was introduced in 1990's as a generalization for Michael Porter's value chain, which explains company cooperation through a sequential model of hierarchical companies. In contrast, value networks incorporate also non-hierarchical collaboration among equal companies. An example of a value network is a group of companies, which together develop a technological standard, such as the mobile telecommunications standards.

My thesis studies value networks from the two perspectives presented by the football metaphor: how to select the right partners, and how to encourage the partners to contribute to the network.

There is no single measure that would distinguish an excellent football player from an average one; rather, the goodness is the sum of many factors. Just like football players, partner companies need to be selected with respect to various criteria. Relevant criteria for partner selection are, for instance, the cost of the partnership, the partner's production quality, financial situation, risk of late delivery, and so forth. These are the football player's strength, speed, and ball-possession skills.

Moreover, the partners of the network need to work seamlessly together. The criteria I mentioned for measuring a single company, do not necessarily tell how well the network works as a whole. Instead, we need additional criteria, which incorporate the synergies between the companies. Consider for instance transportation costs – we need to know the distance between partners in order to measure the transportation costs. The distance, in turn, cannot be measured for a single company, as at least two companies are needed to measure the distance between them.

Another example of criteria that need to be measured for the whole is the success of past collaboration between the partners. Recalling our football metaphor, if the team players have a common history, they know each others' style of play, and can therefore be more efficient in the game. Hence, selecting the players individually into our team, would neglect criteria that are measured for the whole.

To respond to this challenge, the fourth paper of the Thesis constructs linear optimisation models that allow the decision-maker to capture the synergies in multi-criteria partner selection. The synergies can be quite general; in addition to the already mentioned transportation costs and success of past collaboration, for instance cultural compatibility or the similarity of ICT infrastructure are relevant in some cases.

The case example in the fourth paper describes a network of about seventy small and medium-sized Swiss companies, who, from among themselves, repeatedly select smaller groups of companies, which combine their competences to meet the needs of the customer. In the case example, the network's task was to construct a prototype of a specific gear-box part for Porsche. The project would require many kinds of competences, such as engineering, metal treatment, project management, and so forth. For each required competence, the project would need one company.

Porsche's priority was to have the project completed in a tight schedule, hence the most important objective in partner selection was to minimise the risk of late delivery. The second objective was to minimise the total number of partners to ensure efficiency of work. The third objective was to find partners that had successfully collaborated earlier, as successful collaboration history was considered to help keeping the project in schedule. The fourth objective was to minimise costs. Using the models developed in the Thesis, we were able to identify a list of Pareto-efficient partner configurations, of which the network decision-maker could manually select the most preferred one.

In general, the developed models can be useful in portfolio-selection problems, where from a large set of elements, a subset of elements needs to be chosen, with respect to some constraints and optimality criteria. For instance, a portfolio problem is to select which features to include in a mobile device, when the cost and the size of the device are constrained.

In addition to selecting the right partners, the successful network needs to have the right incentives for its partners. The first paper of the Thesis describes the case of a Finnish luxury sailing-yacht manufacturer Nautor. The need for profit-sharing in the Nautor-network became evident when two partners identified that overall they could perform more efficiently by reorganising some of their work. However, the observation was that the network partners may be reluctant to implement their cost-reducing ideas, if there are no commonly agreed utility-sharing mechanisms in the network. Indeed, the network partners may fear that they individually lose if the network increases its global efficiency. To respond to this observation, the first paper develops utility-sharing methods that encourage the network partners to reveal their cost-reducing ideas.

The undirect effect of commonly agreed utility-sharing mechanisms is that they increase transparency in the network, and therefore help foster trust among the network partners.

Increased trust, in turn, reduces transaction costs through decreased bureaucracy and decreased need for monitoring.

The second paper of the Thesis continues on this track by recognising that instead of a static approach, utility-sharing should be seen as a dynamic mechanism, which also takes into account the network's position against its competitors. Moreover, we recognised that sharing cost information among the network partners strongly supports the construction of incentive utility-sharing rules. Hence, open-book accounting practices and incentive profit-sharing rules are a synergetic combination for increasing the competitiveness of networks.

In the context of technological standard-development, utility-sharing rules play a role in ensuring that the participating companies contribute to the development work, and that the standards are not too expensive to be implemented in products. The companies that develop technological standards accumulate patent rights to the technology. Hence, the companies' patent portfolios are a good approximation for their contributions to the standard development. Therefore, it is intuitive to share the royalty payments from technological standards in proportion to the companies' patent portfolios. To justify this intuitive conclusion, the third paper of the Thesis constructs a system-dynamics model for the study of standard-related utility sharing. To the best of our knowledge, it is the first model that incorporates standard development, the related product markets, and the companies' utility sharing under the same frame.

The model suggests that it is indeed applicable to share the standard-related royalty payments in proportion to the patent-portfolio strengths. The model also shows that it is not socially optimal if the total royalty payments received by patent owners is either too low or too high. First, too low royalty payments do not provide enough incentive for the companies to contribute to standard development, which inevitably leads to slow-down of overall technological development. Second, too high royalty payments would make the standards too expensive to be used in product markets. This, again, is not socially optimal, since the efforts of developing the standard would not lead to the benefit of the consumer.

In summary, the Thesis gives structure for some complex network phenomena. In particular, network partners can utilise the models in joint discussions about partner selection and incentive utility-sharing, and thereby increase the competitiveness of their networks.

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I ask you Professor Srinivas Talluri, as the opponent appointed by the Faculty of Information and Natural Sciences, to make any observations on the Thesis which you consider appropriate.