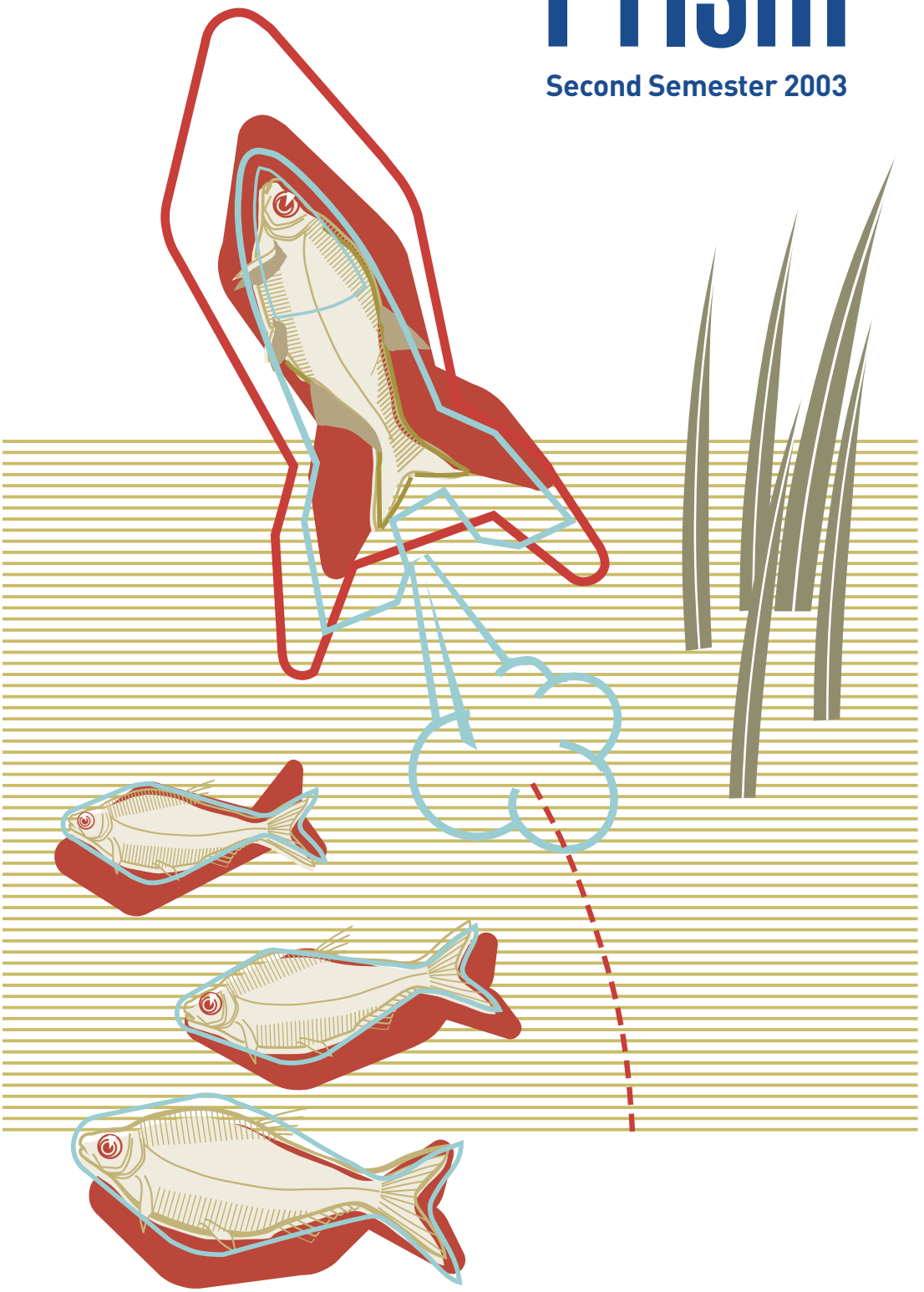
Prism

Second Semester 2003



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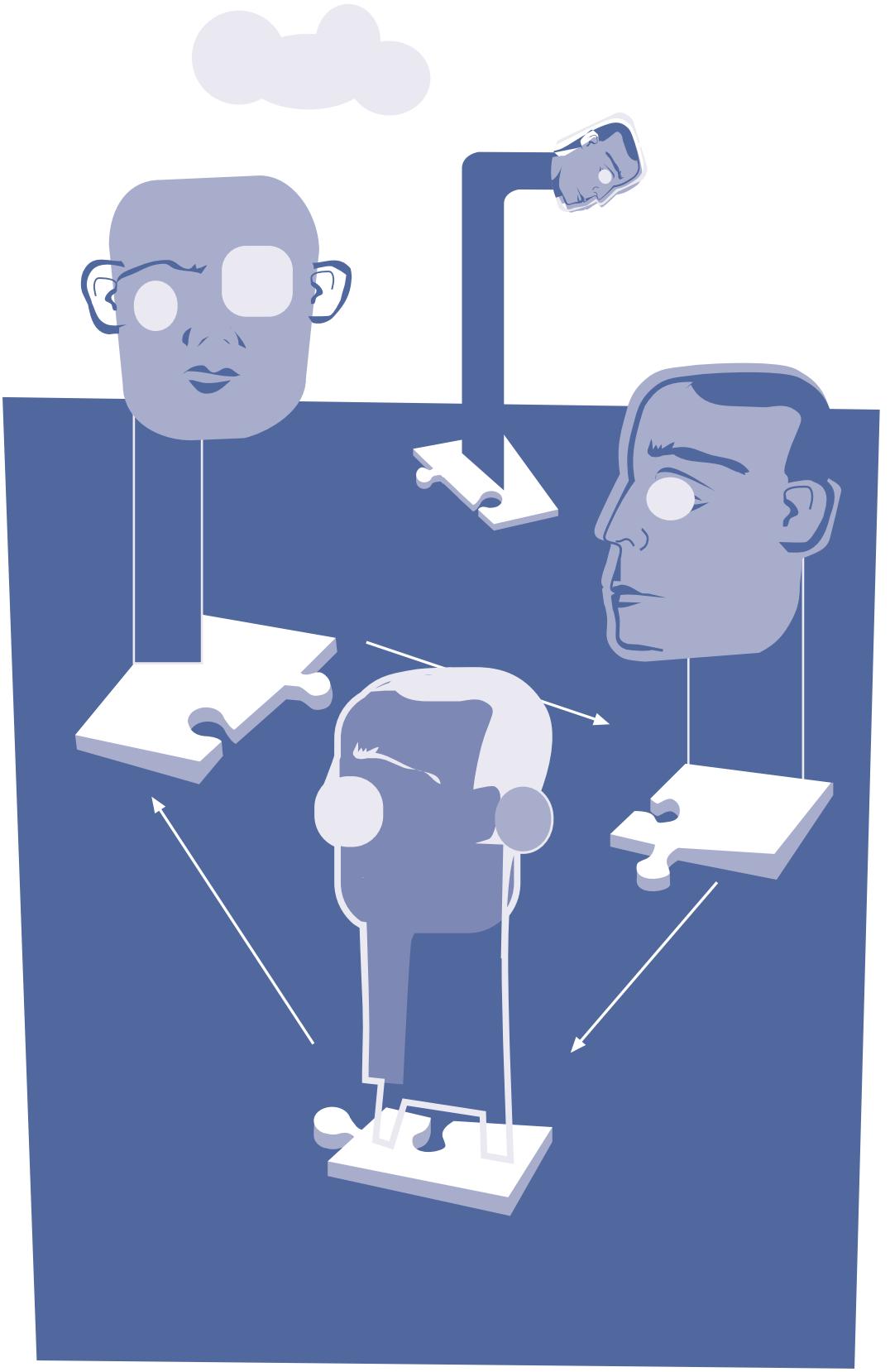


Game Theory in Partnerships: Splitting the Gains without the Pain

René Groot Bruinderink, Daniel Deneffe, and Ferdinand Hoyos

Partnerships and alliances abound, but their popularity does not guarantee that they will always be a corporate success story. In too many instances, partners are not well selected, the synergetic gains are not well shared, or the partnership collapses into what resembles a messy divorce. Groot Bruinderink, Deneffe and Hoyos introduce an effective approach for assessing opportunities for co-operation and minimising the risk of creating an unstable partnership. They answer two central questions: with whom to co-operate, and how to split the gains?

Partnerships and alliances are en vogue. As a recent survey by Arthur D. Little on partnerships has shown (see Prism, First Semester 2003), most executives recognise the growing importance and business value of partnerships. An effective partnership can generate significant extra profits for both parties.

These gains, however, are not easily achieved and many partnerships and alliances do in fact fail across industries, be it airlines, pharmaceuticals, telecommunications or automobiles. In addition, many of the considered partnerships never get established in the first place. In the telecommunications industry, for instance, Philips and Lucent disengaged from their worldwide joint venture after barely one year due to disappointing results in the development of innovative mobile phones. In the pharmaceuticals sector, Aventis and DuPont abandoned negotiations for an alliance related to R&D and marketing in Europe as the potential for synergies decreased in the process of negotiations.

Two main reasons underlie the failure of partnerships. The first is the selection of the wrong partner, i.e. one with whom it is very difficult to realise synergies. A survey conducted by research firm Inc among 500 CEOs in the United States in 2002 revealed that many companies make the mistake of co-operating with the first party proposing a partnership, instead of going through a thorough selection process. The other reason is the inability to negotiate the allocation of the synergetic profits in a way that seems fair to both of the participating parties.

With Whom to Co-operate and How to Split the Gains?

The examples above show that whenever a company considers partnering with other firms with the objective of increasing revenues or reducing costs, it must specifically and carefully address two critical questions:

1. *With whom should we co-operate?*

2. *How should the gains from co-operation be split among the participants?*

The first question, with whom to co-operate, is often addressed with a grain of irrationality. Accurate information about potential partners is often not available. Emotional questions such as "What are the odds that we lose our identity?" or "Will our partner come to dominate us?" blur the rational argumentation for the selection of a partner.

The second question, how to split the gains from co-operation, is equally complex. In practice, companies often choose improvised allocations based on overly simplistic arguments, such as the investments that the partners need to make, or the volumes (traffic, sales, customers, etc.) they bring to the partnership. But we have seen on numerous occasions that these allocation principles do not always represent the true value each company brings to a partnership. As a result, feelings of injustice emerge, often leading to the deterioration or discontinuation of the partnership.

Arthur D. Little's "Development of Stable Coalitions" (DOSC) – approach is particularly useful for analysing potential partners prior to entering negotiations, and for obtaining a stable and reasonable share of the gains from the intended partnership.

When helping clients address these issues, we apply an approach named "Development of Stable Coalitions", or DOSC for short, which is based upon the principles of "Co-operative Game Theory" (see insert). The DOSC approach is particularly useful for analysing potential partners prior to entering negotiations, and for obtaining a stable and reasonable share of the gains from the intended partnership. The primary benefits of applying the DOSC approach in such situations are:

- Better insights in the relative contribution that various industry players could make to a potential alliance, and hence which of these parties should be considered for co-operation.
- An objective assessment of the stability of all possible coalitions, and the risk factors that may threaten their stability.
- The identification of the most promising set or subset of potential coalition candidates.

- Better outcomes in the negotiations about profit-sharing schemes within each coalition.

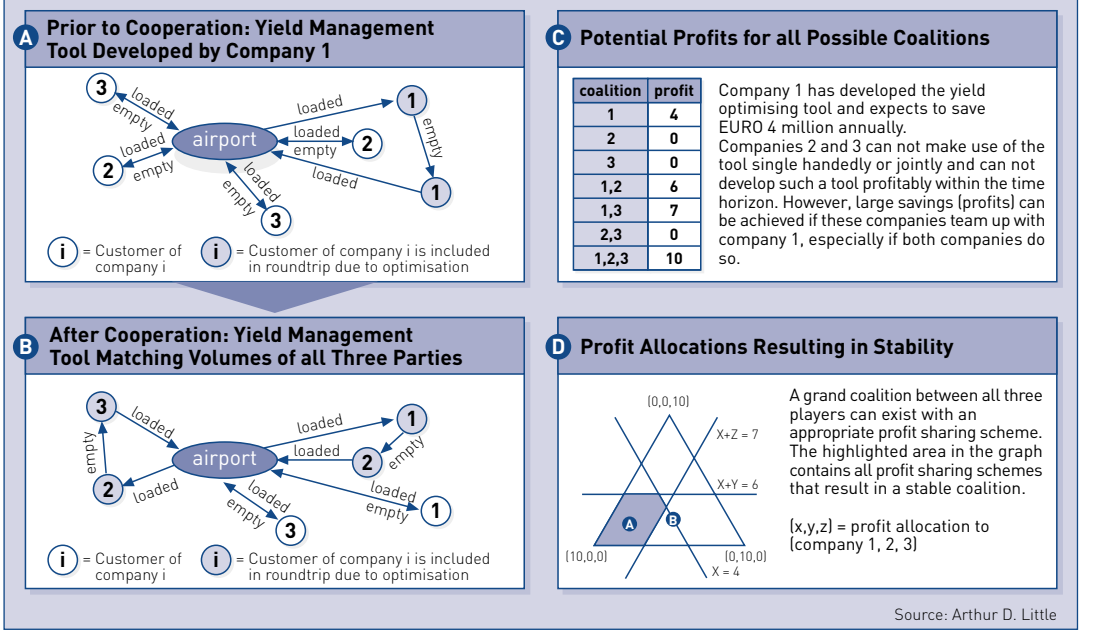
Over the last decade, Game Theory has evolved from an obscure mathematical black-box tool to a more frequently used decision-making support tool. It enables decision-makers to deal with situations in which one company's decision is affected by possible and uncertain decisions taken by other companies. The more widespread use of Game Theory can be attributed primarily to the "non-co-operative" branch of Game Theory, i.e. the assessment of a robust strategy considering potential strategies of competitors.

Below we will describe two examples of co-operative situations – disguised and adapted for reasons of confidentiality – in which we have applied the DOSC approach. Looking at the transport and telecommunications sectors, we will focus on the practical applicability of the approach to concrete business situations, and will not dig into the technicalities of the underlying mathematics.

Developing a Stable Coalition in Transport

The first example concerns three global companies active in the shipping of large parcels, including both short-haul trucking and long-haul air transport. One of them had recently invested in a computerised yield management tool to minimise empty trucking mileage. As short-haul traffic was not reckoned to be a core business, the company considered approaching two competitors to co-operate on short-haul activities, while continuing to compete with them in air transport. The objectives of the co-operation were to share the cost of the yield management tool, and to expand the potential savings from yield management to all parties. The potential to reduce empty mileage increases exponentially as more volume is included in the optimisation because more pick-ups and deliveries will increase the probability of good matches.

Exhibit 1 | Co-Operation of Three Transport Companies on Short-Haul Package Delivery and Pick-up



Source: Arthur D. Little

Exhibit 1A depicts the situation prior to the co-operation. Traffic volumes of company 1, our client, were already optimised using the yield management tool: the truck delivers a parcel from the airport, then drives a short distance without carrying a parcel, and then picks up a parcel from another customer to complete the roundtrip to the airport. Prior to the co-operation, companies 2 and 3 could not benefit from the yield management tool and, as a result, needed to drive long distances without carrying a parcel.

Exhibit 1B shows the benefits gained from co-operation by including the traffic volumes of companies 2 and 3 in the yield optimisation. Combining traffic volumes enhances the probability of good matches within the traffic requirements of all three companies. This in turn results in an overall reduction of empty mileage.

We then set out to get insights into the stability of the potential partnerships and developed a plan on how the gains could be split fairly between the partners. The "potential profit" table in Exhibit 1C shows the joint profit generated by the various possible coalitions ("1, 2" indi-

cates a coalition between companies 1 and 2). Clearly company 1 has a strong position as companies 2 and 3 can obtain profits neither by themselves nor by co-operating without company 1. But large profits can be obtained if all three companies co-operate.

The first step in analysing the attractiveness of these various coalitions is to assess the profits that combinations of companies can obtain in all the possible subcoalitions. The second step is to determine which partnership – if any – to aim for. Finally, once the most efficient partnership is determined, the split of the gains from the partnership – without providing incentives for any of the companies to pursue other coalitions – is worked out.

In this process the two key questions "With whom to co-operate?" and "How to split joint profits from co-operation?" are closely related. Companies will choose a certain coalition because they can agree on a profit-splitting scheme that is superior to profits they can achieve without co-operation or by co-operating within a different coalition. Naturally this holds for all parties involved, and the approach aims exactly at identifying which coalitions all companies will pursue under various profit-splitting schemes.

In this case it made sense for all three parties to co-operate in a grand coalition, provided that the profit split of 10 million euros among the three companies met certain conditions concerning stability and rationality:

- Company 1 needed to obtain at least 4 million euros (company 1's stand alone profit).
- Companies 1 and 2 together needed to obtain at least 6 million euros (the profit they could achieve by excluding company 3).
- Companies 1 and 3 together needed to obtain at least 7 million euros (the profit they could achieve by excluding company 2).

The shaded area in exhibit 1D represents all profit-splitting schemes that met these conditions. X, Y and Z represent the profit allocation to company 1, 2 and 3 respectively. The lines in exhibit 1D provide a graphical repre-

sentation of the mentioned stability and rationality conditions. For instance, prerequisite number one (Company 1 needed to obtain at least 4 million euros) is represented by the area to left of the line X = 4. None of the schemes within the shaded area – representing the three conditions of stability and rationality – provides an incentive for any of the three companies to defect from the grand coalition. This area can be regarded as the win-win area or the bargaining zone as all companies achieve better outcomes than they would without an agreement to co-operate in the grand coalition. With these profit-splitting schemes, no company has an incentive either to pursue a more restricted coalition with any of the other companies or not to co-operate at all.

Applying the DOSC approach results in the identification of superior negotiation outcomes and provides negotiators with the assurance that certain outcomes generate stability in the coalition.

But which of the alternative profit-splitting schemes should company 1 now pursue, i.e. how should the pie be split? Calculating the average marginal contribution of the companies in forming the grand coalition is a fair solution to that question. Again, without going into the mathematics, this average marginal contribution is depicted in exhibit 1D as position A. It corresponds to a split of the joint profits of 10 million euros into 7 million, 1 million and 2 million (rounded numbers) for companies 1, 2 and 3 respectively.

In practice, we detailed several solutions to the splitting of the joint profit. All solutions are rational to a certain extent, but they still have a strong linkage to emotional arguments such as fairness, stability, minimum right, maximal claim, marginal value and maximal complaint, which had to be dealt with. Which solution was "best" thus depended on the specific objectives of the partnership, including recognising each partner's contribution in the grand coalition and respecting each partner's relative strength in more restricted alternative coalitions to minimise the risk of defection.

Applying the DOSC approach results in the identification of superior negotiation outcomes and provides negotiators with the assurance that certain outcomes generate stability in the coalition. It also allows the negotiator to obtain at least what his or her company is entitled to, given the assessment of all competitive alternatives and

the relative strengths that other parties bring to the table.

In the above-mentioned transport company example, the three companies agreed at the start of the negotiations to split profits according to a simple rule: dividing the profits based on volumes rendered to the yield optimisation pool. The corresponding profit-splitting scheme is marked as position B in exhibit 1D. It splits the joint profits into 4 million, 3.5 million and 2.5 million euros for companies 1, 2 and 3 respectively. As this position falls outside the shaded area, the scheme does not create stability due to the fact that company 1's exclusive position is not properly taken into account. The company receives 4 million euros – an amount identical to the profit it could achieve without co-operating! The insights from the DOSC approach enabled company 1 to negotiate an additional side-payment of 3 million euros from companies 2 and 3 in exchange for giving companies 2 and 3 access to the yield maximisation tool. The side-payment transformed profit-splitting scheme B into A, and hence resulted in a stable partnership and major financial gains for company 1.

Splitting the Gains in Telecommunications

The second example concerns the analysis of a potential alliance between national telecommunication operators on the Terrestrial Flight Telephone System (TFTS), which is a public telephone service for passengers in aeroplanes with connections established by radio communication to a nearby ground station. TFTS requires the installation of ground stations and the installation of communication equipment aboard aeroplanes. The TFTS service is economically attractive only if it is sufficiently widespread, i.e. it should be available in a large number of aeroplanes, and the areas where TFTS is available should be sufficiently large and adjacent to each other.

Prior to our involvement, a group of national European telecom operators had jointly decided on the configuration of the TFTS ground stations. They were now discussing how the revenues that would be generated through TFTS were to be split. One proposal was to split the revenues in proportion to the level of investments made in ground stations. This proposal was rejected

because it led to a sub-optimal configuration of ground stations: some operators would install more ground stations than required so as to capture a larger share of the potential revenues. Another proposal was to allocate to each operator the revenues that would be generated via the ground stations that he had installed. Several operators who covered areas with relatively low air traffic density felt that this proposal led to an unfair split.

We took a different approach, thereby incorporating not only the individual characteristics of the operators, but also an analysis of the potential coalitions among them. As a starting point, we made the following assumption: when the national telecom operator of a specific country invests in ground stations, the aeroplanes of the flag carrier and other national carriers of that country would also be equipped with TFTS. The contribution of, say, the Netherlands to the overall TFTS revenues then consists of two parts. First, aircraft of KLM (the Dutch flag carrier) and other Dutch airlines equipped with TFTS generate revenues when flying over other participating countries, for instance Germany. Secondly, the ground station in the Netherlands generates revenues from phone calls from participating non-Dutch airlines when flying over the Netherlands.

We modelled the situation extensively, taking into account the number of ground stations, the number of airlines and aeroplanes, investments and exploitation costs in ground stations, installation and exploitation costs of equipment in aeroplanes, load factors, call rates, and traffic intensity over each square mile in Europe. Using the DOSC approach, we demonstrated that the two previously mentioned revenue-splitting proposals (based on investments in ground stations, or based on revenues generated over countries) did indeed result in incentives for countries not to participate in TFTS. The two proposals did not result in a stable coalition and would not lead to TFTS provisioning by all operators, thereby endangering the entire deployment of the service. We demonstrated that other stable revenue-splitting schemes were indeed feasible and hence that all national operators could participate without having an incentive not to co-operate.

The application of the DOSC approach gave considerably improved insights into the relative strength of each party. Furthermore, better arguments against the proposed – and unstable – revenue-splitting schemes could be brought to the negotiation table.

Benefits and Application Areas of the DOSC Approach

The DOSC approach for establishing partnerships provides companies with a well-informed and hence considerably stronger starting position in the negotiation process preceding a potential partnership.

As the two examples above have shown, the DOSC approach for establishing partnerships provides companies with a well-informed and hence considerably stronger starting position in the negotiation process preceding a potential partnership. The key insights result from several factors:

- Modelling and clarification of the realistic and feasible co-operation options, which are often far from straightforward.
- Analysis of the overall contribution of various industry players and enhanced understanding of the true relative strengths of each party, as opposed to whatever bluffs they may express.
- Assessment of the stability of all possible coalitions, of the risk factors threatening the stability, and solid insights on how to increase the stability and minimise those risks.
- Identification of a favourable set or subset of potential coalition candidates.
- Determination of founded and hard to rebut proposals for profit-splitting schemes within each coalition,
- Creation of superior negotiation outcomes.

The approach provides valuable input for the negotiation process with each of the potential coalition partners. It also gives indications about the potential behaviour of coalition partners that are excluded from these negotiations. The disclosure of results from applying this approach may indeed attract players into the coalition. Practice shows, however, that the results best be held confidential as they reveal each party's relative strength, and will thus also provide your potential coalition partners with valuable information about your company's strength. Practice also shows that coalitions tend to be

less stable when the various payoffs in alternative coalitions are revealed to the other parties due to greed, envy, fear and suspicion.

The Co-operative Game Theory principles that underpin the DOSC approach have proven their usefulness within many industries. Exhibit 2 provides an illustration to some important application areas. These include: obtaining sufficient funds to support the investments required to "kick-start" a network construction or a capacity extension; achieving a better risk/return ratio on the investments required to enter a new market; lowering operational costs in marketing, logistics or purchasing; and joining forces in a tender process. The DOSC approach has also proven its added value in solving cost allocation issues, which are among the toughest in accounting. The analogy with the other application areas lies in the need to split shared costs (the cost of co-operation) among the departments or business units of a company.

Exhibit 2 | Illustration to Application Areas for the Development of Stable Coalitions Approach

Type of Partnership	Rationale for Cooperation	Illustrative Application Areas
Sharing "kick-start" investments in network or capacity	Optimise network planning and simultaneously reduce overall investments	• 3-G network investment optimisation of mobile operators through site sharing • Integrating flight schedules for airlines • Utilities planning transmission network expansion • Telecom carriers to re-route international calls during busy hours
Sharing investments to achieve a better risk/return ratio	Enable investments and/or achieve a better risk/return profile of investments	• Financial institutions in order to get hold of larger funds and to spread the business risk across a larger portfolio • Media companies in order to benefit from co-operation in terms of enlargement of their content offerings and reduced exposure to high profile, but also risky productions
Sharing operational cost	Achieve synergies in non-core activities / operations	• Joint marketing and sales promotions as in airline alliances • Reduced and optimised cost of logistical operators • Purchasing activities in order to obtain better conditions and discounts
Joining forces in a tender process	Increase chances of acquiring projects	• Consortia of companies bidding for large infrastructure projects in order to provide an integral approach combining relevant competencies of partners involved • Professional services companies combining expertise in order to provide higher quality with a reduced budget

Source: Arthur D. Little

Insights for the Executive

The importance of partnering is increasing and companies have many opportunities to establish successful partnerships. Partnerships per se are not a guarantee for success, but selection of the right partner or partners is crucial and a fair and stable profit-split needs negotiating. Accordingly, there can be significant added value in the application of a structured approach for tackling these issues prior to selecting potential partners and negotiating with them.

The DOSC approach, grounded in Co-operative Game Theory principles, provides this structure and therefore contributes significantly to the creation of a set of superior partnerships and negotiation outcomes. It takes time to work it out – but time that is well invested – as the assessment of the synergy potential from coalitions is often not straightforward. The application of the structured approach then leads to valuable insights, for example, about the stability of a grand coalition in which all considered parties co-operate. The approach is superior to intuitive or commonly used schemes for profit splitting in partnerships, as these often do not result in stable coalitions. After all, the relative negotiation strength of any firm depends on what it can achieve without co-operation as well as what it can bring to other companies in various coalitions.

List of references

The Right Game: Use Game Theory to Shape Strategy: Brandenburger and Nalebuff, Harvard Business Review 1995

A game theoretic approach to problems in telecommunication: Van den Nouweland, Borm, Golstein Brouwers, Groot Bruinderink, Tijs: Management Science issue 42 1996

Partnering: The Rules of the Game: Prism, First Semester 2003

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