NORTH ATLANTIC TREATY ORGANIZATION

SCIENCE AND TECHNOLOGY ORGANIZATION

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STO TECHNICAL REPORT **TR-SAS-112**

Public Private Partnership in a NATO Context

(Partenariat public-privé dans le contexte de l'OTAN)

Guidance on where Public Private Partnerships (PPP) have been successfully used by nations to provide or support military capabilities.
Final Report of NATO SAS-112.

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The NATO Science and Technology Organization

Science & Technology (S&T) in the NATO context is defined as the selective and rigorous generation and application of state-of-the-art, validated knowledge for defence and security purposes. S&T activities embrace scientific research, technology development, transition, application and field-testing, experimentation and a range of related scientific activities that include systems engineering, operational research and analysis, synthesis, integration and validation of knowledge derived through the scientific method.

In NATO, S&T is addressed using different business models, namely a collaborative business model where NATO provides a forum where NATO Nations and partner Nations elect to use their national resources to define, conduct and promote cooperative research and information exchange, and secondly an in-house delivery business model where S&T activities are conducted in a NATO dedicated executive body, having its own personnel, capabilities and infrastructure.

The mission of the NATO Science & Technology Organization (STO) is to help position the Nations' and NATO's S&T investments as a strategic enabler of the knowledge and technology advantage for the defence and security posture of NATO Nations and partner Nations, by conducting and promoting S&T activities that augment and leverage the capabilities and programmes of the Alliance, of the NATO Nations and the partner Nations, in support of NATO's objectives, and contributing to NATO's ability to enable and influence security and defence related capability development and threat mitigation in NATO Nations and partner Nations, in accordance with NATO policies.

The total spectrum of this collaborative effort is addressed by six Technical Panels who manage a wide range of scientific research activities, a Group specialising in modelling and simulation, plus a Committee dedicated to supporting the information management needs of the organization.

- AVT Applied Vehicle Technology Panel
- HFM Human Factors and Medicine Panel
- IST Information Systems Technology Panel
- NMSG NATO Modelling and Simulation Group
- SAS System Analysis and Studies Panel
- SCI Systems Concepts and Integration Panel
- SET Sensors and Electronics Technology Panel

These Panels and Group are the power-house of the collaborative model and are made up of national representatives as well as recognised world-class scientists, engineers and information specialists. In addition to providing critical technical oversight, they also provide a communication link to military users and other NATO bodies.

The scientific and technological work is carried out by Technical Teams, created under one or more of these eight bodies, for specific research activities which have a defined duration. These research activities can take a variety of forms, including Task Groups, Workshops, Symposia, Specialists' Meetings, Lecture Series and Technical Courses.

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Public Private Partnership in a NATO Context

(STO-TR-SAS-112)

Executive Summary

This report examines where non-traditional partnering arrangements between governments and contractors have been successful and also where traditional contracting and in-house options are found to be preferable. The case studies[1] and related academic analyses[2] are analysed and observations extracted[3], conclusions drawn[4] and recommendations made[5].

The majority of the case studies arise from situations where a national government (or similar body) needs to deliver a specific outcome and has to determine where, on the continuum from make to buy, it is most appropriate to position an activity and also what sharing of responsibility between the public and private sector is most likely to produce a satisfactory outcome. A limited number of cases are identified where the private sector has approached government with a potentially mutually beneficial partnering proposal.

There are three key elements which must be determined in each case:

- Which party (government or industry) is best placed to take responsibility for each necessary activity or each identified risk;
- How the performance of each party can best be measured in a meaningful and timely fashion; and
- How compensation and penalties can best be arranged to incentivise both parties to work towards to shared goals.

It is concluded that appropriately structured partnering between government and industry can deliver benefits to both parties that would not be available with traditional in-house or contracting solutions. However, setting up complex arrangements is often very time consuming and the overall set-up costs for such a partnership can exceed 10% of the capital value of the project. In the past the cost and duration of such negotiations have often been underestimated.

[1] See Chapter 3.

[2] See Chapter 4.

[3] See Chapter 5.

[4] See Chapter 6.

[5] See Chapter 7.

Partenariat public-privé dans le contexte de l'OTAN

(STO-TR-SAS-112)

Synthèse

Le présent rapport examine dans quelles conditions les arrangements de partenariat non traditionnels entre gouvernements et entrepreneurs sont couronnés de succès et dans quelles conditions les solutions traditionnelles de passation de marchés et de réalisation en interne sont jugées préférables. Ce rapport analyse des études de cas[1] et des analyses théoriques[2], fait des observations[3], tire des conclusions[4] et émet des recommandations[5].

La majorité des études de cas proviennent de situations dans lesquelles un gouvernement national (ou organe similaire) a besoin de produire un résultat spécifique et doit déterminer i) à quel point du continuum entre fabriquer et acheter il ferait mieux de se positionner et ii) quel partage de responsabilités entre le secteur public et le secteur privé est le plus susceptible de produire un résultat satisfaisant. Un nombre limité de cas ont été étudiés dans lesquels le secteur privé a approché le gouvernement et lui a présenté une offre de partenariat mutuellement bénéfique.

Trois éléments essentiels doivent être déterminés dans chaque cas :

- Quelle partie (gouvernement ou industriel) est la mieux placée pour endosser la responsabilité de chaque activité nécessaire ou de chaque risque identifié ;
- Comment mesurer au mieux l'exécution des obligations de chaque partie de manière sensée et opportune ; et
- Comment organiser au mieux la rémunération et les pénalités pour inciter les deux parties à poursuivre des objectifs communs.

Il en résulte que les partenariats structurés de façon appropriée entre le gouvernement et les industriels peuvent apporter aux deux parties des bénéfices que n'offriraient pas les solutions traditionnelles de passation de marchés et de réalisation en interne. Toutefois, la mise en place d'arrangements complexes demande souvent beaucoup de temps et les frais globaux de ces partenariats peuvent être supérieurs de 10 % à la valeur en capital du projet. Par le passé, le coût et la durée de ce type de négociations ont fréquemment été sous-estimés.

[1] Cf. chapitre 3.

[2] Cf. chapitre 4.

[3] Cf. chapitre 5.

[4] Cf. chapitre 6.

[5] Cf. chapitre 7.

Chapter 1 – INTRODUCTION

There has always been a requirement for individual national governments and trans-national alliances to seek to achieve the best value from their investments in Defence. This requirement is of particular interest at present as the economic climate is still, in some countries, exerting a downward pressure on Defence budgets, whilst the current international situation is making ever increasing demands on Defence outputs.

This environment has generated a number of national initiatives as well as the NATO Smart Defence concept that are designed to increase collaboration both between nations and also between nations and Industry. The aim of these activities is to ensure that the best and most efficiently supported skills, resources and experience are deployed to provide Defence outputs in a timely and cost-effective fashion.

This document is designed to inform all those, whether at national or Alliance level, of the general and specific lessons that have already been learned in implementing non-traditional approaches to meeting Defence needs (whether or not they were named as a PPP), so that future developments in this area can have a greater chance of success.

The panel which created this report benefitted from the participation of experts from 8 national governments (Canada, France, Italy, Latvia, Spain, Sweden, Turkey, and the UK) and also from Industry partners (MBDA, AOS, Thales and Leonardo). The expertise of these participants was supplemented by external inputs gathered through a call for contributions through the NATO Science and Technology Organisation (STO).

To structure this research a framework was initially constructed to allow the various delivery strategies previously or currently being employed by nations or the Alliance, or being considered for future use, to be compared and their pros and cons, in a given application, to be appropriately weighed. Creation of a new framework was required as no existing framework was found that satisfactorily met the needs of this study.

A range of case studies were considered and the nine which best illustrated the insights and conclusions of the study were selected. Each was examined to establish where it fitted into the research framework and how well the approach had delivered the desired outcomes of producing relevant outputs and enablers in a timely and cost-effective fashion. Finally, any specific issues, pros and cons that were observed or surmised were captured. (The case studies are summarized in the body of the report, with full details and references being provided in Annex A).

Finally, the lessons learned to date from the case studies are considered, together with available academic insights. These are generalized to provide insights that will assist those responsible for delivering future requirements to determine the strategy most likely to yield a successful outcome in their situation. It is hoped that this report will stimulate nations and the Alliance to consider how this analysis could be refined and extended and that a further study will be conducted, in due course, that will be able to accommodate additional, relevant, case studies.

Chapter 2 – THE MEANING AND PURPOSE OF PPP

Research by the panel revealed a number of completely valid, but mutually incompatible, definitions of PPPs each of which had strong advocates and equally strong detractors. To escape this impasse the panel decided to give the research a broad focus so that individual nations and the Alliance as a whole can make informed decisions about the potential usefulness of all sorts of traditional and non-traditional approaches to delivering Defence needs.

To this end, the Panel chose to define PPP as encompassing all forms of provision of Defence Capabilities, Outputs, Goods and Services, other than a Government Stovepipe (complete, vertically integrated in-house provision) and the Traditional (short-term, transactional) Contracting approaches. It is recognized that some nations have very specific definitions of PPP, but these do not reliably read across to multi-national and Alliance-wide considerations.

In order to maximise the value of this report it was decided to discuss the complete spectrum of routes for delivery of Defence enablers and outputs, so that the non-traditional options considered in detail may be contrasted with more usual approaches.

In order to provide a basis for structuring the wide range of potential delivery approaches the Working Group has identified four key elements that, at a high-level, define different generic approaches. These are:

- Who[1] is the source of the initial need that the activity is designed to fulfil?
- Who is responsible for managing risk and deriving benefit from the delivery activity?
- Who is responsible for providing and sustaining the programme management skills?
- Who is responsible for providing and sustaining project management and technical skills?

Taking these four elements as a basis, the following table has been constructed to illustrate the four generic classes of delivery approaches, together with an indication of how each of the elements is treated under that approach. This framework is based upon the current experience of the participants in SAS-112 and could be updated if further evidence became available that suggested further refinements.

As may be observed from Table 2-1, the different classes of delivery approach offer choices about whether Government or Industry should deliver an element of the overall activity. It must, however, be noted that it is impossible for Government to transfer some risks to Industry. For example, seeking to mitigate operational risks during conflicts by imposing financial penalties on Industry for non-delivery is unlikely to be a successful approach.

It must also be noted that poorly considered and poorly executed Partnering Arrangements can result in Government paying more than would have been necessary under a traditional approach and receiving less value in return. The case studies, academic insights and conclusions of this document are commended to managers at national and Alliance level as a source of potential observations and experience to be considered before they attempt to embark on a new activity.

[1] i.e., Did Government or Industry identify the initial requirement?

Table 2-1: The Classes of Delivery Approach. Government responsibilities/activities are denoted with a 'G' and Industry responsibilities/activities are denoted with an 'I'.

	Government Stovepipe	Traditional Contracting	Government led Partnering	Industry led Partnering
Who is the source of the initial need?	G	G	G	I
Who manages risk and drives benefit delivery?	G	G	Both[2]	Both[2]
Who provides and sustains programme management skills	G	G	Both[2]	As required[3]
Who provides and sustains project management and technical skills?	G	I[4]	I	As required[3]

[2] In the ideal situation, each party undertakes the elements that they are best placed to address.

[3] The exact nature of Industry led Partnering is highly variable.

[4] Provided that skill maintenance is economic for Industry to undertake.

Chapter 3 – CASE STUDIES

This chapter contains relevant details of the case studies submitted by participating nations and by others. The information in this chapter is provided in a standard format, in order to assist with readability. Annex A – Case Studies contains full details of all of the information submitted/available, so that readers may further review areas that are of interest to them.

The following cases studies were selected:

- Case Study 1 – Germany: Project HERKULES (non-operational IT) (Table 3-1);
- Case Study 2 – UK: National Air Traffic Services (Table 3-2);
- Case Study 3 – UK: Future Strategic Tanker Aircraft (Table 3-3);
- Case Study 4 – Italy: Small Arms Ammunition (Table 3-4);
- Case Study 5 – Latvia: Drone Testing (Table 3-5);
- Case Study 6 – Latvia: Military Hotel (Table 3-6);
- Case Study 7 – Spain: Rioja Industry (Table 3-7);
- Case Study 8 – Italy: *Condottiere* (Historical) (Table 3-8); and
- Case Study 9 – Spain: Satellite observation (Table 3-9).

Table 3-1: Case Study 1 – Germany: Project HERKULES (Non-Operational IT).

Name/Nation or Organisation	Project HERKULES / Bundeswehr (German Army).
Class of Delivery Approach	Government led partnering.
Scope of Activity	Modernization, standardization, consolidation and centralization of the Bundeswehr's non-military IT infrastructure, and its maintenance for 10 years (2006 – 2016). Planned value: 7.1 Billion Euros (including taxes).
Required Outcomes	An affordable, reliable, powerful, flexible and secure IT system.
Selection of Delivery Options	Not known, but it is reported that negotiations prior to letting the contract took five years [1].
Benefits Realised	Although it has been reported that Herkules costs rose by 700 million Euros above the budget, once inflation has been allowed for, this was 7% less than originally planned [2]. The contract was completed in late 2016 and BWI, the company created to undertake the contract, became 100% owned by the German Federal Government. The contract allowed the necessary initial investment to be made, which would have been difficult under the normal annualized budgeting process.
Issues	Although BWI is now 100% owned by the Federal Government, it will only become clear over the next few years whether it will be able to maintain its skill base and hence how easy the Bundeswehr will find it to maintain and develop its IT systems in the future.

Table 3-2: Case Study 2 – UK: National Air Traffic Services.

Name/Nation or Organisation	UK Public Private Partnership (PPP) for National Air Traffic Services Ltd (NATS).
Class of Delivery Approach	Government led partnering.
Scope of Activity	Maintain safety and national security whilst injecting private sector money and improved project management skills, to meet expected future growth in air traffic. Planned value: nearly £800 million.
Required Outcomes	A safe and secure air traffic system that makes necessary investment to accommodate future growth and safeguards the interests of the taxpayer.
Selection of Delivery Options	Seven companies expressed an initial interest, but four withdrew citing concerns over regulation of NATS' prices. Of the remainder Nimbus and Airline Group were the leading contenders. The government selected the Airline Group bid as it accepted more of the government's terms, although it was financially less robust. The bidding and selection cost the bidders about £30 million and the Government about £44 million. The Government costs were £17 million more than had been estimated, mainly because the process took 33 months, rather than the expected 18 months. It is notable that government analysis made optimistic assumptions that air traffic would grow consistently into the future, despite there having been three instances in the previous thirty years when this had not been true.
Benefits Realised	The government received £758 million from the successful bidders and currently owns 49% of the successful business that NATS has become. The required levels of Safety and National Security appear to have been maintained.
Issues	In May 2001, three months after the commercial agreement had been signed, the Airline Group told the government that reductions in airline traffic meant that they could not afford the agreed price, which was reduced by £87 million to £758 million. The events of 11 September 2001 then resulted in a downturn in air traffic, which reduced NATS income and also the incomes of the airlines that made up the Airlines Group, which reduced their ability to invest in NATS. The ability of NATS to attract external investment was also limited by questions about its ability to service the debt generated by the PPP structure. It was therefore necessary to refinance NATS and £130 million of extra investment was obtained 50% from the government and 50% from BAA (who ran many of the UK's airports). This investment, coupled with a relaxation in the prices that NATS was allowed to charge airlines allowed a £600 million refinancing in August 2003. Arranging this deal was difficult and took 18 months to conclude. In its investigation the UK National Audit Office noted that it was particularly important that the robustness of a PPP be tested, especially with regard to risks where management cannot control the occurrence of the risks, but merely mitigate the impact.[1]

[1] The various shareholders were not allowed to sell their shares in NATS until mid-2010. The perceived long-term success of NATS is shown by the March 2014 purchase of 49.9% of the Airline Group by the Universities Superannuation Scheme (a pension fund) as part of its infrastructure portfolio. The shares were purchased from TUI Travel, Thomas Cook Group, Lufthansa and Virgin Atlantic.

Table 3-3: Case Study 3 – UK: Future Strategic Tanker Aircraft.

Name/Nation or Organisation	UK Private Finance Initiative[2] (PFI) for Future Strategic Tanker Aircraft (FSTA) (Voyager).
Class of Delivery Approach	Government led partnering.
Scope of Activity	Provision of 14 FSTA aircraft and the associated infrastructure, maintenance and training. Planned value: £10.5 billion over 27 years.
Required Outcomes	The delivery of 14 FSTA aircraft built/modified to the relevant standards, together with the associated infrastructure, maintenance and training.
Selection of Delivery Options	The need for replacement air-to-air refuelling aircraft was identified in 1997, with a PFI being selected as the preferred approach in 2000. It appears that the Ministry of Defence made no realistic assessment of alternatives to PFI, possibly because of the benefits that PFI offered in short-term affordability. This lack of an alternative plan may have impacted the later progress of the contract. Final bids from the two competing consortia were received on 30 April 2003. The MOD maintained competition for five years, in part by contributing to the bid costs of the losing consortium, but when the winning bid was selected there was no effective competition. It then took MOD four years of non-competitive negotiation to close the deal.
Benefits Realised	Full operational capability was achieved with in September 2016, following testing of the final aircraft, which had been delivered in July 2016.
Issues	Although the overall requirements were clear, the detailed specification continued to evolve until late in the process as it proved difficult to specify what was required from the complex service delivery model. The government never obtained visibility of sub-contractor costs and was not able to check whether appropriate margins were made on the aircraft and their modifications. It took over nine years to achieve contract signature, which resulted in a slip in the in-service date of five and a half years. Although the PFI addressed short-term affordability challenges it is still unclear whether it provides the best use of public resources.

Table 3-4: Case Study 4 – Italy: Small Arms Ammunition.

Name/Nation or Organisation	Fiocchi SpA/SGD-NAD (Italian MoD) Small Arms Ammunition Partnership.
Class of Delivery Approach	Government led partnering.
Scope of Activity	Production of small-arms cartridges for the needs of all Italian Armed Forces, expected to total 70 million cartridges per annum. Expected value 200 Million Euros (including taxes) over 10 years.
Required Outcomes	Ensure that the Defence Administration's requirements for the production of ammunition are met more cost-effectively than reference market prices, through synergistic research and production partnering with industry.

[2] A Private Finance Initiative is a specific form of PPP that was used by the UK government.

Selection of Delivery Options	Not known.
Benefits Realised	During the first five years of the contract, savings were realized amounting to 2% of the budget (0.4 Million Euros per annum) which were returned to the Italian Public Administration. In addition, the government owned Military Cartridge Production Facility located in Capua, southern Italy, improved its production performance by 30%, due to the influence of the Fiocchi management and business processes.
Issues	Initially placing the contract was a somewhat protracted process, due the need to follow the procedures for the public tendering of contracts laid down in Italian law. During the contract the production capacity of the Military Facility was reduced due to safety concerns. This reduced the overall production and caused disputes with Fiocchi SpA (the contractor). Quality problems were also identified when the cartridges were tested. All these issues have now been resolved and production is proceeding smoothly.

Table 3-5: Case Study 5 – Latvia: Drone Testing.

Name/Nation or Organisation	Latvian Government and private contractor.
Class of Delivery Approach	Industry led partnering.
Scope of Activity	Testing and evaluation of a drone system developed by the contractor.
Required Outcomes	The prototype drone system is tested in a representative operational environment and any issues encountered are noted for future remediation.
Selection of Delivery Options	The Latvian armed forces represented the most convenient option for operational testing of this system which had been developed by a Latvian company. Coincidentally the Latvian armed forces were, at the same time, looking for opportunities to give troops experience in operating drones.
Benefits Realised	The contractor's product received testing, with the only cost to the contractor being support for the trials. The armed forces received experience of operating a drone system, with the only cost being the need to record and feedback any defects or issues encountered.
Issues	None reported.

Table 3-6: Case Study 6 – Latvia: Military Hotel.

Name/Nation or Organisation	Latvian Ministry of Defence and local hotelier.
Class of Delivery Approach	Industry led partnering.
Scope of Activity	Provision of hotel accommodation for visiting military and civilian personnel of the Latvian armed forces. Planned value: not reported.

Required Outcomes	Reduced accommodation costs for military personnel and civil servants visiting Riga. Increased turnover and profit for hotelier.
Selection of Delivery Options	A local hotelier who had previously served in the Latvian military observed that the Latvian Ministry of Defence spent significant amounts each year on paying commercial rates to accommodate duty visitors in local hotels. The hotelier suggested that the Ministry of Defence purchase a local hotel and require their visitors to use that hotel. He would run the hotel, which would also be open to non-military guests and the profits would be split.
Benefits Realised	Reduced costs to Latvian Ministry of Defence, increased profits to the hotelier.
Issues	None reported.

Table 3-7: Case Study 7 – Spain: Rioja Industry.

Name/Nation or Organisation	Spanish Rioja Producing Firms [3].
Class of Delivery Approach	Stovepipe.
Scope of Activity	Production of Rioja wine. Planned value: approximately 200 million Euros per annum.
Required Outcomes	Efficient production of wine to a cost and quality consistent with the product differentiation strategy of each individual producer.
Selection of Delivery Options	Individual selection decisions (stovepipe / vertical integration versus traditional contracting or partnering) are based upon a combination of cost, the firm's internal capabilities and the degree of end-to-end control that is required to produce a wine of the desired quality.
Benefits Realised	Adopting these strategies for vertical integration, where appropriate, has assisted in building the Rioja into a profitable and internationally known Denominacion de Origen Calificada (DOC).
Issues	Although not evident in this case study, once engaged in a stovepiped approach it can be difficult to ascertain whether the conditions that supported the original delivery option selection still hold, or whether better value would be achieved using an alternative approach.

Table 3-8: Case Study 8 – Italy: *Condottiere* (Historical).

Name/Nation or Organisation	Mediaeval Italian City States.
Class of Delivery Approach	Traditional contracting.
Scope of Activity	Provision of military service by mercenary companies – *Condottiere.* Planned value: varied.
Required Outcomes	Defeat or deterrence of enemy forces in a timely and cost-effective fashion.

Selection of Delivery Options	Initially a judgement was required about whether a city could meet a threat using existing militia (internal) resources, or whether a greater force would be required. Once the decision to employ external resource had been made then the selection decision would revolve around finding a mercenary band that could undertake the necessary work in timely and cost-effective fashion.
Benefits Realised	Military services could be purchased when required, without the need for inhabitants of a town to devote themselves to the economically unrewarding profession of soldiering. Wars in Italy tended to be less bloody and destructive than in other countries.
Issues	Mercenary bands essentially only had two ways in which they could support themselves, waging war and demanding money with menaces. Therefore, in times of peace mercenary bands tended to either resort to common banditry or (sometimes) hold whole towns to ransom. There was a perception, justified in some cases, that the *Condottieri* did not fight as enthusiastically as the inhabitants of a town might do – fighting for home and country is often a better motivator than fighting for money.

Table 3-9: Case Study 9 – Spain: Satellite Observation.

Name/Nation or Organisation	Spanish Ministry of Defence (MoD) and private space operator (HISDESAT).
Class of Delivery Approach	Government led partnering.
Scope of Activity	Development, procurement, launching and operation of a Space Earth Observation System (SEOS). Planned value: 110 M€.
Required Outcomes	The system must accomplish the operational requirement from Spain CHOD (Chief of Defence). Some improvements in the operational modes of use, for the future or next generation. Industrial agreement with Germany contractors.
Selection of Delivery Options	The Spanish MoD set outline requirements that established the required performance and outcomes. The Acquisition agency the selected the nest contracting approach and partners to satisfy the requirements. The Spanish CHOD took part in the final acceptance process, before the entry into service.
Benefits Realised	The SEOS is part of a National Program for Space Earth Observation that delivered a new concept of Earth Observation at any time in any weather. The Spanish Space Industry undertook the full integration of a satellite, and the operator benefits from having global space reconnaissance capabilities, in addition to original Communication capability. The Armed Forces will receive, in the next few months, a new capability in EOSs systems.

Issues	The initial planning was part of a broader National Space Program. The government operator has to undertake various elements of the development, integrate, launch, test and validation in orbit activities in the industrial proposal. During the manufacturing process, opportunities arose to improve the systems capabilities (before Critical Design Review), to include new operational modes. The Spain MoD Acquisition agency had to manage the hypothetical overheads. This kind of system needs constant updating and upgrading through its life cycle. All of these issues have been successfully resolved within the scope of the PPP agreement.

3.1 REFERENCES

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Chapter 4 – ACADEMIC VIEWS

The academic view of any topic can be seen by a practitioner as simplistic. However, this simplicity is frequently an important contribution to understanding and analysis of a certain phenomenon as it focusses on the main factors that influence it, without the view being clouded by all sorts of secondary issues. In this chapter, we first present some academic views of PPP and then reflect upon the main insights from three specific academic sources.

4.1 THEORETICAL VIEWS ON PPP

Whilst practitioners' views on PPPs normally focus on risk management and on contract design and enforcement, the theoretical views of PPPs can be found in the economic literature concerning the vertical boundaries of the firm or the organization which examine the question of whether the organization should *make or buy* each input.

The reasons to buy (using the market or what we have called *traditional contracting*) can be classified as tangible and intangible benefits [1]:

- Tangible benefits depend firstly on the existence of economies of scale, which mean that when a firm in the market, aggregates the demands of several potential buyers it can, thanks to a greater scale, achieve a lower unit cost than an integrated firm or organization could manage. Similarly, buying in the market allows suppliers to derive greater benefits from the learner effect, which again produces lower production costs. Finally, potential suppliers (may) have proprietary information and unique technical knowledge which was well as offering the opportunity to produce at a lower unit cost might also offer the opportunity to deliver certain technological developments that would be impossible in a government stovepipe.
- Intangible benefits of using the market are, by their nature, difficult to quantify and are mostly related to improving incentives and avoiding unnecessary costs. Agency costs are the costs associated with inefficiencies and with the administrative controls of identifying and deterring such problems, which are often inherent in large organizations. Another class of costs that arise when provision is organized internally is *influence costs*. These are the costs of the activities to influence internal investments or allocation of production. Not only the direct costs of a division or department lobbying a central manager, but also the costs of inefficient allocation of scarce resources [2].

As, at least in theory, *buy* offers significant advantages over *make*, the focus of academic effort is on contracting, as the contracts define the conditions of exchange. One of the best known academic explanations of contracting is **Transaction Costs Theory**. Transaction Cost Theory (TCT) states that organizations will outsource their activities when the costs of hiring a service on the market are lower than performing them internally [3]. These costs, in addition to those of production or provision of the service, include those generally referred to as transaction costs". Thus, when carrying out the activity internally, coordination and control transaction costs are borne by the organization [4], while in the case of going to the market, the time and expenses of negotiation, writing, and compliance with the contracts, as well as the costs of noncompliance with the agreed upon are borne.

Predictions of this theory indicate that, the greater the **uncertainty** that accompanies the transaction, the greater likelihood of internalizing the activity in the organization (what we called government stovepipe). Uncertainty makes difficult to predict the required and actual outcome of relevant activities, consequently, when it is passes a certain level, the organization will find it preferable to control the activity by itself. Uncertainty can manifest itself in many ways, ranging from unpredictability in economic, social and institutional environments, to the complexity of the transaction, the difficulty of verifying the result and enforcing what was agreed in the market.

Another feature, which is relevant, particularly when it interacts with uncertainty, is the degree of **specificity** of the relevant assets. In general, when the contracting party goes to the market, the product would be constructed or adapted by the supplier to meet certain requirements, in which process it acquires a different degree of specificity to meet the customer's requirements. For example, infrastructure like highway or water supply works are very specific as they can only perform a single role and only have a single potential owner. This characteristic is important because once the transaction is agreed and the product is given specificity, there could be opportunistic behaviour by the customer (e.g., refusing to pay what is agreed upon) or the contractor (e.g., delivery of low quality outputs), resulting in unhappiness for the disadvantaged party.

Avoiding these risks in a market situation would be difficult, time consuming and economically inefficient. Thus, the TCT suggests that activities involving higher uncertainty and specific assets should be internalized.

In general terms, PPP should be regarded as a form of governance for a given transaction or project which is intermediate between *make* (government stovepipe) and *buy* (traditional contracting). In the PPP cases, there will often be high transaction costs involved in externalizing the activity, although the lack of internal funding and technical skills may encourage public managers to follow this route, despite the potential costs. Thus, and according to the TCT, the public party will tend to adopt a specific PPP in which the greater the level of risk, uncertainty and specificity the more risk that will attempt to transfer to the contractor. This will, in turn, increase the overall risk to both parties associated with the transaction.

Another feature of PPPs is the association of two entities, public and private, which have different nature and general objectives. This problem links with the correct alignment of interests analysed by the **Principal-Agent Theory** (PAT) [4]. The PPP conditions appear in a contract or agreement outlining the responsibilities of each party and designating the optimal risk allocation. In the PAT, there is a principal (government) that wants to contract an agent (private company), in order to execute an economic activity through PPP form. There is an information asymmetry problem, since one of the partners (the agent) has more information than the principal on their work and execution skills. Thus, asymmetry of information generates moral hazard and adverse selection problems, which lead to higher risk in the implementation of the project. The problem is represented in a classical way as an optimization problem seeking to maximize the principal's utility subject to agent's incentive and participation constraints. The effect of the agent's incentive constraint it is ensure that the agent acts in its own best interest and constrains the visibility the principal can have of the agent's action. To diminish the problem the principal should attempt to align their required outcomes with the likely incentives of the agent. For instance, to reduce risk on an infrastructure Design and Build PPP, the principal (government) can allow the agent (private side) to benefit from what it designs and build (e.g., build a highway and receive income from the tolls). This incentive facilitates the risk allocation to the agent since if it fails to adequately manage a risk, this could result in it earning less profit. Thus, in an ideal relationship, "the risk should be allocated to the agent to the extent it does manage the risk."

To reach a generally efficient solution, each party should allocate risk according to their respective capabilities to deal with it; the key question is to know which one is most capable to manage what risks to include them in the allocation process. The **Resource Based View** (RBV) [5] complements PAT going one-step further allocating risk between both sides. This framework is traditionally used to explain the heterogeneity among firms' results in an industry according to the competitive advantage they can create through their resources and capabilities. Furthermore, the RBV allows the explanation of private cooperation due to the lack of tangible and intangible public resources, as well as claims for the singularity of both parties, in order to analyse their resources and capabilities to determine which one is better to manage each risk. This implies that the resources and capacities that each party possesses and contributes, should assign the responsibilities of the risks that originate from their potentially inefficient use and their capabilities to manage the situation. At the same time, risks that do not depend on either party can be allocated in proportion to their resources and capabilities, which require an analysis of both together with the governance structure adopted.

The group has reviewed two pieces of work (a doctoral dissertation and a direct contribution), whose main conclusions are discussed below. First, the PhD Thesis by MacDonald is the most comprehensive view of the decision *make* vs. *buy* in the defence field. Second, the paper by Fleta-Asín, Muñoz and Rosell-Martínez analyses the governance of PPPs.

4.2 ECONOMICS OF MILITARY OUTSOURCING

In his thesis, *The Economics of Military Outsourcing* (completed in 2010 and available online), Peter MacDonald investigates the Economics of Military Outsourcing, which can include both PPP type partnering and also traditional, transactional contracting [6].

He observes that, according to economic theory, as Defence is a public good that is both non-excludable and non-rivalrous, it needs to be publicly funded, as private markets under produce such goods. However, there is no requirement for Defence to be publicly produced and so for each activity necessary for national defence a government will face a make-or-buy decision, i.e., it may produce the activities publicly or it may pay private firms to produce them on its behalf, or some combination of the two.

MacDonald finds clear empirical evidence from the research literature that if an activity:

1) Does not require the use of large specific assets;
2) Is straightforward to specify in contract;
3) Has stable and predictable requirements;
4) Has many potential providers; and
5) Does not rely crucially upon timely contract enforcement;

then substantial savings (in the order of 10 – 20 %) may be realised from outsourcing that activity.

However, these conditions only apply to a small minority of defence activities, not least because of the importance of specific military equipment in many activities.

The theoretical opportunities for the substitution of capital for military labour are examined and it is found that the estimated elasticity is close to zero, suggesting there is little scope for contractors to use capital rather than military labour. It is similarly found that the estimated elasticity for the use of civilian labour rather than military is also around zero. This suggests that it is not possible to costlessly replace military labour with capital assets or with contracted civilian labour, the price is likely to be reduced flexibility.

MacDonald then provides a taxonomy for Outsourcing, which provides eight different categories, depending whether:

- Assets employed are publicly or are privately owned;
- Finance is provided from public or private sources; and
- Outputs are provided by public sector or private sector workers.

It is notable that, in the Defence field, outsourcing activities using private finance are rare.

He also examines what is known about the transaction costs associated with contracted service provision, notably the costs of tendering, monitoring and oversight. Estimates of these costs under contracted provision vary from 2 – 3 % up to 20% with most falling at the lower end of this range.

However, transaction costs (particularly the costs of monitoring) will increase as the importance of non-contractible elements of the service under consideration rises. In defence, this is likely to occur as one

moves closer to the uncertainty of operational use and as more resources must be devoted to overcoming control issues transaction costs are eventually likely to outweigh potential savings. In these circumstances in-house, military providers' use of military employment costs allows them the economise on the transactions costs of ensuring control.

For PPP[1] arrangements, the transaction costs arising from the 'need to find the right private sector partner, and to negotiate, monitor and renegotiate a long-term contract giving him the right incentives to strive for service quality while containing costs', mean that PPPs are dearer to set up and follow up than in-house provision. In the UK, it is estimated that the transactions costs of PPP arrangements for the procurement phase alone (that is excluding any monitoring and renegotiation costs) incurred by government are between 1% and 7% of the capital value of the project, but including the costs incurred by bidders (both winners and losers) gives a total figure of 'well over 10%'[2]. For PFI projects in the UK, the cost of advisors alone averages 2.6% of a project's capital value.

MacDonald concludes with an examination of the applicability of 'bundled' arrangements, where the contractor provides and operates the assets. In this situation PPPs are more beneficial when a better quality of asset can significantly reduce cost at the operational stage (including maintenance costs), when asset quality has a great impact upon the quality of service, and when demand for the asset is stable and easy to forecast.

When considering military equipment demand for the asset is less stable, but where demand stability can be achieved by specifying reasonable availability requirements then military equipment may benefit from bundled PPP type provision. However, the lack of flexibility inherent in tightly specifying availability and quality (where possible) requirements suggests that for assets intended for use on the battlefield unbundled provision is to be preferred. The alternative of government buying the asset and then tendering for an availability based logistic contract separately has certain advantages in terms of flexibility, especially if the logistic contract is let once the equipment is mature and requirements are well understood.

4.3 THE GOVERNANCE OF PPP

Fleta-Asín, Muñoz and Rosell-Martínez have explored Public Private Partnerships, governance structure, resources and capabilities as risk allocation mechanisms (see full paper in Annex B.)

The analysis in this paper recommends addressing the peculiarities of each PPP according to its degree of uncertainty and specificity, as well as the resources and capacities of both partners, in order to determine the governance structure and clauses that best allocate the risks to each party. This approach should result in an alignment between project characteristics, resources and capabilities and governance structure which allows risks to be allocated efficiently. These recommendations are complementary and compatible with international papers and guidelines on PPPs, shedding light on some of the results among them that do not show consensus, disentangling the sources of risk according to the nature of the projects.

The first implication that arises from this work is that PPP risk allocation should focus on the nature of the transaction or PPP activity. The specific details of the project guide the best governance structure that fits with the objective of public party. The higher the uncertainty and specificity of the assets of the transaction is, the higher the transference of the risk from the public party to the private one through the governance structure should be.

In extreme cases, where the transaction is particularly costly given its specificity and uncertainty, two problems for both sides of the collaboration appear. On one hand, the mechanisms of governance in which

[1] These are UK Public Private Partnership arrangements, which have a specific definition, which is narrower than the definition employed in this study.

[2] For example, transaction cost of UK NATS PFI was £77 million compared with a capital value of £758 million.

the risk is transferred to the private party may be excessively onerous and it may also be difficult to determine who the original public owner of the risk was. On the other hand, the public or contracting party may also have greater difficulty in controlling the compliance and good performance of the contractor's activity given the complexity of the transaction.

The second managerial implication is that the risks inherent to the transaction must be identified, as well as the details of the capacities and resources of the public and private parties, in order to determine which ones are best able to manage each risk in particular. Each party can do this through a detailed internal analysis, as well as the history of past satisfactory performance managing risks. Similarly, expert opinions (e.g., Delphi analysis) may provide recommendations on unassigned risks as well as verifying how these were assigned in previous work.

The resources and capacities of both sides not only allow risks to be allocated to the party with the greatest capacity to assume them, but also can guide the chosen governance mechanism. Thus, it should be possible, in advance, to establish a governance structure that will (should) align with the project purposes. For example, in cases where the transaction presents little uncertainty and specificity, and straight-forward maintenance and service contract may be appropriate. While development of infrastructure is required it should be possible to transfer more of the risks to the contractor by allowing them to benefit from good development and delivery through a Design Build Operate arrangement. Alternatively, in extreme cases where there are very large transaction costs, such as the development of an aircraft, a Joint Venture can be created to link ownership and increase the degree of control over operations.

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Chapter 5 – DISCUSSION

Throughout European history, a range of contracting approaches have been used to deliver both military goods and services and also military outputs. One of the earliest, widespread use of contracting, was in Italy in the period covering approximately 1300 – 1550, when various city states employed *Condottieri* (mercenary companies) instead of maintaining standing armies (see Case Study 8). While these arrangements were in use, various examples of good practice emerged which were designed to protect both parties in the contract from unfair or unethical practices. One of the key early observations was that, whilst the *Condottieri* were (reasonably) happy to fight for money, they lacked an alternative source of support during peacetime and so during such periods, tended to resort to demanding money with menaces, with activities ranging from banditry to holding whole towns to ransom.

Although present day contractors involved in supporting Defence clearly have much higher ethical standards than mediaeval mercenaries, the same pressures can still be observed. A contractor whose products and services are very specialised and a large proportion of whose turnover is generated by military contracting may struggle to find alternative sources of income should the government wish to contract less work. The present day response to such a situation will focus more on persuasion than outright violence, but the desired outcome will be the same, persuading the government to give the contractor more income or, if no future work appears likely, pays the costs of the contractor making the affected employees redundant.

Before letting a new contract, or radically altering a current contracting strategy, consideration should always be given to whether one of more contractors will be placed into a situation where a previous stream of income has been removed, they will find it difficult to replace. Such situations cannot (and probably should not) be avoided, but prior identification of the potential situation and consideration of how it will be addressed can minimise the disruption and management effort required to resolve it.

Returning to Italy, we find that another lesson may also be drawn from that period. Although there were a number of committed and diligent mercenary captains, the view eventually emerged that such contractors might not be sufficiently motivated by financial considerations to give up their lives for their employers. For example, there were two notable examples of battles between such contractors where the only casualties were caused by accidents [1]. This perceived poor performance, coupled with tactical and technological advances in foreign armies that the *Condottieri* could not match eventually led to their replacement with regular forces, although the Papal Swiss Guard is a remnant of this historic practice.

Even though this initial example is 500 years old, the lessons are still relevant today as contractors are still unwilling to take undue risks on behalf of a government with whom they have a potentially fleeting relationship (very reasonably). As the employment of mercenaries is now not widespread, the items at risk are normally assets and reputation, rather than life, but the issue remains the same, that a contractor is only likely to take risks and make extra effort if they perceive that it is likely to contribute to a beneficial long-term relationship.

Although governments have often contracted out the provision of certain military goods and services, there has, historically, been a significant element of stove-piped (vertically integrated) government activity, for example in the United Kingdom, in the 19th Century, the manufacture of weapons and ammunition was concentrated in the Royal Arsenal at Woolwich, the Royal Gunpowder Factory at Waltham Abbey and the Royal Small Arms Factory at Enfield. As discussed in Case Study 7, such arrangements yield a high degree of control over the activities undertaken and the quality of what is produced, which is one of the reasons that actual combat is still generally undertaken by government funded armed forces, rather than mercenaries (see Case Study 8). In certain commercial cases, such as the Rioja Industry, commercial enterprises can make the judgement that the potentially increased costs are worthwhile, given the quality and control requirements for the product and similar arguments can be made for government control of key technologies such as the development, production and management of nuclear weapons and other critical technologies.

If a vertically integrated stovepipe approach is currently in use it can be difficult to determine whether it is performing satisfactorily, or whether there is room for improvement. Economic theory suggests that the cheapest approach that produces the required quality and quantity of product is best, however, there may be financial or doctrinal reasons about why the stovepipe should be maintained in the public sector or alternatively should be exposed to commercial pressures and benefits. If a large public enterprise is to be turned over to commercial management and commercial funding (see Case Study 2) government may wish to explicitly control the returns that can be made by industry. Regulation of such areas may significantly influence the viability of an arrangement and so expert advice will be required on this and also the financial viability of contractor proposals. Such advice is rarely cheap and must be paid for throughout the whole selection process. If the selection process takes longer than expected, then the fees to these advisors will also rise.

Even if there is an over-riding requirement for the government to control all aspects of an activity there can often be synergies achieved by gaining insights from Industry or partnering. For example, in Case Study 4 the exposure of the government facilities to the commercial operations resulted in significant improvements in productivity.

As noted in the academic observations section, most of the case studies rest somewhere on the continuum between *make* and *buy*. Case Studies 2 and 3 (UK Air Traffic Control and Voyager Aircraft) are clearly towards the *buy* extreme, with Case Study 7 (Spanish Rioja Industry) tending towards to opposite extreme. Of the others, Case Study 1 is of particular interest, as the company created was initially created by industry, but at the end of the contract has become the property of the government, hence transitioning from *buy* to *make*.

Case Studies 5 and 6 are of a radically different nature – in each of these case studies, industry was able to identify an opportunity where they could make money and where government could also make savings or generate and maintain skills and knowledge at a reduced cost. The present research has not been able to study a sufficient number of these types of partnering to determine whether such partnerships are, by their nature, purely serendipitous, or whether governments or the alliance can take steps to promote such industry innovation.

5.1 REFERENCES

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Chapter 6 – CONCLUSIONS

Overall, there are a number of key conclusions that arise from this work:

1) There are two main classes of PPP, those driven by a government requirement, which will lie somewhere on the continuum between make (undertake using in-house resources) and buy (acquire on the open market through traditional, short term, contracting) and those where industry identifies the initial requirement or opportunity.

2) The industry led opportunities appear to arise relatively infrequently and it has not been possible to determine whether they simply arise serendipitously, or whether steps can be taken to encourage their development, however they offer opportunities for significant government savings with minimal effort.

3) The specificity, sensitivity and quality of the assets required is a significant determinant of which approach is most likely to yield a satisfactory outcome. The more complex and specific an asset and the more difficult it is to control the quality the less likely it is that a buy approach of acquiring the asset or service through traditional contracting is to work.

4) It is also clear that contractors with very specific assets and skills will act in the interests of their owners and attempt to maximise the return from government work and/or minimise the impact of work ceasing.

5) There is a common tendency to underestimate how long it will take to develop and deliver a given PPP solution. This generally results in increased costs to government both from running-on the existing capability and also from paying advisors and other staff involved in the solution development process.

6) The risks in a PPP should be allocated to the party whose skills, experience and resources best allow them to manage the risks. It must be noted that some risks (e.g., operational success) cannot be transferred to contractors.

Chapter 7 – RECOMMENDATIONS

1) It is recommended that further analysis is made of industry led PPP opportunities to determine whether steps can be taken to promote their occurrence.

2) It is recommended, when designing a PPP contract, steps are taken to strike an adequate balance between three main elements that are key to the effective implementation and sustainment of the agreement:

   a) The assignment of most appropriate risks and responsibilities to each party;

   b) The timely measurement of the performance of every party; and

   c) The compensation and penalties arrangements, based on the preceding elements.

3) It is recommended that, before entering into or changing a current contracting relationship where the contractor has significant assets and/or skills that are specific to Defence, some consideration should be given to the likely reaction and how this could best be managed.

Annex A – CASE STUDIES

A.1 CASE STUDY 1 – GERMANY: PROJECT HERKULES (NON-OPERATIONAL IT)

A.1.1 HERKULES: A Firm Foundation for the Future

In 2006, Europe's largest Public-Private Partnership (PPP) got underway. The project was given the name HERKULES and had a ten-year timescale. And its designated task does its name justice. In the framework of the undertaking, the non-military information and communications technology of Germany's Army, the Bundeswehr, was completely modernized and brought into operation. Including value added tax, the contract was worth around 7.1 billion Euros. All ten organizational areas of the Bundeswehr were involved, and thus around 280,000 military and civil Bundeswehr personnel more than 1200 sites and in some 6200 Departments and Units.

As well as modernization, the focus for the BWI consortium – which was specifically founded for the implementation of the project by the partners Bundeswehr, Siemens and IBM Deutschland – was constantly also on the standardization, consolidation and centralization of the Bundeswehr's IT infrastructure. Concentration at a few locations and the unification of systems and applications significantly increases the performance, availability and security of an IT system, while at same time reducing costs for operation and maintenance.

The BWI was tasked with creating an IT system that is reliable, powerful, flexible and secure. This was and is never, an either/or choice. An IT system can only be relied on when it achieves the close interaction of all these criteria for the transfer, processing and storage of data, for the equipment of its work stations and for its system administration and support. A look at the Bundeswehr's present-day, non-military IT system highlights how thoroughly and successfully the BWI has pursued this holistic approach.

Let's look at data communication first. For an IT organization like the Bundeswehr, with its many dispersed locations and high security needs, a dedicated, high availability, high performance **Wide Area Network** (WAN) is an absolute essential. For this reason, establishing such a network figured among the first and most important tasks addressed by the BWI at the very start of Project HERKULES. In so doing, the BWI placed special emphasis on availability, security, high performance and the ability to flexibly expand the fiber optical cable system. The result is that today, the Bundeswehr has at its disposal one of the largest, most stable and most powerful WANs in Germany. And because the platform is standardized, expandable and scalable, the network is not only well prepared for the increasing demand for band-widths and the future requirements of the Bundeswehr, but also opens the potential for it to be used by the Federal Government for IT consolidation in other areas.

The telecommunication of the Bundeswehr is integrated into the WAN. For this purpose, the BWI has constructed, and is operating, a Next Generation Network (NGN). It is based on the Voice over Internet Protocol (VoIP) and enables the simultaneous transfer of all types of data over the transmission network, independent of which service or application is involved.

As well as data transfer, the second central element of an IT system is data processing and storage. At the Bundeswehr, three data centers cover demand for computing capacity and centralized memory capacity for data processing. The sites in Cologne/Bonn, Wilhelmshaven and Strausberg have either been completely modernized or completely renewed by the BWI. The server farms are connected to each other via the WANBw. In this way, they can work as a single unit and can be operated as a single logical data center. In addition, vital resources are duplicated. In this way, flexibility and reactivity are increased sustainably, and a high degree of fail-safe operation is guaranteed.

In the course of Project HERKULES, high-maintenance decentralized sites have given way to centralized operation, which enables a high level of centralized automation. The proliferation of hardware and software is also history. For example, in order to operate Lotus Notes, more than 1600 servers in 1500 separate locations previously had to be administered. Today, fewer than 100 servers are needed. Moreover, all the processes involved are aligned to proven industry standards. Of special significance in this context is the Monitor and Control Center (MCC) in Bonn, which undertakes the centralized control and monitoring of all servers.

The MCC employs standardized procedures, processes and tools. This allows a level of automation of operational control to be achieved which attains as a minimum, and in some areas even exceeds, the industry standard. A further contribution to increased efficiency is enabled by comprehensive virtualization. This makes possible a better utilization of the available hardware resources, since numerous operating systems and applications can run in parallel on a single server. The benefits for the Bundeswehr are: greater flexibility combined with improved availability; and enhanced resilience to malfunctions.

However fundamental WANs and data centers may seem, for the users themselves their performance is invisible and as taken-for-granted as electricity out of a socket. Much more tangible for them is the hardware and software of their work stations and satisfactory system support. In this area, the first step of the BWI was to undertake a comprehensive standardization and consolidation. Three standard types, which are regularly up-dated, have replaced a whole variety of PCs. A previous count of more than 7000 different software products, in a range of different versions, has been reduced to around 300 – a move which also lowers license fees and operating costs. As a further result, central software management also became possible which, in turn, offers systematic and largely automated services like updates and patches and upgrades of the operating system. A centralized software and patch management function ensures that the software of HERKULES-PCs is always up-to-date and thus makes an important contribution to IT system security, an aspect to which the BWI attaches special importance.

As well as modern work station equipment, comprehensive user support contributes to the fact that Bundeswehr staff can concentrate on their own job content. With the User Help Desk (UHD), the operations competence centers and the Service Centers, the BWI has created a three-tier structure for IT-Service and Fault Management. The UHD is the first point of contact for Bundeswehr personnel and is manned 24 hours-a-day, all-year-round. The operations competence centers implement all system changes, so that users need no longer involve themselves in updates or installations. Approximately 1000 staff at the 25 Service Centers carry out on-site service. They can be at any Bundeswehr location in Germany within two hours. This all-embracing support is highly valued by Bundeswehr personnel. In regular surveys on IT system satisfaction, the employees at the BWI Service Units constantly receive highest ratings.

HERKULES has fulfilled all the conditions that the Bundeswehr set when it decided in favor of IT modernization in the form of a Public-Private Partnership: the fastest possible implementation; an appreciable reduction in the workload of personnel, who are no longer obliged to undertake specific tasks themselves; and a maximum of technical stability and thus also economic reliability. Today the Bundeswehr has everything at its disposal that defines dependable modern information and communications technology: robust and scalable data networks; resilient high-performance data centers; modern IT work stations; and comprehensive user support. And that is not all. The non-military IT system is so designed that that it can grow to meet new challenges. Consequently, the Bundeswehr is well equipped for the future.

At the end of 2016 HERKULES was completed according to plan. The BWI still exists. Now 100 percent owned by the Federal Government, the enterprise will be developed to become the Government's IT system house and will continue to ensure the secure and reliable operation of the Bundeswehr's information and communications technology. To actively shape its future challenges, the BWI has reorganized itself and established, among other things, an Innovation Management (IM) function. IM assumes the central role in the BWI's preparedness for new requirements: at the express wish and request of the owner, in future the BWI will generate new forms of IT services like, for example, Cloud Computing and services in the area of

the Bundeswehr's mission-relevant IT. Beyond this, it should also provide IT services for other Federal Government Departments and Agencies. This, however, can only be achieved via a high level of innovative capability – on both the part of the BWI and the part of the Bundeswehr. Consequently, both the Federal Ministry of Defence and the BWI are engaged in projects to establish sustainable IM functions and link them to each other.

The BWI is now required to act as a driver of innovation to advance the Bundeswehr's IT system and to accept a comprehensive design mandate. For this reason, the enterprise perceives the development of its innovative capabilities as a central element in its corporate strategy. An IM function creates an important foundation for delivering up-to-date, sustainable benefits.

An organization that understands itself as an IT system house must also offer solutions that are not yet in its current portfolio. It is necessary to continually analyze the needs of customers and businesses, to closely study the market for suitable solutions and then to put forward proposals for the development of services and their implementation in both a timely and economic manner. And if the corresponding solution is not yet on the market, the system house will be required to become active in its development, in collaboration with suitable partners. It will thus be indispensable for the BWI to develop a strong commitment in the field of strategic portfolio management. The line of approach is clear: the BWI portfolio must be demand-oriented, flexible, adaptable, powerful, highly modern, efficient and forward-looking – and as a matter of course, as well as all the above, be able to meet the high security requirements of the Bundeswehr and other Government Departments and Agencies.

In the BWI, the Federal Government has acquired a powerful, modern IT house that has gathered a huge fund of experience over the past ten years. And not only in the construction and operation of complex IT infrastructures, but also in the successful management of extremely demanding, multi-layered major projects. This comprehensive know-how, which stands comparison with standards in industry, is of incalculable value – and for the Federal Government it opens up ways to establish and consolidate modern and reliable IT infrastructures in numerous other areas. In this way Project HERKULES has laid a foundation that can support far more than the information and communications technology needs of the Bundeswehr.

A.1.2 Information Submitted to Support This Study

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A.2 CASE STUDY 2 – UK: NATIONAL AIR TRAFFIC SERVICES

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A.3 CASE STUDY 3 – UK: FUTURE STRATEGIC TANKER AIRCRAFT

A.3.1 Information Submitted to Support This Study

Report by the Comptroller and Auditor General HC 433 Session 2009 – 2010: 30 March 2010. Delivering multi-role tanker aircraft capability. Available at https://www.nao.org.uk/wp-content/uploads/2010/03 /0910433es.pdf.

A.4 CASE STUDY 8 – ITALY: *CONDOTTIERE* (HISTORICAL)

Issues: Throughout much of mediaeval Europe, the feudal system produced a society where peasants and minor nobility owed a duty of military service to their Lord, and the Lord, in turn, owed a duty of military service to the monarch. Feudal armies could, therefore, theoretically be raised with no requirement for external payment. However, feudal service generally had a fixed duration and sometimes those owing service were not very enthusiastic about the conflict, so situations arose during protracted or contentious wars where the employment of mercenaries became common.

In much of Italy, the feudal system never took root, and the landscape was dominated by numerous independent, urbanised and economically developed states. In that region, armies were initially, mainly, composed of urban militias where the poor of a town would serve as infantry and the richer inhabitants as cavalry, all under the command of the urban aristocracy. Over time the importance of mercenary contingents rose as the military effectiveness of militias fell, political tensions within towns meant that the loyalty of militia members could not be assured and greater aggression resulted in wars lasting longer and hence requiring standing armies to prosecute. Whilst these pressures were felt all over Europe, it was only in Italy that the very formal system of mercenary bands (*Condottiere*) and their contractual arrangements arose.

Many mercenary bands formed either to fight in wars in Italy, or entered Italy in search of work when peace had broken out elsewhere in Europe. Issues arose in times of peace, as small bands of unemployed mercenaries would resort to banditry to sustain themselves whilst larger bands would attempt to extort protection money from towns. However, over time that situation improved, the discipline in mercenary companies was improved and standard business practices arose, which provided benefits to both sides, the contractors (mercenaries) would not be cheated by unscrupulous employers (towns) and towns would not be held to ransom by mercenaries. The commanders of a mercenary company selected soldiers to enlist and the company entered into a *condotta* or contract with the employer, which stipulated the *ferma* (service period). When this was complete, there was an *aspetto* (wait period) while the employer considered renewing the contract. If the contract definitively expired then the contractor could not declare war against their employer for two years.

Although this case study relates to activities over 500 years ago, the lessons are still relevant to current contracting. The contracts being discussed here were traditional in nature in that they covered the provision of services for a fixed period of time, with no certainty of the contract being renewed. In this situation the contractor will, if short of work, attempt to coerce the government to provide sufficient funds to keep them in business. In the historical context, the mercenaries used the threat of force to back up their arguments.

In present day NATO countries, such crude attempts at persuasion are unlikely, but the use of lobbyists and media reports to threaten dire outcomes if contracts are not renewed is all well attested.

If Government or Defence contracts represent a small proportion of the turnover of a given contractor, then it is unlikely that the contractor will devote effort in obtaining follow-on work, above that which they would apply to a normal customer. However, when Defence or other government work is a large portion of the turn-over of a contractor, then extreme efforts will be made to obtain follow-on work or to obtain government funding for any corporate restructuring that becomes necessary. In situations where certain contractors or industries are unduly dependent on Defence or other government work, or where letting certain contracts might produce this situation, then thought must always to given to the cost and effort needed to produce an exit strategy.

A.4.1 Information Submitted to Support This Study

[1] Paret, P., Craig, G.A., Gilbert, F. (1986). *Makers of Modern Strategy: from Machiavelli to the Nuclear Age*. Oxford University Press. ISBN 0-19-820097-8.

[2] Nicolle, D. (1983). Italian Medieval Armies 1300-1500. Osprey Publishing, Oxford.

Annex B – PUBLIC PRIVATE PARTNERSHIPS: GOVERNANCE STRUCTURE, RESOURCES AND CAPABILITIES AS RISK ALLOCATION MECHANISMS

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Contribution to SAS-112: Comparative Analysis of Private-Public Partnership in the Management of Military-Industry Activities.

B.1 *ABSTRACT*

Risk is a crucial topic in project management, particularly in major public projects. This paper deals with the optimal allocation of risks between parties when the governance (and contracting) of these projects takes place under Public Private Partnerships (PPPs). According to some general literature in economics and management, we propose that the election of a governance form for a project contracting depends, on one hand, on the nature of the project itself. On the other hand, the governance form and risks allocation depend on the capabilities of every party involved. We perform two analyses to test both hypotheses. In the first one, we examine 1555 projects from different countries registered in the PPPs World Bank Database, to test if the characteristics of the project influence the concrete form of PPP. The findings show that the greater the specificity and uncertainty of the project, a specific PPP form is chosen to transfer more risk to the private party. In the second analysis, we review 17 risk allocation articles about PPPs. Results show that risks are allocated according to the fundamental capacities of each party, whereas those related to a joint entity should be shared.

B.1.1 Acknowledgements

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B.1.2 Keywords

Public Private Partnership; Risk Allocation in Project Governance; Governance Structure; Transaction Costs Theory; Resources Based View; Principal-Agent Theory; Institutionalism.

B.2 INTRODUCTION

Project governance has received attention by academic literature in project management [1] and particularly the governance of major public projects [2]. A Public Private Partnership (PPP) refers to an agreement between the public and the private sectors in which some of the services or tasks that are the responsibility of the public side are provided by the private sector under a clear agreement of shared objectives, in order to provide a public service or infrastructure [3], [4], [5]. This kind of cooperation has a number of particularities that differentiate it from traditional organizational forms (i.e., markets and hierarchies). The most significant are the commonly long duration of PPP, the funding of the project (where private sector has a relevant role), the participation of a private party in different stages of the project (design, completion, implementation and/or funding) and the distribution of the risk between the public and the private partners [6], [7], [8].

The PPP formula has become popular in recent decades, because of its advantages. A PPP allows the government to benefit from the participation of the private sector in financing and managing public service expansion by outsourcing risk to private entities [7], [9]. This permits the contractor to exploit the skills, experience and technology innovation of the private party [7], which can improve the operational efficiency of the public assets [10]. Consequently, the government can use its financial capacity to undertake other types of activities, and concentrate on its core competences, focusing on policymaking, planning and regulation [11], [12].

Given its importance, most studies focus on identifying the critical factors of PPP implementation (e.g., Refs. [13], [14]). However, there is no consensus about which factors are the most important and how the risk should be allocated between the parties [15], [7], [16]. This may be because academic articles about PPPs analyze them as a homogeneous unit of analysis, rather than attending to two singularities that affect their risk distribution.

The first of these singularities is that PPPs have different legal forms of articulation – from a contract to a third party to a public/private joint venture – and therefore the importance of risk factors and their distribution changes for every party [17], [18]. Moreover, academic works analyze the experiences without linking the characteristics of the project with the kind of PPP adopted [17]. Thus, researchers systematically ignore the influence of the different PPPs adopted and the nature of the project, which affect the risk allocation.

The economic theory related to the PPPs allows these particularities to be addressed. The first particularity of a PPP is the use of an external entity to perform an activity by the private party, which is usually analyzed by Transaction Costs Theory (TCT) according to the benefits and costs related to externalize an activity, which could be internalized among the boundaries of the public sector. The TCT not only examines the decision related to externalize or not, but also studies the hybrid forms of the governance structures that deal with the transaction (e.g., to sign a management contract or operate it through a joint venture). Thus, TCT allows the decision model to be expanded to consider a spectrum of situations between the two extremes, suggesting which PPP form is better according to the characteristics of the transaction/project.

The second particularity of a PPP is the association of two entities, public and private, which have different natures and general objectives. This problem links to the right alignment of interests analyzed by Principal-Agent Theory (PAT). The PPP conditions appear in a contract or agreement outlining the responsibilities of each party and designating the optimal risk allocation. The PAT problem may diminish according to the control and responsibility analysis made by each party, as well as the assignation of those elements to the party with the greatest capacity to manage them. The Resource Based View (RBW) (see Ref. [19]) sheds some light on considerations of the resources and capabilities that the private and public parties possess to deal with the risk; and in addition, Institutionalism attributes to the government the role of establishing the legal framework and rules to transact [20]. Thus, RBW and Institutionalism complement the PAT problem, guiding which party should assume which risk.

The structure of the paper is as follows. We first analyze the above-mentioned theoretical perspectives linked with PPP in order to identify the risk allocation mechanism and its managerial implications. The second section refers to the academic literature, where two separate subsections are analyzed: the nature of the project – how its characteristics influence the concrete structure of PPP chosen to assign risks; and the perspective of the agents who carry out the project – how their resources and capacities allow certain risks to be assigned to each party. In the third section, we test both hypotheses previously set out in each subsection, using PPP World Bank Database experiences and academic articles that deal with risk allocation. Finally, section four contains the conclusion and the managerial implications of the findings.

B.3 THEORETICAL BACKGROUND

B.3.1 Governance Structure as a Form to Allocate Risks

Transaction Cost Theory states that organizations outsource their activities outside their limits when the costs of hiring a service on the market are lower than performing them internally [21]. These costs, in addition to those of production or provision of the service, include those generally referred to as "transaction costs". Thus, in the case of carrying out the activity internally, coordination and control transaction costs are assumed by the organization [22], while in the case of going to the market, the time and expenses of negotiation, writing, and compliance with the contracts, as well as the costs of noncompliance with the agreed upon are assumed [23].

The TCT therefore suggests that these overall costs of carrying out an activity would be different when carried out within the company and when it goes to the market, mainly depending on the characteristics of the transaction. For this reason, outsourcing decisions has been extensively analyzed, taking into account the attributes of the transaction as the object of study [24], [25], [26].

Once the attributes are analyzed, the managers decide if they externalize the activity, and in case they do it, the best governance structure and the agreement between the parties is formalized through the "contract", which contains the requirements of the economic agents involved [27]. Thus, the governance structure chosen to externalize the activity, and the conditions reflected in contracts depend, *inter alia*, on the characteristics presented by the transaction between the parties [28], [29], [30], [31].

The transactions' characteristics are important because of the assumptions that govern the behavior of the agents. One assumption, limited rationality, would prevent the decision maker from anticipating all possible contingencies and consequences that accompany the transaction [32]. Furthermore, opportunistic behavior could see the agents in the transaction hiding relevant information before making the transaction (i.e., adverse selection because appears ex -ante), or not acting as agreed (i.e., hidden action because it appears ex -post), [33] [22], [26].

The greater the presence of bounded rationality and opportunistic behaviour the market, the greater the **uncertainty** that accompanies the transaction and, consequently, the predisposition to internalize the activity in the organization. Uncertainty makes it difficult for the company to predict the outcome of its actions, consequently, when uncertainty is greater, the organization will prefer to control the activity by itself [21], [25], [23]. Uncertainty can manifest itself in many ways. It is increased in unstable economic, social and institutional environments [25],[26], by the complexity of the transaction [34], the difficulty of verifying the result [25], [35], how critical the activity is [34] and the difficulty of enforcing what was agreed in the market [23].

Another feature which is relevant when it interacts with uncertainty, is the degree of **specificity** acquired by the asset being transacted [21]. In general, when the contracting party goes to the market, the object of exchange would be adapted by the supplier to meet certain requirements, in which process it acquires a different degree of adaptation to comply with the customer (e.g., specific infrastructures like highway or water supply works) [23]. This characteristic is important because once the transaction is agreed and a specific degree of specificity is acquired, there may be opportunistic behavior by of the contracting party (e.g., he refuses to pay what is agreed upon) or the supplier (e.g., delivery of low quality infrastructures), causing a hold-up problem for the most disadvantaged party [33].

In general, the greater the specificity of the necessary assets in the productive process, the greater the vulnerability of the organization to opportunistic behavior on the part of the supplier [36], since the supplier could abuse prices or decrease the level or quality of service [35]. For that reason, the provision of highly specific assets through the market is the least efficient option for the interests of the public sector [37]. Thus, the TCT suggests that activities involving higher uncertainty and specific assets should be internalized [33], [23].

The PPP cases usually present high transaction costs through the market, although the lack of funding and technical skills may draw public managers to externalize them to the private sector [7], [10]. Thus, and according to the TCT, the public party will tend to adopt a specific PPP in which more risks are transferred to the private party when there is a greater presence of characteristics in the project, uncertainty and specificity, that generate such risks. The higher the specificity and uncertainty of the service/product provided by PPPs, the higher the risk associated with the transaction [33], [26], [22].

These characteristics requires the analysis of the different PPP types and their associated risk levels (see Figure B-1). According to the European Commission [6] the main principal forms are:

- Management and Operating Contracts (include specific tasks, usually everyday maintenance jobs, are contracted to the private sector);
- Leases (contain a private company rents the assets of a utility, and maintains and operates them, in return for the right to revenues);
- Concessions (involves the construction of a new asset or for the modernization, upgrade, or expansion of an existing facility);
- Build-Operation-Transfer projects (BOTs include transferring responsibility for the construction and operation of a single facility or group of assets to a private sector partner); and
- Design-Build-Operate-Transfer projects (DBOTs, contain the design, build and operation of the tasks); and Joint Ventures (the public and private parties share the ownership of a company to operate together, usually with permanent intention).

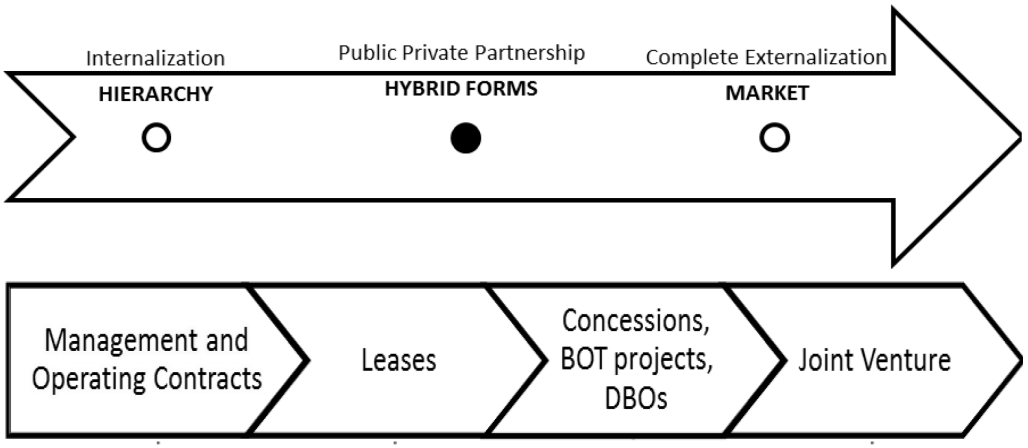

Figure B-1: Public Private Partnership as Hybrid State Between Market and Hierarchy. Source: Authors' elaboration based on Refs. [6] and [8].

These PPP types involve governance mechanisms where specificities can seem medium (e.g., garbage collection in a city) while their long duration creates a temporary hold-up problem when the contract becomes long (e.g., a three year contract collecting garbage), as well as some governance structures including assets creation by the private party (e.g., Build and Transfer agreements), their temporal exploitation (e.g., Build Operate and Transfer Agreements), or even the permanent use of them (e.g., joint venture and partial divestitures with the public administration) where the specificity becomes greater. In addition, each PPP has its own particularities, becoming specific by nature, since the service or asset is created *ad hoc* for the private party. On the other hand, one characteristic shared by PPP forms is that their long duration makes the costs of uncertainty higher and more difficult to evaluate [38], [30]. In the extreme situation of a PPP almost completely externalized, where the risk level is highest because of uncertainty and specificity, both parties would share the ownership through Joint Venture, in order to diversify risks and benefits.

One of the differences among the decomposed PPP forms is the risk transferred from the public sector to the private party [6], [8]. There is a consensus that the Figure B-1 scheme is ordered in terms of risk transferred from the public party to the private one, indicating that there exists a relationship of transaction within each PPP form. It means that, for instance, Management and Operating Contracts, in general, do not transfer as much risk as concession or BOT projects to the private party. Consequently, the governance mechanism allows the public sector to allocate PPP global risks according to the project characteristics. Thus, the PPP adopted is one of the prior decisions for arranging a successful transaction, because each structure influences the terms under which an activity will be transferred from the government to the investor, thereby demarcating the authority, responsibility, and benefits between both parties.

This means that the risk level, usually analyzed as a "black box", and the attributes of the transaction are two dimensions related to each other, whose intersection determines an adequate form of government to manage it. Then, in Figure B-2, we can establish, as a cause in the X-axis, the degree of specificity and uncertainty of the transaction/project; in the Y-axis, as an effect, we have the level of risk associated as an assessment of these characteristics; and as an echeloned vector of both axes, arises the most appropriate form for each transaction. It means that there is a relationship between the nature of the transaction and the right governance structure adopted to pre-shape the risk assignation. Then:

B.3.1.1 Hypothesis 1

The higher the uncertainty and asset specificity of the project, the higher the risk allocated to the private party through the governance structure of the partnership.

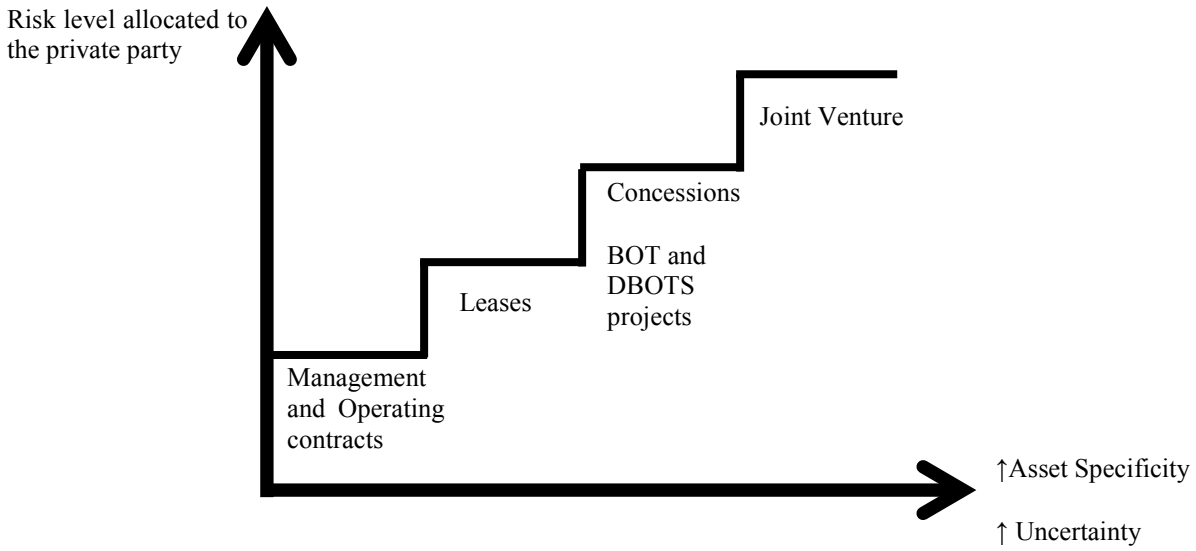

Figure B-2: Relationship Between Transaction Attributes, Risk Level and PPP Forms. Source: Authors' elaboration based on Refs. [6] and [8].

B.3.2 Resources and Capabilities as a Risk Allocation Criterion

Once the governance structure is adopted, the possible risks that the parties may suffer during the process are multiple. The proper allocation of these risks through contract conditions is critical to the success. This circumstance requires determining which party should assume the risks once there is a specific form of government that regulates it.

Some authors use the Principal-Agent Theory (PAT) to analyze the risk allocation in PPP [39], [18]. In the PAT, there is a principal (government) that wants to contract an agent (private company), in order to execute an economic activity through PPP form. There is an asymmetry of information problem, since one of the partners (the agent) has more information than the principal about their work and execution skills. Thus, asymmetry of information generates moral hazard and adverse selection problems, which leads to higher risk in the implementation of the project. The problem is represented in a classical way as an optimization problem seeking to maximize the principal's utility subject to agent's incentive and participation constraints [22].

Concerning the agent's incentive constraint, its effort is unobservable and has its own objectives that differ from those of the principal. To diminish the problem, the principal should give the agent incentives to execute, in order to obtain a certain level of performance. For instance, to mitigate a Design and Build PPP, the principal (government) can allow the agent (private side) to exploit the use of what it designs and builds (e.g., build a highway and get money from the tolls) [40]. These incentives facilitate the risk allocation to the agent, since he assumes a risk that could derive in less profit. Thus, "the risk should be allocated to the agent to the extent it does manage the risk" [6].

To reach a globally efficient solution, each party should allocate risk according to their respective capabilities to deal with it; the key question is knowing which party is most capable of managing which risks, to include them in their maximization process. The Resource Based View (RBW) complements PAT, going one-step further allocating risk between both sides. This framework is traditionally used to explain the heterogeneity among firms' results in an industry according to the competitive advantage they can create through their resources and capabilities [41], [19].

Furthermore, the RBW explains private cooperation due to the lack of tangible and intangible public resources, as well as claims for the singularity of both parties, in order to analyze their resources and capabilities, thereby determining which one is better to manage each risk. This implies that the resources and capacities that each party possesses and contributes, should be used to assign responsibility for the risks that originate from their inefficient use of their resources and their capacity to deal with risk. At the same time, risks that do not depend on either party can be allocated in proportion to their resources and capabilities, which requires an analysis of both, together with the governance structure adopted.

Concerning the principal or public side, its institutions shape "the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction" [20]. Consequently, an "institutional framework" is "the set of fundamental political, social, and legal ground rules that establishes the basis for production, exchange, and distribution" [42]. These institutional frameworks interact with private organizations. Thus, markets can be considered as institutional constructs, since the contexts generated by governments set the framework in which transactions are regulated. This approach points out that an adequate institutional framework favors economic functioning, since investors rely on secure property rights, facilitate investment in human and physical capital, government power is limited and restricted by an independent judiciary, and contracts are effectively, supporting private economic transactions [43].

Following the institutional basic attributions, the sources of risk identified in PPPs by other authors – as a favorable legal framework (unforeseen legislative changes, changes in the regulation of taxes and in the regulation of the sector) [7], [44], stable macroeconomic conditions related to the volatility of inflation and type of interest [45], a developed financial market [46], guarantees provided by the government in the process of collaboration, political stability [7], [47], expropriation or nationalization of assets [16], as well as social acceptance for the correct communication of the project [48] – should be largely assumed by the public party, both for their control over the circumstances and their ability to manage them, given the greatest resources of the public party.

On the other hand, RBV is applied to the resources and capabilities of the firms deployed in the environment. The firm's resources include physical capital resources, human capital resources and organizational capital

resources [19]. As Das and Teng point out [49], they can be decomposed into other specific ones. Thus, physical capital resources include the physical infrastructure and technology, access to raw materials and geographical location. Human capital resources include the contracted people and their training and experience, including managerial resources. In addition, the organization's capital resources include the formal structure of the company, formal and informal planning, controlling and coordinating systems, as well as the relations within the organization and between the organization and the environment, shaped by the institutions and exogenous circumstances.

In this case, the private sector, prior to the constitution of the PPP, takes responsibility for the sources of risk analyzed by other authors associated with the availability of material and labor [46], its financing capacity [50], [48], design deficiencies [51], [44], construction costs [52], [15], implementation delays [44], [53], low productivity of designated operations [7], [47] or maintenance that is more expensive than expected [52], [16].

Thus, as we can see in Figure B-3, the public and private entities have their resources, capacities and competences well defined before the existence of the PPP, as they constitute extreme organizational forms. After PPP creation with a specific governance structure, two different mechanisms assign the risks concerned to each other:

1) **Governance Transformation:** risks reallocated depending on the PPP adopted, *inter alia*, because of transaction's nature and analysis of resources and capabilities.
2) **Natural Transformation:** risks shared because of PPP creation.

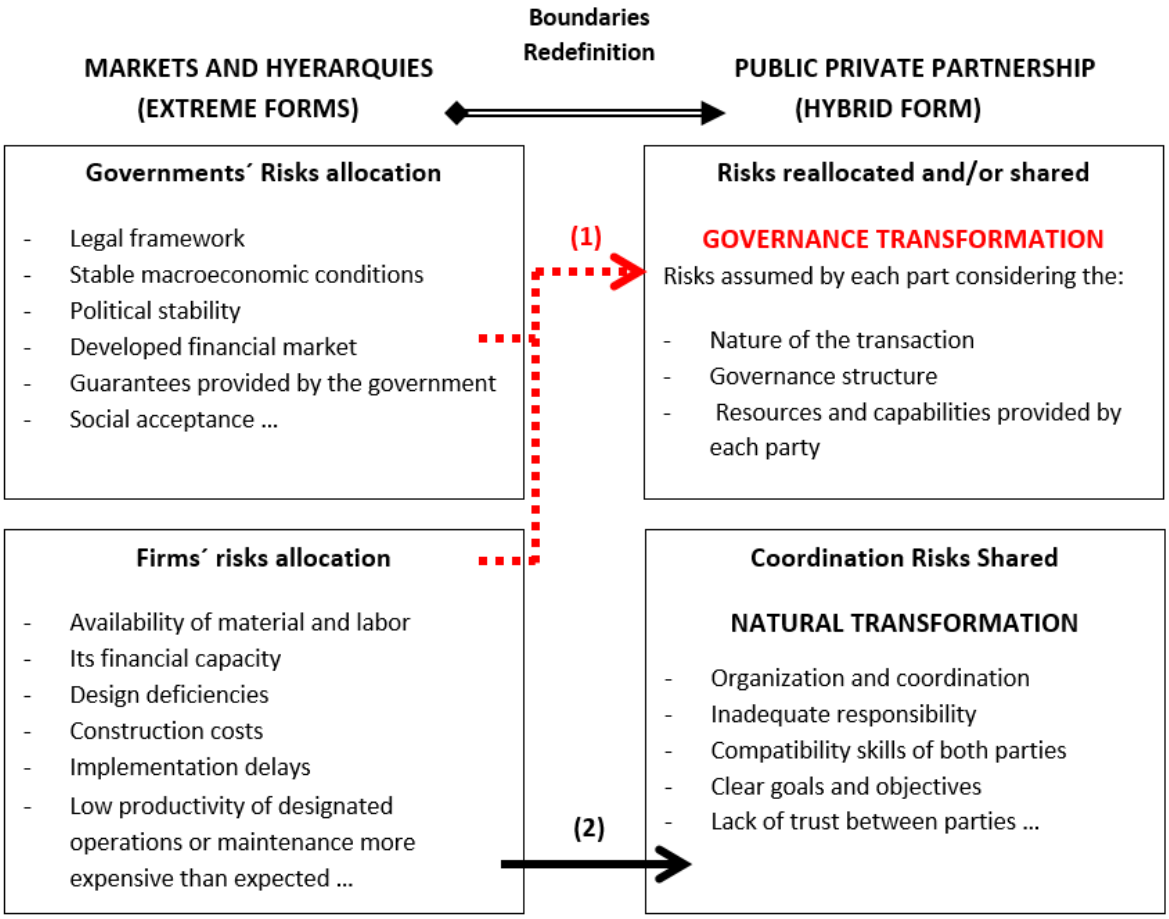

Figure B-3: Risk Allocation Transformation in PPP Forms. Source: Authors' elaboration based on a list of risks in Ref.[7].

On one hand, there is a set of risks inherent to the PPP cooperation – whatever the specific governance structure adopted – which drives the parties to assume the coordination of risks together as a **Natural Transformation**. Thus, empirical PPP reveals that the organization and coordination risk between entities [48], [16], the inadequate responsibility of each one [7], compatibility skills of both parties [7], clear goals and objectives [47], [54], or the lack of trust from each party [55], [54] should be shared.

On the other hand, the PPP form or governance mechanism determines, to a large degree, the risks managed by each party. In this case, the **Governance Transformation** arises, in which the responsibility of some risks is assigned to each party according to the PPP structure adopted. For instance, the commercial or demand risk is usually assumed by the public party in-service and Management Contracts, while in the Lease agreements they are shared, and concessions and BOTs transfer it to the private party [40]. Alternatively, another example is the Joint Venture, which transfers in advance most of risks to both parties sharing the ownership [6]. Thus, the governance structure already allocates some risks in advance.

Finally, there are exogenous factors that affect the achievement of the project. These are not dependent on any party. The allocation of these risks may depend on the capacity of each party to manage them. It is suggested that they be shared and constitute the less controllable events such as force majeure [7], [16], geotechnical conditions [7], or the environmental [45], [56], [16], [54].

Thus, once the firm's disposal is focused on the ability of the firm to maintain a combination of resources that cannot be possessed or built up in a similar manner by others (the public side), the responsibility should fall on the private party who has the rights of ownership and use over them (e.g., extra expenses arising because of internal circumstances). On the other hand, risks related to the resources or capabilities related to the public sector (e.g., changes in the legal context) should fall on its party. Thus:

B.3.1.2 Hypothesis 2

The public and private parties should allocate project risks according to their natural resources and capabilities to manage it.

B.4 METHODS, DATA, VARIABLES AND RESULTS

To check Hypotheses 1 and 2 we use two different methods.

B.4.1 Governance Structure as Risk Allocation (H1)

B.4.1.1 Method and Data

To prove the H1, the relationship between the characteristics of the transaction and the governance mechanism, we used the World Bank Project Database of PPPs (WBPD) [8]. The database has data on over 6,400 infrastructure projects in 139 low and middle-income countries, collected from 1992 to 2016, in sectors as energy, information and communication technology, transport and water and sewerage sectors. It also includes the governance structure of each PPP project (management and operating contracts; lease; concessions, BOTs, DBOTs; and joint ventures) as well as its characteristics such as their total investment, physical assets amount and contract duration, among others.

In order to analyze significant differences in the values of PPP characteristics by type, descriptive statistics and non-parametric tests are performed, since the quantitative variables do not meet normal (Kolmogorow-Smirnov and Shapiro-Wilk test) and heteroscedasticity (Levene test of equal variances) assumptions. Therefore, we analyze the significant differences between the different groups of PPPs in the medians of the project's characteristics through Wilcoxon rank-sum test. In parallel, we run a Two-sample T-test with unequal variances for the same groups of to test their means.

B.4.1.2 Variables

As the previous section explains, the nature of the transaction has two dimensions: the asset specificity and the uncertainty of the activity.

The **Asset Specificity** refers to investments in assets that are dedicated to a particular supplier and whose redeployment entails considerable switching costs [33]. There are several sources of specificity, among which are the human resources dedicated to the contracted activity, as well as the physical assets used for the economic activity projected [22], [23]. In the PPPs study, it is important to decompose both, since there are certain projects whose nature does not generate investments in physical assets or are residual (e.g., management contracts and services). The Asset Specificity is usually proxied by the total amount necessary for the project [57], [58], [59] and total physical assets [60]. Thus, two variables are used to proxy this characteristic: the **Total Investment** as the sum of investment in millions of US dollars, and the **Physical Assets** investments recorded in millions of US dollars in either the year of financial closure or year of investment.

On the other hand, **Uncertainty** refers to unexpected events that may occur during the transaction. There are several sources of uncertainty such as the market, technological and behavioral conditions of agents [61]. At the same time, these changes can occur largely when the service delivery periods are longer, since the probability of the environment changing is greater. It means that uncertainty grows with the distance of the relevant horizon [28]. This circumstance is especially important in the case of PPPs because of their long duration [6]. It can affect the price of the inputs, technology, the particular relationship between the two sides, and the costs associated with writing, monitoring and enforcing the contracts [58]. Because of these reasons, the uncertainty is applied in previous studies through the contract length [38], [30]. Thus, the PPP **Duration** collects the length of time measured in years that the terms of a contract agreement are in place, in order to calculate the uncertainty.

B.4.1.3 Results

For the purpose of H1 verification, we selected all the PPPs with the necessary variables available, as well as the types of PPPs governance structures. Thus, after the screening process and excluding the missing data, the sample contains 1.555 PPPs from every sector and most of the countries of the total database.

Table B-1 reports the descriptive statistics disaggregated by the governance structure:

- Management and operating contracts;
- Leases;
- Concessions;
- BOTs and DBOs projects; and
- Joint Ventures.

Each one can be decomposed into subtypes of PPPs ordered from the lowest to the highest transference of the risk towards the private party [6].

In this way, we observed that the uncertainty proxied by the duration of the PPPs increases gradually from the Management and Operating Contracts (Rental= 3.17 years; Management Contract= 13.79 years); Leases (24.14 years); Concessions, BOT and DBOs projects (BOT = 27.69; BROT = 29.06). With regard to Joint Ventures, the average duration of temporary contracts amounts to an average of 24.30 years, although it is a figure characterized by having a permanent duration unlike the other structures of governance, which have a fixed duration.

With regard to the asset specificity, proxied by the evolution of physical assets and total investment, there is also a positive correlation between their size and the governance structure used to manage them. Thus, it can

be seen how the total investment increases from Management and Operating Contracts (Rental = 13.79, Management Contract = 94.72), Lease Contract (183.88); Concessions, BOT and DBOs projects (BOT = 344.58; BROT = 320.26) and Joint Ventures (Temporary = 271.51; Permanent = 408.96). Similarly happen with the physical assets.

Thus, there is a correspondence between the variables that approximate the uncertainty and the specificity of the investment, with respect to the governance structure that is adapted to these characteristics, as formulated in Hypothesis 1.

B.4.2 Resource and Capabilities as Risk Allocation (H2)

B.4.2.1 Method and Data

To analyze H2 we focused on articles that mainly deal with the risk allocation between the parties, in order to describe qualitatively their suitability to the theoretical framework proposed. Following Osei-Kyei and Chan's method [13], 17 articles from 2002 until 2015 were found in academic search engines (see Table B-2). The works were published in the International Journal of Project Management (6), Construction Management and Economics (3), International Journal of Public Sector Management (1), International Journal of Public Sector Management (1), Australian Journal of Public Administration (1), Journal of Financial Management of Property and Construction (1), Research in Transportation Economics (1), Journal of Management Engineering (1), Journal of Construction Engineering and Management (1) and International Journal of Strategic Property (1).

As Table B-2 shows, the articles focus on experiences in different countries such as UK, Australia, Ireland, India, China, Portugal, Nigeria, Greece, Taiwan, Singapore and Indonesia or even cities like Hong-Kong. Most of the studies are practical, although some theoretical ones are included. The methodology they applied includes surveys and case studies from different sectors.

B.4.2.2 Variables

The articles use a different number and type of risks such as Thomas *et al.* (2003): 8 risks [52], Li *et al.* (2005): 46 risks [7], Ibrahim *et al.* (2006): 61 risks [55], Roumboutsos and Anagnostopoulos (2008): 36 risks [45], Ke *et al.* (2010): 37 risks [56], Chung *et al.* (2010): 10 risks [48], Chan *et al.* (2010): 34 risks [47], Marques and Berg (2011): 20 risks [16], Xu *et al.* (2011): 11 risks [46], Chou *et al.* (2012):37 risks [9], Hwang *et al.* (2013): 42 risks [54], or Chou and Pramudawardhani (2015): 69 risks [9].

Among the studies, an extended and understandable framework is the one that allows them to classify risks into macro, meso and micro risks, as found in Li *et al*., 2005 [7]; Bing *et al*., 2005 [62]; Chan *et al*., 2010 [47]; Hwang *et al*., 2013 [54]; De Clerk *et al*., 2012 [63]. Thus, Li *et al*. (2005) classify risks in three levels: exogenous risks occurring outside the project (macro level), arising within the boundaries of the project (meso level) and due to inherent differences between the public and private entity (micro level) [7].

The use of this structure is convenient because of two advantages. Firstly, this classification allows evaluation of the degree of control that each of the parties naturally has, to put it in relation with the TCT and the RBV analyzed. Thus, the variables analyzed are MACRO-Public, generally related to the natural resources and capabilities linked to the public party; MESO-Private, generally related to the ones related to the private party; and MICRO-Shared, generally related to both parties. The second advantage is that the structure allows the use of prior existing studies, with a more detailed disaggregation of the risks, to group them into any of these three categories.

Table B-1: Descriptive Statistics of PPP by Governance Structure, Wilcoxon and T-Tests. Source: Authors' elaboration based on World Bank Database of PPPs [8].

Governance Structure	Subtype of PPP	Obvs.	Transaction characteristics	Mean	Median	Std. Dev.	Min.	Max.	Wilcoxon Test	T Statistic (Welch)
(1) Management and operating contracts	Rental	17	Duration	3.17	3	0.95	2	5		
			Physical Assets	13.79	11.8	8.57	2	34		
			Total Investment	13.79	11.8	8.57	2	34		
	Management contract	11	Duration	16.54	15	12.76	3	50		
			Physical Assets	77.36	6	217.16	0	730		
			Total Investment	94.72	15.95	215.66	0.8	730		
									Group (2) vs. (1)	
(2) Leases	Lease contract	35	Duration	24.14	25	13.47	10	75	5.411***	5.355***
			Physical Assets	56.41	6	103.50	0	400	-0.733	0.607
			Total Investment	183.88	25.5	504.55	0.5	2543	1.621*	1.568

Governance Structure	Subtype of PPP	Obvs.	Transaction characteristics	Mean	Median	Std. Dev.	Min.	Max.	Wilcoxon Test	T Statistic (Welch)
									Group (3) vs. (2)	
(3) Concessions BOT projects, DBOTs	Build, operate and transfer	744	Duration	27.69	26	10.54		99		
			Physical Assets	340.05	110	854.66		14800		
			Total Investment	344.58	112.5	855.71		14800		
	Build, rehabilitate, operate and transfer	663	Duration	29.06	30	13.39	4	95	3.585***	1.826**
			Physical Assets	221.90	77	458.89	0	4100	5.464***	8.918***
			Total Investment	320.26	110	760.35	0.2	10508	3.890***	1.696*
									Group (4) vs. (4.1)	
(4) Joint ventures and divestitures	(4.1) Partial divestiture (Temporary)	76	Duration	24.30	20	8.17	15	55	4.104***	4.079***
			Physical Assets	141.02	47	220.78	0	1106	4.179***	5.079***
			Total Investment	271.51	130	389.85	10	2818	-1.916*	0.981
	(4.2) Partial divestiture (Permanent)	9	Duration	∞	∞	–	–	–		
			Physical Assets	74	41.95	107.82	0	278		

Governance Structure	Subtype of PPP	Obvs.	Transaction characteristics	Mean	Median	Std. Dev.	Min.	Max.	Wilcoxon Test	T Statistic (Welch)
			Total Investment	408.96	114	433.93	0	1150		
	Total Obvs.	1555								

***Significant at 1%, **Significant at 5%, *Significant at 10%.

Table B-2: Academic Articles Suggesting Risk Allocation. The articles are ordered by year of publication. Source: Author.

Authors	Publication	Countries	Sector	Method	Authors	Publication	Countries	Sector	Method
Thomas *et al.* (2003)	Construction Management and Economics	India	BOT road projects	Survey (62)	Ke *et al.* (2010)	International Journal of Project Management	China	Several	Survey (93)
Hurst and Reeves (2004)	International Journal of Public Sector Management	Ireland	Design, build, operate and finance the five schools over a 25-year period	Case Study	Chung *et al.* (2010)	Research in Transportation Economics	Australia	Tollroad projects	Unstructured in-depth interviews
Hodge (2004)	Australian Journal of Public Administration	Australia	Infrastructure project	Case Study	Chan *et al.* (2010)	Journal of Management in Engineering	China	Several	Survey (105)
Li *et al.* (2005)	International Journal of Project Management	UK	Construction projects from several sectors	Survey (53)	Marques and Berg (2011)	Journal of Construction Engineering and Management	Portugal	Water infrastructure projects	Case study
Ibrahim *et al.* (2006)	Journal of Financial Management of Property and Construction	Nigeria	Infrastructure	Survey (36)	Xu *et al.* (2011)	International Journal of Strategic Property Management	China	Water Infrastructure project	Case study

Authors	Publication	Countries	Sector	Method	Authors	Publication	Countries	Sector	Method
Shen *et al.* (2006)	International Journal of Project Management	Hong Kong	Hong Kong Disneyland (KDLD)	Case study	Chou *et al.* (2012)	Transport Policy	Taiwan	High Speed Rail and general infrastructure projects	Survey (64)
Jin and Doloi (2008)	Construction Management and Economics	Australia	Infrastructure	Survey (44)	Hwang *et al.* (2013)	International Journal of Project Management	Singapore	Several	Survey (48)
Abednego and Ogunlana (2006)	International Journal of Project Management	Indonesia	Traffic infrastructure	Case Study	Chou and Pramudawardhani (2015)	International Journal of Project Management	Taiwan, Singapore, China, UK, Indonesia	Several	Survey (59)
Roumboutsos and Anagnostopoulos (2008)	Construction Management and Economics	Greece	Construction projects	Survey (27)					

B.4.2.3 Results

Among the 17 articles analyzed most of them agree that MACRO-Public risks such as political (Thomas *et al*., 2003 [52]; Li *et al*., 2005 [7]; Ibrahim *et al*., 2006 [55]; Chung *et al*., 2010 [48]; Chan *et al*., 2010 [47]; Xu *et al*., 2011 [46]), legal changes (Hurst and Reeves, 2004 [51]; Shen *et al*., 2006 [44]; Abednego and Ogunlana, 2006 [50]; Roumboutsos and Anagnostopoulos, 2008 [45]; Chan *et al*., 2010 [47]; Marques and Berg, 2011 [16]; Chou *et al*., 2012 [53]; Chou and Pramudawardhani, 2015 [9]), natural (Roumboutsos and Anagnostopoulos, 2008 [45]), expropriation or nationalization (Ke *et al*., 2010 [56]; Chung *et al*., 2010 [48]), social risks (Chan *et al*., 2010 [47]) or site availability (Li *et al*., 2005 [7]; Ibrahim *et al*., 2006 [55]) should be allocated in the public party.

On the other hand, MESO-Private risks related to the project level are usually allocated to the private party (Ke *et al*., 2010 [56]) like construction (Thomas *et al*., 2003 [52]; Hurst and Reeves, 2004 [51]; Hodge, 2004 [15]; Shen *et al*., 2006 [44]; Abednego and Ogunlana, 2006 [50]; Roumboutsos and Anagnostopoulos, 2008 [45]; Chou and Pramudawardhani, 2015 [9]), cost overrun (Thomas *et al*., 2003 [52]; Shen *et al*., 2006 [44]; Chou *et al*., 2012 [53]), finance (Roumboutsos and Anagnostopoulos, 2008 [45]; Chung *et al*., 2010 [48]; Xu *et al*., 2011 [46]; Chou and Pramudawardhani, 2015 [9]) or delay in supply (Chou *et al*., 2012 [53]; Chou and Pramudawardhani, 2015 [9]).

Finally, MICRO-Shared risks such as planning (Hurst and Reeves, 2004 [51]; Marques and Berg, 2011 [16]), relationship between the parties (Li *et al*., 2005 [7]; Ibrahim *et al*., 2006 [55] [7]), the inadequate responsibility of them (Li *et al*., 2005 [7]), compatibility skills of both parties (Li *et al*., 2005 [7]), clear goals and objectives (Chan *et al*., 2010 [47]; Hwang *et al*., 2013 [54]) or the lack of trust from each party (Ibrahim *et al*., 2006 [55]; Hwang *et al*., 2013 [54]) should be shared.

However, these results have particularities. For example, some academic works suggest that legislative changes, instead of being assigned to the public, should be assumed by the private party (Hurst and Reeves, 2004 [51]), or that operation risk should be assumed by the public party (Hodge, 2004 [15]). Another example is the risk of market demand, which certain academic papers suggest should be assigned to the public (Hurst and Reeves, 2004 [51]), private (Chung *et al*., 2010 [48]) or shared (Xu *et al*., 2011 [46]).

According to some authors, the allocation of certain risks depends on each particular case (Li *et al*., 2005; [7] Hwang *et al*., 2013 [54]). This reasoning, as set out in the theoretical section, should be done by taking into account the nature of the transaction, the concrete governance mechanism of the PPP that pre-allocates the risks and influences their importance and the ability of each party to manage other risks not assigned.

Despite the importance of these issues, the articles that analyze risk allocation do not mention (with exceptions such as the work of Thomas *et al.* [52]) the kind of PPP mechanism, resources and capabilities of each project.

B.5 CONCLUSIONS AND MANAGERIAL IMPLICATIONS

Our paper deals with the governance of major public projects, focusing on the allocation of risks in public private partnerships. We ground our hypotheses on generally accepted literature in economics and management, testing them by means of an empirical investigation as well as through a review of empirical papers.

The analysis carried out in this paper recommends addressing the peculiarities of each PPP according to its degree of uncertainty and specificity, as well as the resources and capacities of both partners, in order to determine the governance structure and clauses that best allocate the risks to each party. It means that there should be an alignment between project characteristics, resources and capabilities and governance structure

in order to allocate risks efficiently. These recommendations are complementary and compatible with international papers and guidelines on PPPs, shedding light on some of the results among them that do not show consensus and disentangling the sources of risk according to the nature of the projects.

The first implication that arises from this work is that PPP risk allocation should focus on the nature of the transaction or PPP activity. The particularities of the project guide the best governance structure that fits with the objective of public party. The higher the uncertainty and specificity of the assets of the transaction, the higher the transference of the risk from the public party to the private one through the governance structure should be.

Thus, the theory predicts that activities with low transaction costs are properly executed through **Service and Management Contracts**. In this case, the risk transferred to the private sector is scarce [40]. Precisely, this type of structure is used for activities such as toll collection, installation, maintenance and reading of water consumption, garbage collection, as well as vehicle or computer maintenance [6], [64], which are economic activities characterized by a lower degree of specificity than other PPP forms.

Also, the practical experiences show that this kind of contract usually has shorter duration, relates to a task of relatively lower complexity, requires fewer resources and capabilities to perform it and carries lower uncertainty during the provision of the service. Thus, service and management contracts usually last between 1 and 5 years [64]. According to the World Bank Database register, examples of this kind of contract can be found in the water sector concerning treatment plants (e.g., Zhuzhou County Wastewater Treatment Plant in China, signed in 2011 for 5 years; Société des Eaux de Saint Marc in Haití, signed in 2009 for 15 years) or electricity distribution (e.g., Spanco Nagpur Discom Limited in India, signed in 2011 for 9 years).

When the nature of the transaction entails greater specificity and uncertainty, the public or principal party will try to transfer greater risk to the private party or agent. This will be performed through a contractual form that frees the public party to a greater extent from the risk. Then, the government can use **Lease** contracts to make the private operator takes on the operational risk [40]. This structure is used in water, public transport and sanitation sectors as well as energy distribution [6]. We can also find examples recorded by the World Bank Database. For instance, a Lease agreement is used in the transport sector to manage terminal ports (e.g., Lazaro Cardenas Multi-purpose Terminal II project in Mexico, signed in 1995 for 15 years); runway and terminals (e.g., Batumi International Airport project in Georgia, signed in 2007 for 20 years; or Antalya Havalimani Airport in Turkey, signed in 2007 for 17 years); as well as water utility to manage sewerage (e.g., Kirov Water Utility in Russia, signed in 2003 for 15 years; or Senegalaise des Eaux in Senegal, signed in 1996 for 10 years) [8]. As we can see, with these examples and as the theory predicts, the nature of the transactions becomes more complex and involves longer duration, with more risk arising because of the uncertainty. In fact, lease agreements extend for a longer period of 5 to 15 years [6].

Governments can perform even more complex transactions through management and service contracts or leasing. This is the case of **Concessions** to build a new asset or to modernize, upgrade or expand an infrastructure [6]. In these cases, the incentive to transfer the risk from the public to the private party will be greater [40]. The government will try to reduce coordination costs by transferring more phases of the transaction chain to the private sector and may choose different contractual forms. For example, it can commission not only the construction but also its exploitation and later transfer to the public party (**Build Operate Transfer**, BOT); and even require that the private party realizes the design before its construction (**Design Build Operate Transfer**, DBOT). The advantage of this formula is that it allows control over the life cycle of the cost by providing incentives to the private entity to execute it correctly [6].

The activities usually carried out with this formula are of greater complexity and duration, usually lasting between 20 and 30 years [64]. This contractual form usually includes wastewater treatment or mass transit systems [6]. The World Bank Database shows examples of BOT in electricity generation (Cambodia Pte Ltd. Power Plant in Cambodia, signed in 1997 for 19 years), transportation for terminal ports (Shanghai

Container Terminals in China, signed in 1993 for 50 years), highway construction (Foshan Guangzhou-Sanshui Expressway in China, signed in 1993 for 35 years) and natural gas distribution (Laiyang Xinao Gas Company Limited in China, signed in 2002 for 30 years) [8].

In extreme cases, where the transaction is particularly costly given its specificity and uncertainty, two problems appear for both sides of the collaboration. On one hand, the mechanisms of governance by which the risk is transferred to the private party may be excessive, as well as it being difficult to determine the counterparties for which it assumes such risk. On the other hand, the public or contracting party may have greater difficulty in controlling the compliance and good performance of the activity given its complexity.

It is in these cases that sharing the property structure between both parties can mitigate this problem, so as not to limit the project or even cancel it. The form of a **Joint Venture** facilitates the control of public versus private and, at the same time, forces the public to be responsible for the risk that would be suffered by the private party [39]. However, Joint Ventures are not a magic recipe, since some of the problems persist, as is the case of the principal-agent, and others arise as a consequence of their organizational form, such as their concrete ownership design, among others [40]. According to the World Bank, examples of these transactions can be found in the information and communication sector (PT Indonesian Satellite Corporation Indosat from 1994 until today) or bridges and highway (e.g., Anhui Expressway Company Limited in China, from 1996 until today), among others [8].

The second managerial implication is that the risks inherent to the transaction must be identified, as well as the details of the capacities and resources of the public and private parties, in order to determine which party is best able to manage each particular risk. Each party can do this through a detailed internal analysis, as well as by reviewing the history of past satisfactory experiences managing risks. Similarly, expert opinions (Delphi analysis) may provide recommendations concerning unassigned risks, as well as serve to verify those that would be assigned in previous works.

The resources and capacities of both sides not only allow risks to be allocated according to the party with the greatest capacity to assume them but can also guide the chosen governance mechanism. Thus, it is possible to establish a governance structure that predetermines in advance an assignment that meets most of the project purposes. For example, in a case where it is determined that the transaction presents little uncertainty and specificity, such as garbage collection, a maintenance and service contract may be appropriate. In the case of highway infrastructure development, it is possible to transfer a greater risk by both designing and exploiting the product, thus sharing the results through a Design Build Operate form. Alternatively, in extreme cases where there are large transaction costs, such as the development of commercial aircraft, a Joint Venture can be created to link ownership and increase the degree of control over operations.

After an appropriate PPP form is identified and resources and capabilities analyzed, contracts can reflect the unassigned allocation of risks that are not defined *per se* by the structure in which the parties operate. This involves drafting clauses in the contract that accurately determine the risks identified and the parties that will carry them out.

Although there is a need for a comprehensive analysis of each party's resources and capabilities, there are several natural risk attributions, which can serve as a guide for risk allocation. While the risks associated with the environment of the operation and whose control depends on the government, would fall on the public party; the risks associated with the day-to-day management of the resources contributed by this party usually fall on the private side. Likewise, the risks that arise from the fact of coordinating between the two should be shared. However, there is no consensus about some specific risks. This may be because some of the risks must be reallocated according to the characteristics of the project, which requires an analysis of their nature as well as detailed resources and capacities on the part of both parties in order to transfer well.

This lack of consensus has first-order implications for management. Given that a certain risk assignment is given by the concrete PPP in which the project is articulated, which in turn influences the part that must be managed by the others, the academic works that analyze the importance of the critical factors and on which party they must fall, should focus on considering these circumstances.

For instance, the natural allocation of macro, micro and meso risks can be altered by specific situations, for example when the public sector is a small country, with even less capacity to manage certain risks than private enterprise. Or, there might be an international infrastructure company whose ability to diversify macroeconomic risks is greater than some underdeveloped or small governments. This would explain the apparent atypical behavior of PPPs that economic theory predicts.

B.6 REFERENCES

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14. Abstract

The main goals of this report are to provide guidance on where Public Private Partnerships (PPP) have been successfully used by nations to provide or support military capabilities, to highlight good practice to be followed and to discuss pitfalls to be avoided.

All of these goals have been achieved, however one element of the original proposal, to report on specific national constraints on the use of PPP, proved impracticable to deliver within this work package as it was discovered that each nation's constraints are very individual and complex. It was therefore judged that further work on this aspect would be best conducted nationally, rather than via research under the umbrella of the NATO Science and Technology Organization.

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