



Available online at [www.sciencedirect.com](http://www.sciencedirect.com)

**ScienceDirect**

Procedia Manufacturing 19 (2018) 127–134

**Procedia**  
MANUFACTURING

[www.elsevier.com/locate/procedia](http://www.elsevier.com/locate/procedia)

6th International Conference on Through-life Engineering Services, TESConf 2017, 7-8  
November 2017, Bremen, Germany

## Identifying information asymmetry challenges in the defence sector

Mario Sceral<sup>a\*</sup>, John Ahmet Erkoyuncu<sup>a</sup>, Essam Shehab<sup>a</sup>

<sup>a</sup>*Manufacturing Department, Building 30, Cranfield MK43 0AL, UK*

---

### Abstract

Nowadays austerity policy and reduced funding promote the Defence Sector (DS) interested in improving interactions across the supply network to achieve more outcomes with less expense. The quality of the information link plays a key role in the supply chain. The information is often lost causing costs increase. Information Asymmetry (IA) exists when two or more parties in a contract/project have different types or amounts of information, and choose not to share or fail to understand information that is shared. This paper aims to outline some of the challenges faced within the DS as a result of the existence of IA. This is the first step towards improving the management of IA and has been supported by a literature review and through semi-structured interviews with subject matter experts. Therefore, the conclusions in this paper can be used for further developments in this area of study.

© 2018 The Authors. Published by Elsevier B.V.

Peer-review under responsibility of the scientific committee of the 6th International Conference on Through-life Engineering Services.

*Keywords:* Information Asymmetry; Information Sharing; Defence Information; Information Management

---

---

\* Corresponding author.

*E-mail address:* {mario.sceral}@cranfield.ac.uk

## 1. Introduction

Interactions between defence actors are often based on the exchange of information. In this field the, quality, quantity and number of different types of information are key factors in promoting healthy interactions. The management of information often has a direct impact on the increase/decrease of costs associated with the acquisition or maintenance of defence capability. In many cases, organizations have to bear extra cost if there is a lack of information.

The Information Asymmetry (IA) is precisely defined as a situation in which respective parties own different amounts and types of information over time about a project or contract. The first definition of IA was given in 1970 as “Information asymmetry models assume that at least one party to a transaction has relevant information, whereas the other(s) do not” (1). Market analysts study the dynamics of relationships between buyers and suppliers in order to properly understand the basis for robust and valuable partnerships (2). In an ideal information sharing situation, buyer(s) and supplier(s) share the same type and amount of information while bidding or delivering a project. Nevertheless, this ideal state is often not the case. In such a situation, some agents involved in for example a trade possess information that other agents involved in the same trade do not have access to (1). Usually, these asymmetries arise either as a consequence of confidentiality on useful insights or from the deliberate action of sharing misleading or insufficient amount of information (3). In the defence sector (DS) a particularly common issue giving rise to IA are intellectual property/commercial confidentiality related concerns or security considerations.

In supply-chain management, information understanding is a key dimension: purchasers need a lot of information about the current and likely future condition of suppliers that are important to them (4). The Ministry of Defence (MoD) aims to focus and overcome this issue, primarily on the capability of information management where IA is one element. In general terms, the defence sector aims to continuously improve the capability and availability of complex engineering equipment. Capability is the ability to achieve a desired effect in a specific operating environment (5). The MoD’s approach is to (re)build the UK’s defence forces. The whole force concept is about the professional co-ordination of all elements within defence that deliver capability including defence suppliers (4).

The expected benefits of the management of IA results are: improved capability, improved MOD policy, improved recovery time or readiness, improved resilience, reduced defence costs, reduced industry costs, reduced rework, reduced stores, reduced time per maintenance operation and reduced timely delivery of capability

## 2. Methodology

The purpose of this paper is to identify the challenges in IA and a systematic research methodology was followed as illustrated in Figure 1:



Fig 1: Methodology flow

### Understanding the Context

The preliminary stage of this research involved conducting a comprehensive literature review. It has been done using scientific sources such as journal articles, conference papers and books. A database of relevant articles has been developed using Science Direct, Scopus and Google Scholar. The keywords identified up to this point in the research are: information asymmetry, information sharing, industrial relationship and information management. For each keyword a list of articles has been chosen. A list of inclusion and exclusion criteria was set in accordance with (6) which includes:

- 1) The inclusion criteria are: Clear article? Methodology? Date after 1995? In scope?
- 2) The exclusion criteria are: English language article? Information Asymmetry? Before 1995?

For each criterion it has been given a fixed score 0, 0.5 or 1:0 if does not fit the criteria, 0,5 if fit the criteria to 50%, 1 if fit the criteria to 100%. All the scores are summed; if the total is less than 3, the article is rejected for detailed literature review. The score was assigned after reading the abstract, the introduction and the conclusion sections. Overall, it is observed that there is a lack of information asymmetry knowledge that has been studied in relation to the defence sector.

- Current practices identification

This part of the work requires an overview of the defence sector that can be merged with the LR to identify and highlight the research gaps in IA. The authors have interviewed personnel from within the defence sector to obtain an overview of current practices. The purposes of the interviews were:

1. Understand the role that IA plays within a defence context. During this study, four unstructured interviews were done in order to understand the current practice with respect to the management of IA.
2. Identify the main challenges for IA in the defence field

Four different stakeholders were interviewed:

- 1) Commander (Cdr.) of Royal Navy, 19 years of experience
- 2) Analyst Manager of DSTL, 4 years of experience
- 3) Military Advisor of DSTL, 17 years of experience
- 4) Naval Architect in DSTL, 21 years of experience

- Challenge

As a result of this work, different challenges have been determined below for the IA subject in the defence field:

- How to identify and quantify the IA situation
- How to identify and quantify Uncertainty

### 3. Literature Review

Four different definitions have been identified from literature for introducing the concept of Information Asymmetry:

1. “Information asymmetry models assume that at least one party to a transaction has relevant information, whereas the other(s) do not” (1)
2. “Information asymmetry occurs when the knowledge of one contracting party is inferior to that of the other party regarding the counterparty's true intentions and planned activities” (7)
3. “The asymmetric information perspective highlights that when the information is imperfect, obtaining information can be costly,” (8)
4. “Differences in information held by parties to a transaction where this information is relevant to determining an efficient contract or a fair price or for monitoring or rewarding performance” (9)

It is understood from these definitions that there are slight variations in terms of the scope considered. A large body of literature addresses the way in which supply chain nodes interact in order to reduce the parties' costs and the overall supply chain cost, in terms of inventories, order, and transportation (10). Information sharing is a typical prerequisite to engage in a deal. Welfare economics theory explains how prices would adjust in a situation of competitive economy. However, when information holdings are asymmetric, prices are distorted and hinder the achievement of optimal resources allocation (11). The effects of information asymmetry are strongly dependent on context and, for this reason, cannot be standardized or easily predicted. Information asymmetry can have a positive impact on performance, trust, satisfaction and commitment, and a negative impact on opportunism (12).

IA is determined by two components (13):

1. The extent to which basic common information exists between participants;
2. The level of coordination or communication among team members.

Information Asymmetry scenarios can be grouped into two main categories (14): ‘Adverse Selection’ and ‘Moral Hazard’. The first case refers to a situation where one party is aware of information that is hidden to the counterparty. However, ‘Adverse Selection’ does not prevent a deal being struck. An example of this is the sale of a used car where the buyer has less information than the seller. The ‘Moral Hazard’ refers to a post agreement information asymmetry. For instance, the insurance company cannot know if the driver is careful enough when he/she drives. However, it is forced to allocate its customer to a specific risk class (15).

Usually, both parties in a deal do not own the same information and they do not have the same amount of information. The general concept is that someone owning information is unlikely to share it, unless he/she can obtain a reasonable profit out of it. Indeed over the last 15 years there is a growing trend for buyers to manage their relationships with suppliers in order to avoid adversarial approaches in favour of more transparent, equity-based and long term, collaborative ways of working (16). Nevertheless, the perfect coordination of a deal is possible even under IA (17). Notably, the situation of IA is not always a negative fact [9] but it is strictly dependent on the context. In order to analyse a situation of IA, it is first required to define the category of the information studied. There are different hypotheses for some methodological factors that affect the nature of the relationships between different actors of a deal as shown in Table 1 (12).

Table 1. Information Asymmetry Division

Categories of IA	Class	Class
Product Type	Goods	Services
Market Type	Industrial	Consumer
Organizational Settings	Intra	Inter
Construction Operationalization	Performance	N Performance
Relationship Duration	Short	Long

In the defence sector participants are not always authorized to share all information with the suppliers and sometimes with internal colleagues, hence there may be cases that causes IA to influence projects. More precisely in the defence field there are intra-organizational IA situation and inter-organizational IA situations. Intra-organizational means a scenario between two different divisions of the MoD, inter-organizational means a scenario between MoD and its Tier one Supplier (ToS).

Traditionally, information sharing was considered negatively. Hence, the buyer(s) and the supplier(s) in a deal displayed competitive behaviour to achieve the desired profit or affordability [8]. This competitive behaviour motivated the parties to hide information. Similar situation happened in the defence field too. Without robust information about costs, schedule and technical performance, and the trade-offs between them, there will be a limited understanding of the optimal investment portfolio in defence capabilities or to select the most productive contractors to deliver those capabilities [7].

#### 4. Defence Sector Perspectives of Information Asymmetry

The Department of Science and Technology Laboratory (DSTL) was visited twelve times in order to interview the personnel listed in the Methodology Chapter. MoD and ToS own different information. It is not common that both of them have the same type and level of information.

Figure 2 presents results from the first information analysis conducted with collaboration of DSTL employees. Through the interviews and the LR different scenarios were defined in a situation of Information Asymmetry:

- MoD/ ToS (blue/red) could be the owner of a part of information:
  1. Right understanding of the information owned
  2. Different understanding of the information owned

- MoD/ ToS has a lack of information (Green)
  1. Part of the gap is known, captured and shareable
  2. Part of the gap is known captured but not shareable
  3. Part of the gap is known but not captured
  4. Part of the gap is unknown information

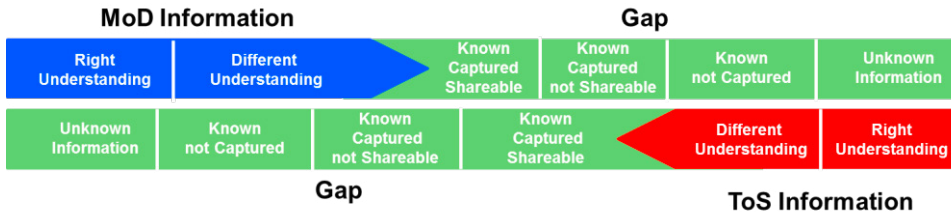


Fig 2: Classifying features in the Information Asymmetry landscape

This graph in Figure 2 does not refer to a specific situation; hence it can happen also that the ToS has more information than the MoD. All the gap strips presented in Figure 2 have boundaries. In order to identify that, the boundary conditions are needed. This condition delimits the field of work that has to be analysed. In order to improve military capability, management of information is needed. Indeed, there are few migrations that could be done between the different boxes shown in Figure 2 example given between the information that MoD understand with different meaning or the information that MoD has and the gap of information. The Capability in the defence sector is traded in part by Defence lines of Development (DLODs) (18). The DLODs provide a mechanism for coordinating the parallel development of different aspects of capability. The different aspects are: training, equipment, personnel, information doctrine, organization, infrastructure and logistics (TEPIDOIL). In all these aspects, information is an important point, hence it is important to analyze all of the DLOD activities. For the ‘Equipment’ it could be the data information to establish a new missile system or a new sensor to pick up some data from the missile. This highlights the need to manage the information for each of the DLODs.

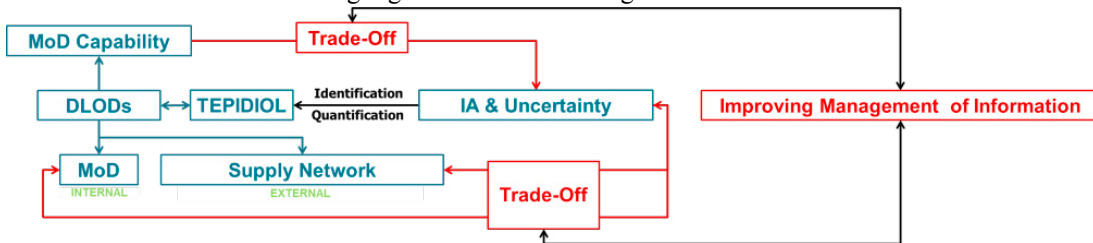


Fig 3: Capability Trade Conceptual Diagram

As is shown in Figure 3, the DLODs are linked with MoD Capability and MoD, or MoD Capability and the supply network. The IA situation could be internal (intra), hence between MoD Capability and MoD; or could be external (inter) between MoD Capability and Supply Network. In the first case, IA situation is between two different parts of the MoD, and does not involve any external parties. In the second case, the IA situation could be externally driven, hence between MoD and one of its Tier one Suppliers.

As an output inferred from the interviews that the authors did, it is important to identify and to quantify the entity of the IA in this aspect. Another important task is to identify and quantify the uncertainty in IA, in order to verify the connection between the IA and the uncertainty. The Uncertainty is a situation in which something is not known (19). Both of them can influence each other. The project started with the scope to find challenges based on the trade-off between IA, MoD and Tier one Supplier relationship, but similar IA challenges within internal environment of MoD will not be excluded if they have significant occurrence in the case studies

### 5. Type 45 case study

The case study is drawn from the Royal Navy and is the Type 45 destroyer case study. The naval shipbuilding sector

is important to the UK economy. Preliminary work by MoD economists estimates that the MoD spent around £1.4bn on shipbuilding and repair in 2014/15, of which approximately 96% was spent with five UK prime-contractors (20). As a case study for IA situation from the Royal Navy, the Type 45 destroyer case is analyzed in this section.

The Type 45 fleet had to replace the Type 42 fleet. Type 42 warship became too old, indeed it was considered vulnerable particularly because of the lack of a self-defence missile system and the maintenance cost for this warship increased dramatically as the warship became increasingly old. The need of a new generation of warship was demonstrated in the Falklands war (21). There were a few projects that aimed to replace the Type 42: the proposed Type 43, the proposed Type 44, the proposed NATO Frigate Replacement for 1990s, the tri-national Common New Generation Frigate (Project Horizon) that became the Franco-Italian Horizon Frigate which eventually contributed to Type 45 Destroyer.

In the program NFR-90, the NATO allies wanted to develop a new generation of frigate warships. USA, Italy, France and United Kingdom took part in this project. Unfortunately, the selection of systems, such as the propulsion or the anti-ship missile, was not common; hence the cost and the complexity of this project increased drastically. In 1989, the United Kingdom left the project, and later Italy and France did the same too (21). Thereafter, the United Kingdom and France decided to build the Anglo-French Future Frigate and Italy joined the project too. However, there was a problem of imbalance in this project. In particular, UK was supposed to build 12 warships, France chose 2 warships and Italy chose 2 warships. As a result, UK left the project after 7 years; it became too difficult to build a viable and equitable partnership in collaborative initiatives (21).

At the end of the 2<sup>nd</sup> millennium, UK chose to build the Type 45, supported by the recent fusion of GEC Marine and British Aerospace, the two English companies that founded the BAE SYSTEM. BAE was integrally the first contractor for destroyer Type 45.

The Type 45, the NFR-90 and the tri-national Common New Generation Frigate were supposed to use the same engine in the WR21. As the new Type 45 project had to base its fundamentals on previous attempts, reorganization and collection of relevant information from all the different actors in previous projects were tricky.

The information across Type 45 was not shared completely between the nations, since the beginning even before the UK thought to build it alone. Therefore, the UK government finally chose to build the destroyer alone.

The first HMS Daring ship was delivered in 2009; in 2010 the HMS Daring lost all power in mid-Atlantic and had to be repaired in Canada.

This case illustrated the importance of IA problem for the whole Royal Navy, where against projected plans/budgets Type 45 has cost more and arrived later than was intended. Due to the relevance of all the reasons explained above, Type 45 was chosen to be the first case study of this project.

## 6. Current practice and challenges identified with IA

Based on the literature reviews and on the interviews, three challenges for the defence sector are highlighted in this section.

*The first challenge* is to improve the capability in managing the trade between the information that MoD and ToS have and the information that is “known, captured, and shareable”. This is an important task as shown in the Figure 4, significant amount of time can be saved through proper management of the relationship between different pieces of information.

The Security Information in whole of the JFC (Joint Force Command), Royal Navy, British Army and Royal Air Force are partially managed using the JSP 440. There is a motivation to manage the information considering their impacts on the Capability. The military policy is to share information that is classified sharable hence provide a profit from this information sharing in terms of Capability improvement. They do not share information if there is a connection between it and its impact on the Capability.

From the interview an example was highlighted within a company that provides furniture for the MoD that would like to change the furniture design. In this case, they have informed one section of the DLODs of this change. Unfortunately this information was not shared across the DLODs; hence this type of information has had an impact on the DLODs. This is a common intra IA situation. This is an example that illustrates all three important aspects at once:

1. The information shared by the Company has not been captured by the MoD. It is important to manage the migration between the information known and the information that is known, sharable but not captured.

2. This information has had an impact to the DLODs, so this information is classified by the military as information that has an impact on the capability
3. The interconnection between the different aspects of the TEPIDFOIL is really important. This has caused the failure in this specific case.

The Figure 4 below shows that there is temporal component associated with IA that is being recognized within the research method and analysis. In this diagram, information is classified as: (1) known sharable and captured, (2) known and not captured and (3) unknown information.

The black line that starts from the origin represents the MoD information, when this line merges with the Supplier line, the green one, there is a perfect information sharing. Information Asymmetry happens when these two lines do not cross. Proper management of the trade between the MoD/ToS information and the information that is known sharable and captured can save significant amount of time throughout the whole process. During this research particular attention is given to information that is known and not captured as it is believed that improving IA management in this part of the IA landscape may result in a capability improvement which is proportionally higher than may be the case when compared with other parts of the IA landscape.

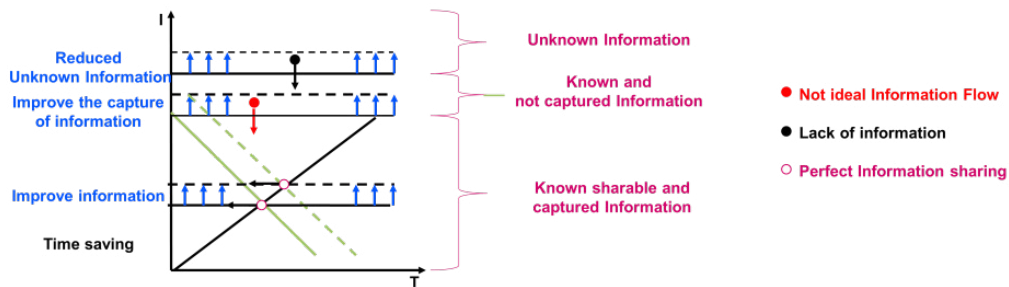


Fig 4: Information Time diagram

The second challenge for the defence field is to focus on managing the trade between the information that MoD and ToS has and the information that is “known, not captured, and shareable”.

An example of not ideal information sharing is presented in red in the Figure 4. There were some issues in the interconnection between the different aspects of the TEPIDFOIL causing impact on the DLODs. This situation has caused many problems in the system and an Information Asymmetry situation happened that affected the Capability. The investment in the Royal Navy Capability decreased when they chose to build the Destroyer Type 45. This type of situation has exerted more challenges on the Royal Navy.

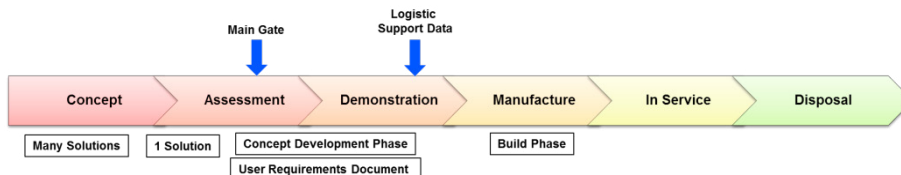


Fig 5: CADMID cycle TYPE45

The third challenge is to find the IA connection with the Type 45 failure. In order to identify the connection, a specific analysis on how a Capability is chosen and developed for MoD has to be conducted. The Platform Team follows a life cycle classification called CADMID (Concept, Assessment, Demonstration, Manufacture, In Service and Disposal) Figure 5. A list of the information asymmetry situations that appear to have taken place in the case of the Type 45 case study at this stage in the research includes:

1. Change in official requirement during an accelerated development process
2. Change in Destroyer max speed requirement during the CADMID process and no analysis was conducted to justify such change in requirement.
3. No mitigation plan for engine systems failure.

As expected by the MOD, the system did not work mainly due to IA situation, particularly an inter IA situation because the project involved external parties.

There was also an intra IA situation regarding this specific case too. Within the MoD there were not found yet reasons or studies that have examined or provided the constraints in speed required for the ships. Nevertheless, a design change has subsequently been requested in order to achieve higher speed for the Destroyer.

## 7. Conclusion and Future Work

In general, there is a lack of connections between IA and the defence field and also lack of systematic studies as identified from the literature. The challenges highlighted in this paper demonstrate the important connection between IA and defence field. This study assumes that by proper management of IA, it is possible to improve the MoD capability. The early results from the interviews indicate that MoD needs a framework to identify and quantify IA in the whole defence system.

This paper has also highlighted that the impact of IA should not be ignored. The interviews demonstrated that IA is an important challenge in defence but there is a lack of awareness of the importance of IA management. This type of situation has been widely studied in the literature for the financial sector but not much for the defence field. The first and second challenges highlighted in this paper serve as the starting points on how to analyze case studies in different IA situations. In future work, two lines of the Front Line Command (FLC) of the MoD, the British Army and Royal Air Force, will be analyzed and a framework to identify IA in a complex defence system will be developed.

## References

- [1] Akerlof G. The Market of Lemon: quality uncertainty and market mechanism. 1970.
- [2] Schmitz T., Schweiger B., Daft J. The emergence of dependence and lock-in effects in buyer-supplier relationships - A buyer perspective. *Industrial Marketing Management*. Elsevier Inc.; 2014.
- [3] Clarkson G., Jacobsen TE., Batcheller AL. Information asymmetry and information sharing. *Government Information Quarterly*. 2007.
- [4] Louth J., Taylor T. *Beyond the Whole Force*. Rusi. 2015.
- [5] Hinge A. Hinge, Alan, *Australian Defence Preparedness. Principles, Problems and Prospects : Introducing Repertoire of Missions (ROMINS) a Practical Path to Australian Defence Preparedness*, Australian Defence Studies Centre, Canberra, 2000: *Principles, Problems and Prospects : Introducing Repertoire of Missions (ROMINS) a Practical Path to Australian Defence Preparedness*, Australian Defence Studies Centre, Canberra, 2000. 2000.
- [6] Booth A., Papaioannou D., Anthea S. *Systematic approaches to a successful literature review*. 2016.
- [7] Dehlen T., Zellweger T., Kammerlander N., Halter F. The role of information asymmetry in the choice of entrepreneurial exit routes. *Journal of Business Venturing*. 2014.
- [8] Stiglitz J. The Contributions of the Economics of Information to Twentieth Century Economics. *The Quarterly Journal of Economics*. 2000.
- [9] *Investment Appraisal and Evaluation*. Joint Service Publication 507. 2014.
- [10] Zissis D., Ioannou G, Burnetas A. Supply chain coordination under discrete information asymmetries and quantity discounts *Omega journal*. 2014.
- [11] Do Quy Toan. Asymmetric Information book chapter in *The Social Science Encyclopedia 2nd edition*. Adam Kuper and Jessica Kuper (eds.). 2004
- [12] Tong PY., Crosno JL. Are information asymmetry and sharing good, bad, or context dependent? A meta-analytic review. *Industrial Marketing Management*. 2015.
- [13] Grant R.M. Toward a knowledge-based theory of the firm. *Strategic Management Journal*. 1996.
- [14] Keane M., Stavrino O. Adverse selection, moral hazard and the demand for Medigap insurance. *Journal of Econometrics*. 2016.
- [15] Akerlof G., Spence M.A., Stiglitz J.E.. *Markets with Asymmetric Information* *Markets with Asymmetric Information*. Bank of Sweden Prize in Economic Sciences 2001;
- [16] Cox a. The art of the possible: Relationship management in power regimes and supply chains. *Supply Chain Management*. 2004.
- [17] Zissis D., Ioannou G., Burnetas A. Supply chain coordination under discrete information asymmetries and quantity discounts. *Omega* 2014.
- [18] Gov.UK. Defence Lines of Development analysis with MODAF. 2009; : 1–2. Available at: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/36720/20090210\\_MODAFDLODAnalysis\\_V1\\_0\\_U.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/36720/20090210_MODAFDLODAnalysis_V1_0_U.pdf)
- [19] Lindley D V. *Understanding Uncertainty*. Wiley-Interscience. 2006.
- [20] Parker J. *An Independent Report to inform the UK National Shipbuilding Strategy FReNg*. 2016.
- [21] Gates J (corps of naval constructors). *Type 45 destroyer owners' workshop manual*. HAYNES. HAYNES (ed.) 2010. 2010 p.