
This item was submitted to [Loughborough's Research Repository](#) by the author.
Items in Figshare are protected by copyright, with all rights reserved, unless otherwise indicated.

Generating value from whole-life solutions - a new opportunity for the UK rail industry

PLEASE CITE THE PUBLISHED VERSION

<http://www.pomsmeetings.org/ConfProceedings/011/>

PUBLISHER

Production and Operations Management Society (© The author)

VERSION

VoR (Version of Record)

LICENCE

CC BY-NC-ND 4.0

REPOSITORY RECORD

Clayton, Richard J., C.J. Backhouse, Samir Dani, and J. Lovell. 2019. "Generating Value from Whole-life Solutions - a New Opportunity for the UK Rail Industry". figshare. <https://hdl.handle.net/2134/8624>.

This item was submitted to Loughborough's Institutional Repository (<https://dspace.lboro.ac.uk/>) by the author and is made available under the following Creative Commons Licence conditions.



CC creative commons
COMMONS DEED

Attribution-NonCommercial-NoDerivs 2.5

You are free:

- to copy, distribute, display, and perform the work

Under the following conditions:

BY: **Attribution.** You must attribute the work in the manner specified by the author or licensor.

Noncommercial. You may not use this work for commercial purposes.

No Derivative Works. You may not alter, transform, or build upon this work.

- For any reuse or distribution, you must make clear to others the license terms of this work.
- Any of these conditions can be waived if you get permission from the copyright holder.

Your fair use and other rights are in no way affected by the above.

This is a human-readable summary of the [Legal Code \(the full license\)](#).

[Disclaimer](#) 

For the full text of this licence, please go to:
<http://creativecommons.org/licenses/by-nc-nd/2.5/>

Abstract number: 011-0563

Generating Value from Whole-Life Solutions – A New Opportunity for the UK Rail Industry

R.J. Clayton¹, C.J. Backhouse², S. Dani³ and J. Lovell⁴

¹ Systems Engineering Doctorate Centre, Sir David Davis Building, Loughborough

University, Loughborough, LE11 3TU, UK

Tel: +44 (0) 1332 266 349. Email: r.clayton@lboro.ac.uk

² Wolfson School of Mechanical and Manufacturing Engineering, Loughborough

University, Loughborough, LE11 3TU, UK

³ Loughborough University Business School, Loughborough University,

Loughborough, LE11 3TU, UK

⁴ Bombardier Transportation, Litchurch Lane, Derby, DE24 8AD, UK

POMS 20th Annual Conference

Orlando, Florida U.S.A.

May 1 to May 4, 2009

Abstract

The UK government has started to demand a “whole-life, whole-system” view of new contracts within the UK rail industry; requiring the industry to transform the way it does business in order to deliver this new paradigm. This paper describes the work of a collaborative academic-industry research project; based in one railway vehicle manufacturing company. The aim of the project is to maximise benefit across the value chain throughout the whole-life of a fleet of railway vehicles. This paper presents preliminary results and a review of the relevant literature to discuss how the traditional approach to value generation must change in order to deliver whole-life solutions. The discussion describes how an organisation’s structure, approach to contracting and spares provisioning, supplier and customer relationships and people issues (behaviours and cultures) significantly impact upon the ability to deliver value to the manufacturer, their customers and suppliers in whole-life service contracts.

Key words: whole-life solutions, rail industry, whole-life service contracts, value chain

Introduction

The 2007 ‘Rail Technical Strategy’ (RTS) which accompanied the UK government’s ‘Delivering a Sustainable Railway’ white paper outlined the aim to have “world-class reliability of both infrastructure and rolling stock” [1]. In order to achieve this, the RTS highlighted the need for “government and industry [to work] together taking a whole-life, whole-system cost approach in exploiting opportunities” [1].

This commitment to taking a whole-life, whole-system viewpoint is reflected in current trends by government departments, through Public Private Partnerships / Private Finance Initiatives, in which the “public and private sectors join to design, build or refurbish, finance and operate new or improved facilities and services to the general public” [2].

The whole-life, whole-system paradigm has the potential to completely change the dynamic of UK railways; provided that the industry can transform itself to deliver whole-life service offerings, maximised to deliver benefit throughout the value chain.

Within this environment, traditional rolling stock manufacturers are facing increasing pressure to provide greater levels of service provision as part of their core product offerings. Academic literature suggests that this shift from product focused to product-service focused offers significant benefits not only to end-users but also to manufacturers [3-6]. The key arguments generally put forth include [4]:

1. Economic arguments – a substantial amount of revenue can be generated from a large installed base over its lifecycle [6] and services are usually more resilient to the economic cycles that drive equipment procurement
2. Customers are demanding more services – pressure to downsize and create more agile firms focused on delivering their core business leads to the outsourcing of non-core activities. This is reflected in the UK railway industry with more train operators choosing to outsource the maintenance activities traditionally performed internally
3. Competitive argument – as services are less tangible than products and more knowledge-intensive, they are much more difficult to imitate – setting up barriers to

the competition and creating dependency, thus giving a more sustainable competitive advantage [5]

Despite these advantages, the list of manufacturing organisations that have strong service strategies is relatively small. In order to make the transition from offering products to product-services an organisation must overcome significant barriers, including:

1. Economic – there is a change in the way that profit is gained [7, 8] – it is much more difficult to place an economic value on services
2. Cultural shift – a change in mindset is required in both the market and organisation. It may be difficult for customers to place a value on having a need met as opposed to physical ownership [7]. Within the organisation it may prove difficult to excite the designers and engineers of multi-million pound pieces of equipment about a contract for maintaining the asset
3. Fear of risk absorption – by starting to take ownership of the life of assets; the risk of operation is being transferred from the end-user to the manufacturer – e.g. in availability contracts it is the manufacturer/service provider who is responsible for ensuring that an asset is available
4. Lack of experience – changing to become a service provider requires significant investment by the organisation. The organisation may need to be restructured and delivering a product-service is likely to be more complex than delivering product functionality
5. Co-operation with customers and suppliers – in the traditional product focused environment relationships between customers and suppliers are transactional and

often confrontational (they are both trying to make money from one another) [8]. When delivering a product-service both customers and suppliers need to work together to deliver co-value propositions

Given the above considerations, it is no wonder that few manufacturers have strong service strategies - this is especially true in the UK railway industry. With the UK government now demanding whole-life contracts, there is an increasing need for traditional rolling stock manufacturers to deliver whole-life service solutions. This article reports on the traditional method of value generation within the UK railway rolling stock market and discusses how this is changing and the likely implications.

Background to the UK railway industry

The UK railway industry is highly complex with significant interactions and inter-dependence between all stakeholders. Since the privatisation of British Rail (as a result of the Railways Act 1993 [9]) attempts have been made by various governments to re-structure the industry to

- better meet the needs of passengers and freight; and to
- better control the costs associated with operating a railway system.

Figure 1 illustrates the current structure of the UK rail industry.

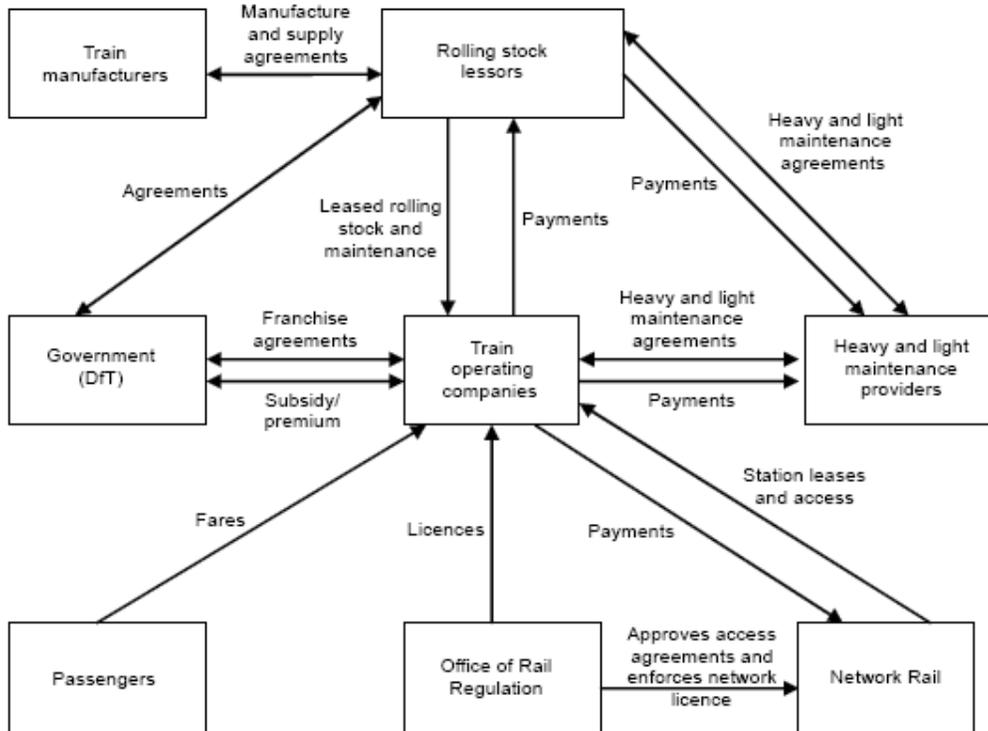


Figure 1: An overview of the structure of the UK rail industry [10]

The part of the railway industry which delivers passenger/freight movement consists of two key sectors – building, operating and maintaining rolling stock; and constructing and maintaining tracks (and all related infrastructure)¹. These two sectors are jointly funded by the government and private companies. For example, in 2007 the UK government subsidised Network Rail £3.6 billion to manage the railway infrastructure and gave almost £1 billion in subsidy to train operators to run passenger services [11].

¹ Other sectors include; train operation; train and track safety and inspection; insurance; utility provision; and regulation – not shown in Figure 1.

The traditional approach to value generation from rolling stock

In the UK railway market a tender is typically issued for the design, construction, delivery and warranty of a new fleet of rolling stock. Rail vehicle manufacturers will bid for the contract with the lowest cost offering usually winning. Manufacturers value their offering in terms of production costs plus a margin and aim to minimise production costs while maximising margin and undercutting the competition.

In most cases, the finance to procure a new fleet is provided by a Rolling Stock Company (ROSCO), who becomes the asset owner. They generate value by leasing the vehicles to train operators for the length of a franchise (~ 5 – 7 years). Once the franchise has expired, the ROSCO will look to lease the vehicles to another operator. This then continues until the vehicles reach the end of their useful lives (~ 30 years).

Once the fleet is about to enter service, the operator/ROSCO will tender a contract for the maintenance of their vehicles for the life of the franchise. Maintenance providers will then bid for this contract, with the operator/ROSCO awarding the contract to the lowest bidder.

Depending on the type of lease contract, maintenance is the responsibility of the ROSCO (wet lease), operator (dry lease) or both operator and ROSCO for light and heavy maintenance respectively (soggy lease). Whoever has responsibility for maintenance can choose to either carry out the work internally or outsource the work. If maintenance is outsourced by either operator or ROSCO then three types of maintenance agreement are typical:

1. Material supply agreement – the operator/ROSCO carries out the maintenance activities; spare parts are provided by the service provider. Value is created for the service provider by effectively managing the supply chain and inventory. The operator's perceived value comes from the risk transfer associated with consumption
2. Technical support, spares supply agreement – the operator/ROSCO carry out the maintenance activities; spares parts and a few on-site personal (for technical advice) are provided by the service provider. Value is created for the service provider by effectively managing the supply chain and inventory with some of the risk offset by having personnel on-site who understand the maintenance issues associated with a given class of vehicles. The operator's perceived value comes from the risk transfer associated with consumption and the detailed technical knowledge (provided by the on-site personnel) associated with maintaining a fleet
3. Full maintenance agreement – the operator/ROSCO pay the service provider a monthly fee to guarantee predetermined levels of availability, reliability and safety. The service provider is responsible for all maintenance work and spares provision. Value is created for the service provider by effectively managing the supply chain, inventory and maintenance activities. The operator's perceived value comes from complete risk transfer of service activities – they are able to concentrate on their core business, moving passengers

In the traditional model (shown in Figure 1) for each interaction there is a contract – e.g. the interaction between operator and ROSCO is managed via a leasing contract – and typically with each interactions is a flow of money in either direction. Organisations try to maximise value generation for themselves by managing these

interactions – i.e. by trying to reduce the flow of money out of the organisations while maximising the flow of money into the organisation. For example, operators will try to maximise their number (and price) of fares while simultaneously trying to minimise the amount they pay for light and heavy maintenance. The perception of industrialist, interviewed in the course of this research, is that this has led to very transactional and confrontational relationships with one party trying to maximise their returns at the expense of another [12-14]. In this environment, the robustness of the contract and the precise allocation of responsibility and risk need clearly defining.

The current structure of the UK railway industry has created a disconnect between rolling stock manufacturing and servicing – service contracts are awarded immediately prior to a fleet entering service and follow a separate bidding process from that of buying the fleet. This has led to a complete separation of capital and operational expenditure, making it difficult to convert reduced lifecycle cost benefits to optimised total cost of ownership for all stakeholders [15-17].

In this context, manufacturers are not incentivised to improve the reliability of a fleet – the manufacturing organisation may not win the service contract, so why make it easier for your competition? If the manufacturing organisation did win the service contract then, depending on the type of maintenance contract, the manufacturer may actually be harmed by delivering too much reliability – e.g. with a material supply agreement if reliability is high then the organisation will sell fewer spares.

The 'new' approach to rolling stock procurement

When viewed as a system, the (primary) purpose of the UK railway industry is to safely transport passengers and freight. In order to achieve this, all elements within the railway industry need to work together in a holistic way – even though the individual elements may have their own goals. For example, operators want to maximise their profits by operating passenger services, Network Rail want to manage the existing fabric of the railway network, utility providers want to maximise their profits by providing electricity, gas and water to the railway network, etc.

The complexity within the railway system lies not in any technical aspect, although these are complicated, but in the interactions and relationships between the different stakeholders; aligning their often competing goals in order to deliver the system goal - safely transporting passengers and freight on-time. This becomes especially important with the whole-life approach and requires greater co-operation and communication between all stakeholders.

Recognising this, in a recent tender request (Thameslink programme) the Department for Transport are seeking an enterprise to deliver a bundled solution which includes design, build, maintenance and finance [18]. The manufacturer must provide a financed solution and are expected to work closely with the financier to provide an optimised solution. The financier will be paid a pre-determined monthly fee for the use of each vehicle by the operator, with the usage of the rolling stock guaranteed by the Department for Transport for part of its useful life.

In order to encourage the manufacturer to address whole-life costs and maintenance considerations when designing the trains, the Department for Transport is expecting that the manufacturer will be responsible for the maintenance of the rolling stock [18]. Recognising the importance of having highly reliable rolling stock, the Department for Transport will introduce a reliability incentive and penalty regime. Whilst the maintainer will take in lead role in maintaining the rolling stock, the operator will support the planning and scheduling of the work.

Figure 2 describes the proposed structure of the Thameslink programme, with the umbrella agreement being the enterprise that will deliver the whole-life solution.

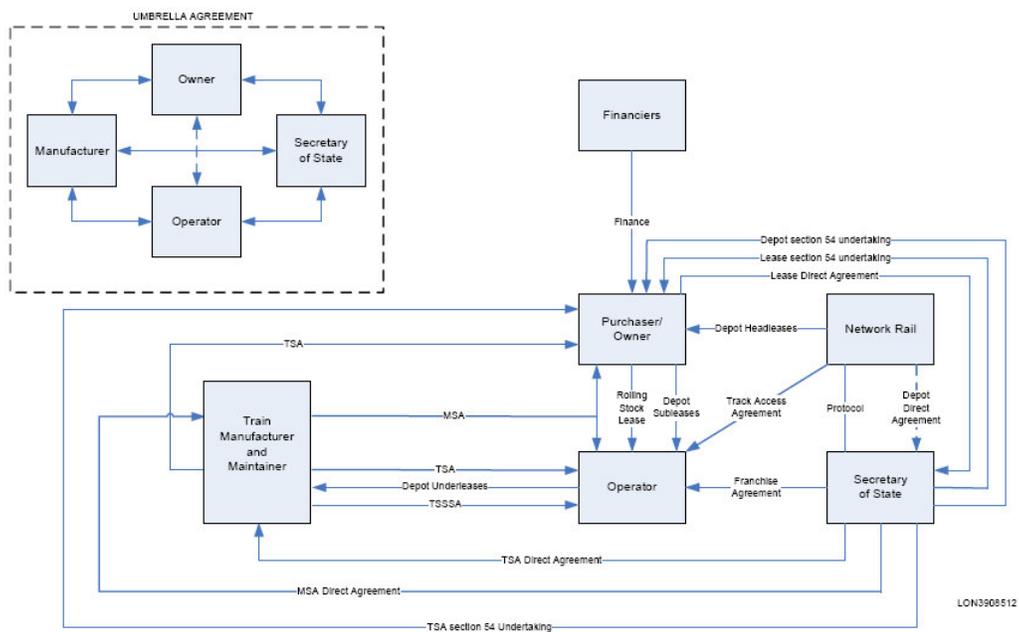


Figure 2: Proposed structure of the Thameslink programme [19]

Generating value from whole-life solutions

Through the Thameslink contract, the Department for Transport is demanding that rolling stock manufacturers supply greater levels of service provision alongside their traditional product offering, with the aim of providing more optimised whole-life solutions.

For a manufacturer, value is still generated upon the sale of rolling stock (to a ROSCO). However, now that the manufacturer is guaranteed to be the maintainer further value can be generated by maintaining the fleet of rolling stock; effectively managing the supply chain, inventory and maintenance activities. This in itself is unremarkable. Indeed, in the traditional approach value would be generated in the same manner if the manufacturer chose to, and was successful in, bidding for the service contract – rolling stock manufacturers operating in the UK market all have separate service divisions.

The guarantee, offered by the Department for Transport ensuring that the manufacturer is the maintenance provider, offers a significant opportunity to enhance the value derived from a fleet of rolling stock by better linking capital and operational expenditure. In this new paradigm, the manufacturer is incentivised to design for reliability so long as whole-life cost is minimised.

Rail vehicle manufacturing divisions within the manufacturer's organisation need to work more closely with the service division in order to design the vehicles. The relationship with the other organisations in the enterprise (i.e. the financiers/ROSCO and train operator) must be much less transactional and confrontational; each partner

must recognise that the only way to succeed is for the entire enterprise to make money. Contracts between organisations within the enterprise need to reflect this – championing the joint goals, identifying that problems are jointly owned, fairly sharing risk and creating an imperative towards continuous improvement. Ideally, if one organisation within the enterprise was making significant profit (above a predetermined threshold) this profit should be taken by the enterprise and shared. Similarly, some degree of loss sharing should also be accepted by the enterprise.

In the same way, a manufacturer's relationship with its suppliers must also become less transactional and confrontational. This is especially challenging in the UK railway industry where the suppliers tend to be either small specialist companies or large multi-national organisations. Spares contracts need to be agreed for the whole-life of the vehicles (or until the parts become obsolete). Small companies may be willing to transform in order to deliver whole-life contracts, however, may be incapable of accepting the additional risk incurred. Large organisations are probably capable of accepting the risk, however, the railway industry may be such a small part of their overall business that there is little incentive to change.

If manufacturers begin to realise that in order to maximise their long-term returns the entire enterprise and its suppliers must make money then economic growth becomes linked to customers' perception of the value of an offering and not necessarily to product streams. In this environment there is recognition that companies create value which is perceived by customers and that customers buy value [20].

In this scenario, the enterprise sees itself as a supplier of a system focused on understanding how value is created in the eyes of customers [3, 8]. The traditional approach to value generation by rolling stock manufacturers of assembly, selling and delivery, spare parts supply and upgrades expands to include all areas of customer concern – financing and leasing, maintenance, scheduling and capacity planning, catering and servicing, parts-depot operations, refurbishment and releasing, and driving the vehicles. This challenges manufacturers in how they define their value adding activities and requires the whole organisation to develop new capabilities in systems integration, operational service, business consulting and financing [3].

Perhaps the biggest challenge for rolling stock manufacturers in transitioning to become complete service providers focused on generating offerings based on customers' perception of value lies in people and their behaviours and culture. UK rolling stock manufacturers have over 150-years of internal inertia to overcome. Employees and their managers rightly take pride in their manufacturing excellence, however, the skills and abilities required to deliver this differ significantly the skills and abilities required to provide services. Even in service divisions within rolling stock manufacturers, the focus is typically on fixing the immediate concern and reacting fast enough. Although exciting, with success being easily measurable, this reactive nature does not lead to optimised whole-life solutions. Systemic thinking skills need engendering, encouraging managers to consider the long-term implications of their decisions on the whole enterprise and creating tools and processes to support this. Individuals and teams should no longer be rewarded for good fire-fighting but for preventing fires in the first place; the heroes in traditional manufacturing organisations are not likely to be the heroes in a service-oriented organisation.

Conclusion

This paper describes that the UK government is demanding a “whole-life, whole-system” view of contracts within the UK railway industry. Within this environment, rolling stock manufacturers are facing increasing pressure to provide greater levels of service provision within their core offerings. This will profoundly change the way a traditional manufacturer handles its customer and supplier relationships and defines its value adding activities.

The research has identified that the traditional approach to value generation is transactional and confrontational between manufacturers, suppliers and customers. The current structure of the UK railway industry has created a disconnect between rolling stock manufacturing and servicing leading to a complete separation of capital and operational expenditure. Manufacturers are not incentivised to improve the reliability of a fleet and, because of the contracting structure, are actively discouraged from doing so.

The Thameslink programme, tendered by the Department for Transport, is seeking an enterprise to deliver a bundled solution which includes design, build, maintenance and finance. The tender creates an incentive for manufacturers to deliver a highly reliable and cost effective solution by guaranteeing that the manufacturer will also be the maintainer – better linking capital and operational expenditure. In order to enhance the value generated from such contracts the relationships within an enterprise and with the supply chain must be seen as a partnership and no longer transactional or confrontational. There needs to be recognition that in order for an organisation to be successful the entire enterprise needs to be successful – i.e. organisations must

develop co-value propositions. This recognition is slowly gaining ground in the UK railway industry – particularly that of rolling stock.

In the future, economic growth should become better linked to a customer's perception of value and not necessarily to product streams. In this context, customers buy value and traditional manufacturers need to develop new capabilities in systems integration, operational service, business consulting and financing to supply this value. This requires traditional rolling stock manufacturers to start to see themselves and their enterprise as suppliers of a system. Perhaps the biggest challenge to this is to overcome the internal inertia of the manufacturing organisation by changing the mindsets of employees and managers and acquiring the skills required for systemic thinking.

Future research will attempt to quantify, measure and track how value is generated throughout the enterprise in order to understand how value changes through time in different levels of whole-life service provision.

Acknowledgements

This paper would not have been possible without the financial support given by the UK government via EPSRC and the collaborating company. Neither would it have been possible without the support of the industrialist interviewed as part of the research and the access granted by the industrial partner. The views expressed are in this paper are those of the authors, but were derived from collaboration and discussion with these people. We thank them for their time, knowledge and invaluable insights.

References

- [1] Department for Transport, "Rail technical strategy," TSO, London, Tech. Rep. N5618298 c13 07/07, 2007.
- [2] John Laing plc. PFI/PPP explained. [Online]. 2008(22/12/2008), Available: http://www.laing.com/pfi_ppp/948.htm
- [3] T. Brady, A. Davies and D. M. Gann, "Creating value by delivering integrated solutions," *International Journal of Project Management*, vol. 23, pp. 360-365, 7. 2005.
- [4] J. B. Quinn, T. L. Doorley and P. C. Paquette. (1990), *Beyond products: Service-based strategy*. *Harvard Business Review* 68(2), pp. 58-67.
- [5] S. Vandermerwe and J. Rada, "Servitization of Business: Adding Value by Adding Services," *European Management Journal*, vol. 6, pp. 314-324, 1988.
- [6] R. Wise and P. Baumgartner. (1999), *Go downstream: The new profit imperative in manufacturing*. *Harvard Business Review* 77(5), pp. 133-141.
- [7] T. S. Baines, H. W. Lightfoot, S. Evans, A. Neely, R. Greenough, J. Peppard, R. Roy, E. Shehab, A. Braganza, A. Tiwari, J. R. Alcock, J. P. Angus, M. Bastl, A. Cousens, P. Irving, M. Johnson, K. Kingston, H. Lockett, V. Martinez, P. Michele, D. Trandfield, I. M. Walton and H. Wilson, "State-of-the-art in product-service systems," *Proc. IMechE Vol. 221 Part B: J. Engineering Manufacture*, vol. 221, pp. 1543-1551, 2007.
- [8] O. Mont, "Product-service systems," Swedish Environmental Protection Agency, Stockholm, Sweden, Tech. Rep. AFR-REPORT 288, 2000.
- [9] "Railways Act 1993 (c. 43)," vol. 2008,
- [10] Competition Commission. (2007). *Rolling stock leasing market investigation: Industry background working paper*. Competition Commission, [Online]. Available: <http://www.competition->

commission.org.uk/inquiries/ref2007/rosco/pdf/working_paper_industry_background.pdf

[11] Office of Rail Regulation. (2008, 10/09/2008). National rail trends 2007-2008 yearbook. Office of Rail Regulation, www.rail-reg.gov.uk. [Online]. Available: <http://www.rail-reg.gov.uk/upload/pdf/375.pdf>

[12] R. J. Clayton, "Meeting minutes: Commodity buyer," Tech. Rep. RC140109-MIN-001, 2009. Internal Document

[13] R. J. Clayton, "Meeting minutes: Strategic buyer," Tech. Rep. RC200109-MIN-001, 2009. Internal Document

[14] R. J. Clayton, "Meeting Minutes: Vice president, product planning and strategy," Tech. Rep. RC310708-MIN-002, 2008. Internal Document

[15] R. J. Clayton, "Meeting minutes: Bid manager," Tech. Rep. RC031008-MIN-002, 2008. Internal Document

[16] R. J. Clayton, "Meeting minutes: Strategic planning director," Tech. Rep. RC291008-MIN-001, 2008. Internal Document

[17] R. J. Clayton, "Meeting minutes: Fleet director," Tech. Rep. RC120608-MIN-002, 2008. Internal Document

[18] Department for Transport. (2008), Thameslink rolling stock project: Summary and overview. Department for Transport, London. [Online]. Available: <http://www.dft.gov.uk/pgr/rail/pi/thameslinkrollingstock/summaryandoverview.pdf>

[19] Department for Transport. (2008, Appendix F: Thameslink rolling stock agreements wiring diagram. Department for Transport, London. [Online]. Available: <http://www.dft.gov.uk/pgr/rail/pi/thameslinkrollingstock/itt/appendixf1.pdf>

[20] M. J. Goedkoop, C. J. G. van Halen, H. R. M. te Riele and P. J. M. Rommens, "Product service systems, ecological and economic basics," VROM, Neatherlands, Tech. Rep. 1996/36, 1996.