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A VOICE OF THE CUSTOMER REPORT FOR NETWORK RAIL

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This assessment/report is all my own work and conforms to the University's regulations on plagiarism





Table of Contents

Executive Summary.....	1
Management Question.....	2
Introduction.....	2
Methodology.....	3
Literature Review.....	6
What is transport system modelling?.....	7
What have been raised as the primary concerns of transport system users?	7
Have similar cases been addressed in other industries and/or countries (Automotive, software, US and Japan)?	9
What is the future vision of transportation intermodal systems?	13
Survey Design.....	16
The Five factors.....	17
Survey Results.....	19
Quantitative Questions.....	19
Qualitative Questions	32
Expected Findings	33
Unexpected Findings.....	33
Customer perspectives on current processes and models.....	34
Recommendations	35
Strategic Implications.....	36
Conclusion.....	36
References	37
Appendix 1 - Problem Space Map.....	40
Appendix 2	41
Appendix 3	43



Executive Summary

This report provides the findings from the consultative project for the Capacity Planning Team of Network Rail by 'Team Red 5' from the Cranfield University MBA programme. The project was carried out to support Network Rail in understanding their customers' needs and requirements for the future rail modelling system(s) for the UK rail network.

The importance of this cannot be overemphasised, especially with the advent of the digital railway. To cope with the huge increases in demand on the rail network, accurate and timely modelling is a necessity.

Before setting out to make plans for improvement, it was imperative for Network Rail to ask its customers what factors are most important to them and build a plan with the feedback and comments.

The management question posed to address this situation is:

'What are the major customer feedbacks and suggestions that Network Rail should consider to enhance its system modelling service?'

The literature review explores the following themes:

- what is transport modelling
- what are the primary concerns of transport system users
- review of cases in other industries and countries
- View on the future vision of transportation intermodal systems.

A mixed survey, with quantitative and qualitative questions, was used which focussed on five parameters that was agreed to be relevant. These five factors are Cost, Time, Quality, Capacity and Engagement.

The responses were analysed and it was evident that Engagement and Capacity are the two most important factors. Based on these findings, recommendations were made.

The first recommendation looks to improve capacity by focusing on people, process and system improvements.

Other recommendations included considerations about improving communication with clients focused on reducing the response time to customer queries and concerns.

Taking a longer-term view, the recommendation based on literature review of railways in other developed countries, suggest that significant capital investment will be required to meet the vision 2030.

These recommendations will have a direct impact on the strategic plan for Network Rail by improving customer satisfaction and reducing cost of operations and increasing profits for all stakeholders.



Management Question

What are the major customer feedbacks and suggestions that Network Rail should consider enhancing its system modelling service?

To answer this question, the five key points listed below will be investigated:

- Customer perspectives on current processes and models.
- Customers 'vision' for the future; what they would ideally like.
- Insights into other transportation modelling systems with a close look on how upgrades have been conducted in different sectors.
- Recommendations for how these findings can be integrated with ongoing work strands.
- Overall strategic implications for Network Rail.

Introduction

As a part of its continual improvements and in preparation for the digital railway¹, Network Rail is in the process of upgrading the capacity and performance of its modelling systems, while remaining cost effective. The Capacity Planning Team at Network Rail has identified gaining user and customer input as an aspect that required further investigation. The opportunity for Team Red 5 from the Cranfield MBA to investigate this matter in a consultative role was deemed a good opportunity. A collaborative approach to addressing the problem was adopted very early in the client/consultant relationship. This allowed rapid progress to be made in defining the requirement, and subsequently in developing the questionnaire.

Network Rail was particularly interested in understanding customers' needs and general views on their current service. This study aims to identify:

- What is good about the current approach?
- What can be improved?
- How can it be improved?
- What is important to the customer?

The project is intended to support the Whole System Modelling Programme, which has far reaching implications for many departments within Network Rail, external partners, and customers. Network Rail has already undertaken significant data gathering with internal stakeholders and their future solution options, although in their infancy, are starting to take shape. The Whole System Modelling Programme Team have identified that, in the past, minimum external stakeholder engagement had taken place before change projects.

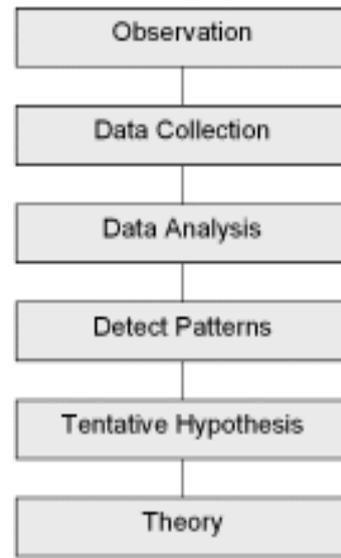
¹ Digital Railway is the industry's improved plan to tackle the UK's capacity crunch by accelerating the digital modernisation of the railway.



The proposal is based around engaging with the direct customers (primarily the Train and Freight Operating Companies), through electronic questionnaire. This project is in the B2B domain, therefore the general public's opinion has been excluded from the formula.

The client representative for the project is Mrs Jill Evans who is the Project Manager for Whole System Modelling and Capacity Planning.

An inductive study methodology has been implemented for this assignment. Observations were gathered via survey questionnaire emailed directly to customers. The survey contained both quantitative and qualitative questions. The sample was ensured to reflect customer view across various zones. The data collected was analysed (utilizing appropriate tools) to detect patterns in customer response and a tentative hypothesis was derived to back up a theory or a final recommendation. An in-depth literature review has also been undertaken to understand the primary concerns of transport system modelling users, draw parallel across other industries and/or countries, and derive a view on the future vision of transportation intermodal systems.



Methodology

This methodology briefly describes the approach employed to investigate and provide answers to the management question. This section covers the methods used for research design, literature review, data gathering, data analysis, as well as the limitations and challenges faced during the research phase.

Research Design

The key purpose of this research was to find out and give expression to the Voice of the Customer, enabling Network Rail to understand the customers' perception and to be more responsive to addressing their needs.

The research into the voice of the customer was carried out using an inductive process, flowing from observations to findings, and then to theory (referred to as insights).

Network Rail has a B2B relationship with its customers. They provide services to train operators across the UK. The external customers are the UK Train Operating Companies (TOCs) and the Freight Operating Companies (FOCs). The Network Rail Whole System Modelling Programme also provides capacity planning, modelling and timetabling for their internal customers.

The cross-sectional survey had a sampling frame that comprised internal customers and external customers of Network Rail, especially the TOCs.



Using a stratified sampling method, our Network Rail contact team identified relevant stakeholder staff of the TOCs, FOCs and internal departments, informing them about the survey through one of the general meetings. Once the list of recipients was generated, the survey questionnaire was sent via email to a sample size of 272 individuals.

Literature Review

The literature review started with a broad look at systems modelling in both books and peer reviewed academic journals. The focus was to understand what is transport system modelling by considering how railways generally operate and understanding the different interaction on the different trackage lines. As the management's question and the project's aims were refined and iterated to deliver the requirements aligned to the customer expectations, it became clear that the original focus of the literature review was misaligned to the new requirements. As such guidance and advise where essential for the team to pursue the right facts and research. This is when the team got introduced to a customer Business Intelligence (BI) provider, who granted access to data, and a highly productivity meeting gave an expanded insight into the target for the literature pertaining to the redefined project requirement. This was more focused on customer related elements, than the previous focus on the mechanics of modelling the UK rail system.

To redefine the literature review, considerable time was designated to developing areas of focus, which led to four specific questions being developed. In addition to understanding the transport system modelling, it was essential to understand users' concerns, other industries, and the long-term outlook of the rail system. As such, the themes for the questions were developed as follows:

- Modelling transport systems.
- The primary concerns of transport system users.
- Industries and other countries analysis.
- Future vision of the transportation systems.

Having set the parameters, more focused research could be achieved, and themes started to emerge, that were then expanded to give a deep analysis of peer reviewed material.

The Network Rail team provided documentary analysis, which comprised several documents, reports and business intelligence for the purpose of the research. They had conducted an internal survey with the capacity planning department, which identified what challenges they believed they were facing, and possible solutions to tackle the issues. The resultant Whole System Modelling (WSM) Problem Space Map (Appendix 1) summarised the perceived challenges into five broad areas, and these served as the basis for the design of the questionnaire.

Concerned that the customers' challenges may not be limited to these five areas, the questionnaire made provision for the respondents to extend their feedback to other areas not mentioned. The customers were expected to touch on pinch areas that they might have come to accept and overlook – where the discomfort or dis-ease has been taken for granted.



Data Gathering

The survey questionnaire had a mixture of both qualitative (30%) and quantitative (70%) elements. The purpose was to capture the opinion and satisfaction of the customer concerning the usage of the WSM models in achieving effective results.

Working with a questionnaire provided the opportunity to collect standardised information (hence comparable) from a large number of people across the sampling frame. It was designed using Qualtrics (a sophisticated and robust research/survey software) which allows for a dynamic and intelligent way of posing relevant questions to survey, as well as insightful analytics.

The questions were streamlined based on five parameters namely (discussed in detail in later section):

- Time (Speed)
- Performance and Quality of service
- Capacity
- Customer engagement (communication)
- Cost

For the quantitative aspect, the survey had respondents rate their satisfaction levels with Network Rail based on pre-identified challenges and parameters.

To gather qualitative data, respondents were given the option to voice their concerns and issues, which may not have been identified in the questionnaire or was outside the scope of it. Customers were also given the opportunity to suggest ways and ideas for improvement.

The questionnaire was thorough enough to give detailed information. The questions were straight to the point, avoiding those that would not add significant value to the data set. The questionnaire was designed to be anonymous, so that people could express their views freely and without fear or inhibition. Importantly, the first question got details of the aspect(s) of the modelling service used by the respondent; this helped to put the responses in perspective and to make analysis of the data gathered more meaningful.

The end Response rate for the survey was 27%.

Data Analysis

The quantitative data was primarily analysed by Qualtrics (the survey software). The data collected was used to produce charts which made interpretation of the data straightforward.



For qualitative analysis, each response was coded into smaller sentences and then into single factors that the respondents felt most strongly about.

The coding was carried out by three members of the team to remove bias. The three different scores were then averaged.

Recurring key words were also formed into word clouds, with the most frequent words being highlighted.

Limitations and Challenges

Limitations in gathering data included the 27% response rate received. The drop off was rated by the Qualtrics to be very high, but this was primarily because the respondents had the option of not answering the last question (which asked for their names, if they were happy to give it in the otherwise anonymous survey).

The fact that the client team provided the choice of possible respondents could form a bias in the stratified sample size.

Due to anonymity, it was not possible to identify if the responses gathered represented the whole population or if these responses were skewed towards a dutiful team.

It might be the case that due to the brevity of the questionnaire (which was designed as such to minimise drop off rates), some respondents may not have had enough opportunity to express themselves. For this reason, our team initially proposed further qualitative one on one interviews (via phone or Skype), but this was not achievable due to time constraints.

Literature Review

To explore effectively the issues surrounding Rail Transport system modelling, a subset of literature was selected based on its relevance to the following questions:

1. What is transport system modelling?
2. What have been raised as the primary concerns of transport system users?
3. Have similar cases been addressed in other industries and/or countries (Automotive, software, US and Japan)?
4. What is the future vision of transportation intermodal systems?

A search of the academic material shows that Network Rail is subject to significant newspaper and media coverage, and has high levels of public interest. Commentaries and editorials have primarily voiced negative concerns over Network Rail's management of the railways. The views presented in the popular media cannot be discounted, since these perspectives often influence public's perception of an issue the most. Nevertheless, this review of the literature focuses on the information presented in peer-reviewed journals and government sponsored reports in the hope that these findings are based more on sound research and systematic analyses of the issue.

What is transport system modelling?

Railways are continuously under pressure to cut costs and become more efficient. This pushes for adopting continuous innovation and investment in technology. Nevertheless, the rail system's complex and closely coupled nature can act as a disincentive to innovation because it makes it difficult to see at an early stage in the development process, what the impact of innovation will be on the system (Bouch and Roberts, 2013²). The complexity is demonstrated in the wide range of infrastructure and train characteristics present in the system.

Generally, trains operate differently depending on the number of tracks. In a single-track system, the most common, trains move in opposite direction and compete for the same track. This requires the presence of sufficient buffer trackage to prevent potential deadlocks (Lu et al, 2004³). When it comes to densely populated areas, train operators are constantly required to configure trackage. This has pushed some rail networks to adopt not just single-track lines, but double and even triple-track lines. Add to this the fact that different points on the rail network may have different speed limits, because of varying local conditions, and thus you end up with a highly complex system model. To address this issue, several techniques have been used and tested. Lu et al (2004) talks about a dead-lock free simulation methodology that considers multiple trackage configurations in the same rail network with multiple speed limits while taking into account the acceleration and deceleration rates of the trains on the rail.

In their paper on merging sections in transportation systems, Hoshino et al (2016⁴) talked about Personal Rapid Transit (PRT) system. For PRT, control methods can be classified as point-follower control and vehicle-follower control. A ground-based computer generates virtual traffic cells, and real vehicles are controlled to follow the front edge of the cell.

What have been raised as the primary concerns of transport system users?

Terrorism remains one of the biggest threats and concerns for transport system users. The recent metro explosion in St Petersburg shed light on the vulnerability of the passenger rail systems to terrorist attack. Peterman (2005⁵) argues that the number of riders and access points make it impractical to subject all rail passengers to the type of screening airline passengers undergo. This is

² Bouch, C. and Roberts, C. (2013) 'Developing system models to help Great Britain's railways embrace innovative technologies with confidence'. Available at:

<http://journals.sagepub.com/doi/pdf/10.1177/0954409713500485> (Accessed: 14 May 2017).

³ Lu, Q. Dessouky, M. and Leachman, R. (2004) 'Modeling Train Movements through Complex Rail Networks'. Available at: http://www-bcf.usc.edu/~maged/publications/train_paper95.pdf (Accessed: 14 May 2017).

⁴ Hoshino, T. Tian, C. Komuro, T. Tsuboi, K. and Hamamatsu, Y. (2016) 'A Model for Merging Sections in Transportation Systems and Its Analysis'. Available at:

<http://onlinelibrary.wiley.com/doi/10.1002/ecj.11834/epdf> (Accessed: 14 May 2017).

⁵ Peterman, D. (2005) 'Passenger Rail Security: Overview of Issues'. Available at:

<http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA453703> (Accessed: 14 May 2017).

since rail services make scheduled stops along fixed routes, and their operations depend on efficient access to station and trains.

Generally, different stakeholders have different concerns. These stakeholders, shippers, freight carriers, residents, and administrators, have different goals presented in various forms as well (Taniguchi et al, 2014⁶). Shippers want to receive and send their goods in a reliable manner that does not violate the designated time window of delivery to lower their delivery costs. Freight carriers try to meet the shippers' needs using their resources and public infrastructure and information to maximize their profits. Residents in urban areas require minimum irritation from urban freight transport and desire communities that are more comfortable. Finally, municipalities try to enhance the quality of life for residents as well as decrease the congestion levels within the urban road network, decrease the negative environmental impacts, and increase security relating to transport.

An important factor to consider in modelling is timetabling. This is one of the major planning tasks in railway traffic and involves two parties to execute (Schletchle et al, 2011⁷). The first party consists of railway operators who need to compute timetable that uses a small number of trains and crews and that satisfies passenger demands like short travel and transfer times. Whereas the other party, consists of infrastructure companies that must decide about the allocation of the paths to the train requests of the operators. The problem arises when conflict between different requests occur. As such, it is critical that infrastructure capacity is kept in usage, and that good connections are guaranteed at all-important points in the network argues Schletchle et al. (2011). Nevertheless, this state is hard to achieve by manual planning, which demands a need for methods that allow for the use of optimization algorithms in timetabling to solve models like the periodic event-scheduling problem or the train-timetabling problem.

Disruptions are another major concern for transport system users. 'Railway disruption management' is a joint approach used to deal with the impact of disruption, and enabling transport system users to provide the best possible service for passengers in any case of disruption (Ahuja et al. 2009⁸). To manage disruption properly however, several steps need to be addressed. Those steps include strategic planning, rolling stock management, and crew management (Caprara et al. 2007⁹). Strategic planning is related to the desirable level of reliability to be provided to the customer, and the

⁶ Taniguchi, E. Fwa, T. and Thompson, R. (2014) 'Urban Transportation and Logistics: Health, Safety, and Security Concerns.' CRC Press, pp. 168-169. Available at: <http://proquestcombo.safaribooksonline.com/book/information-technology-and-software-development/9781482209112/firstchapter#X2ludGVybmlFsXOJ2ZGVwRmxhc2hSZWFkZXI/eG1saWQ9OTc4MTQ4MjIwOTExMi8xNjg=> (Accessed: 14 May 2017)

⁷ Schletchle, T. Brondorfer, R. Erol, B. Graffagnino, T. and Swarat, E. (2011) 'Micro-macro transformation of railway networks'. Available at: http://ac.els-cdn.com/S2210970611000047/1-s2.0-S2210970611000047-main.pdf?_tid=b6d03ebc-3f37-11e7-bcf4-00000aacb35d&acdnat=1495489598_66722fbd3a0e7d5fa9a2984fe29e8955 (Accessed: 22 May 2017).

⁸ Ahuja, R. Mohring, R. and Zaroliagis, C. (2009) 'Robust and Online Large-Scale Optimization'. Springer, pp.399.

⁹ Caprara, A. Kroon, L. Monaci, M. Peeters, M. and Toth, P. (2007) 'Handbook in Operations Research and Management Science', Chapter 3. Available at: <http://www.sciencedirect.com/science/handbooks/09270507/14/supp/C> (Accessed: 22 May 2017)

resources required doing so. The main resource to factor when planning is rolling stock management, in which Caprara et al (2007) argue that railway transportation demand is concentrated in two peak periods per workday. This pushes for the difference between peak demand and off-peak demand to be taken into account alongside the demand for railway transportation. The other main resource to factor in planning is crew management, which deals with strategic issues related to the location and capacities of crew depots. Balancing the capacity for drivers and that for conductors per depot is important especially if drivers and conductors are assumed to operate in teams.

Capacity and the efficiency of railway networks remains important research topics in engineering, operations research, and mathematics since several decades. Transport system users, though, are faced with a challenge to master the trade-off between accuracy and complexity in the planning, optimization, and simulation models. Gille et al (2010¹⁰) highlights the use of both microscopic and macroscopic models where they went about to apply microscopic models for running time calculations and the accurate simulation of railway operations, and macroscopic models for long term traffic and strategic infrastructure planning.

Have similar cases been addressed in other industries and/or countries (Automotive, software, US and Japan)?

To gain a perspective from other industries this literature review has investigated general themes and conceptual models, and notable changes in the automotive and software industries

Karwowski & Ahram (2012, p.3923¹¹) identified that a significant issue facing many organisations when integrating new business requirements is the lack of automation. The increasing complexity of systems means the need for enhanced information and knowledge has never been greater. As such, the design of complex service systems should consider attributes between human–human and human–machine interactions, both in terms of employees and service users.

Their model of User Centred Design (UCD) is a proactive approach for making informed and appropriate design decisions. Karwowski et al. (2012) however, observed that executives are often pressured to make quick, unfounded decisions, which in time have disastrous effects on the design of a system.

¹⁰ Gille, A., Klemenz, M., Siefer, T., 2010. Applying multiscaling analysis to detect capacity resources in railway networks, timetable planning and information quality. WIT Press, Chapter A7, pp. 73–82.

¹¹Karwowski, W, & Ahram, T 2012, 'Innovation in user-centered skills and performance improvement for sustainable complex service systems', *Work*, 41, pp. 3923-3929, Business Source Complete, EBSCOhost, viewed 9 May 2017. Available at:

<https://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,ip,shib,url,uid&db=bth&AN=71928996&site=eds-live>

According to Nadel and Piazza (2005¹²) two of the many justifications for employing a user-centric method are:

1. Users of the service often have unspoken needs that are hard to articulate. Through systematic data gathering, a skilled analyst can uncover how users conceptually think about a task.
2. Usability problems are often symptomatic of deeper business issues.

Further to these reasons, the 'Center for Business Knowledge' has identified four pillars of knowledge management shown in Figure 1: People, Process, Culture and Technology. With process and user knowledge as a foundation, end-user data gathering provides insights about user behaviour enabling the design of an interface/architecture that is intuitive and logical.

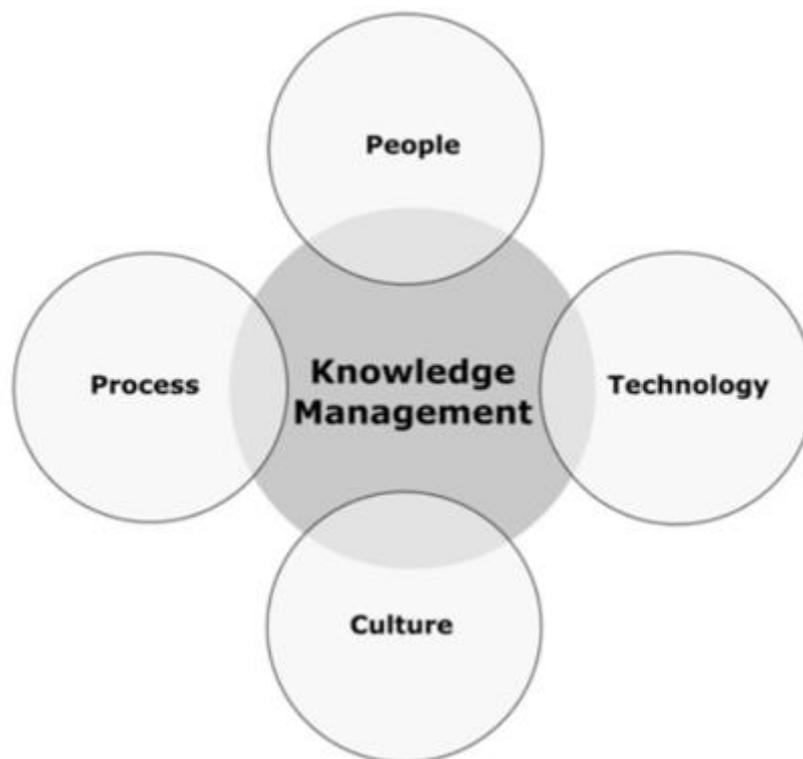


Figure 1: The four pillars of knowledge management (Modified from original by A. Bourdreau , G. Couillard, 1999)

Bourdreau & Couillard (1999, p.27¹³) state that 'system integration is recognizing that any entity (e.g., a group, a department, or a plant) is a system made up of numerous components that must work in

¹² Nadel, J, & Piazza, G (2005). Managing the Knowledge Behind Business Decisions through User-Centered Design, Center for Business Knowledge.

¹³Bourdreau, A, & Couillard, G 1999, 'Systems Integration and Knowledge Management', Information Systems Management, 16, 4, p. 24, Business Source Complete, EBSCOhost, viewed 12 May 2017. Available at: <https://eds.a.ebscohost.com/eds/detail/detail?sid=f3b46ddd-76bb-4a09-a073->

harmony if top performance is to be achieved'. They recognise that to become a knowledge organisation, firms require 'multidimensional effort that addresses organisational beliefs and commitment, organizational form, people know-how, and IT knowledge support'.

A key to success is the ability to incorporate knowledge management into the system; the dynamics of this are illustrated in Figure 2. As technologies, especially IT, change and mature, companies must exploit them to offer new levels of service and quality to the market. At the same time, the marketplace is changing through globalization, sophistication of customers, and demographics. All these translate into new business requirements to which industry leaders respond by using technology and system integration solutions. These continuous dynamic interactions keep on modifying the world in which all organizations evolve (Bourdreau & Couillard 1999, p.30).

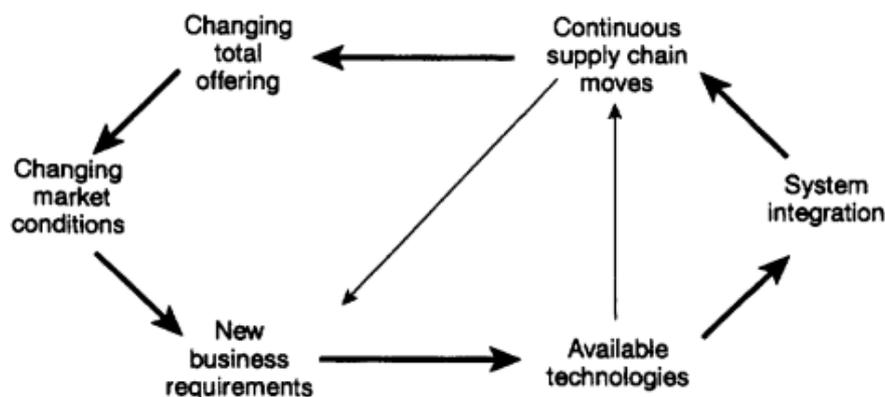


Figure 2: Dynamics of Business Realities (A. Bourdreau , G. Couillard (1999))

In a study focusing on the automotive sector, which is one of the largest industrial sectors worldwide, Jacobides, MacDuffie, & Tae (2016, p.1943¹⁴), examine the division of labour and terms of engagement of staff. Using both research and historical evidence, it provides great insight into how firms shape their sectors to capture more value, in terms of the Industry Architectures (IA).

These efforts, IA research suggests, are not only driven by the capabilities of the sectors' participants (Jacobides and Winter, 2005; Langlois and Robertson, 1995), or transactional features (Argyres and Bigelow, 2010; Williamson, 1985), but also by their interests in terms of value capture. To affect the IA, firms try to become "bottlenecks" (Baldwin, 2015 cited by Jacobides, MacDuffie, & Tae (2016)) by controlling scarce resources or outputs, which leads to having power over peers.

[827299e20199%40sessionmgr4007&vid=0&hid=4111&bdata=JkF1dGhUeXBIPWNvb2tpZSxpcCxzaGliLHVybCx1aWQmc2l0ZT1lZHMtbGl2ZQ%3d%3d#AN=2795221&db=bth](https://www.ebscohost.com/urn/10.1108/JBS-03-2017-0011)

¹⁴ Jacobides, M, MacDuffie, J, & Tae, C 2016, 'Agency, structure, and the dominance of OEMs: Change and stability in the automotive sector', Strategic Management Journal, 37, 9, p. 1942, Complementary Index, EBSCOhost, viewed 9 May 2017.

When reviewing vertical partnerships within the automotive industry Fichman and Levinthal (1991) and Asanuma (1989), cited by Kotabe, Martin, & Domoto (2003, p.294¹⁵), used the concept of relation-specific skills or assets to describe how a buyer and supplier can develop over time distinctive routines that make ongoing collaboration more effective. Conceptual research now suggests that a firm can benefit from harnessing complementarities with suppliers. Such benefits can accrue more strongly in firms that foster durable business relationships.

A critical feature of relation-specific assets is that their build-up is time-bound. As Kogut and Zander (1992, p390) cited by Kotabe, Martin, & Domoto, (2003) put it 'complex organizations exist as communities within which varieties of functional expertise can be communicated and combined by a common language and organizing principles'. To the extent that close integration is required, long-term relationships embed future transactions with a learned and shared code (Kogut and Zander, 1992, p.295).

Martin and Salomon (2002), cited by Kotabe, Martin, & Domoto, (2003, p.310), argue that two distinct capabilities contribute to successful inter-firm knowledge transfer:

1. Source transfer capacity, which pertains to a company's ability to transmit knowledge outward.
2. Recipient transfer capacity, which pertains to a transferee's ability to assimilate knowledge from a willing external source.

The most successful technology transfer will occur in pairs of firms that possess the necessary combination of source and knowledge transfer capacity. Extending both arguments, it presumably takes time for partners to fine-tune their transfer capacity and specialize it to each other.

Parry et al (2012)¹⁶ reviewed the notion of value creation in business markets for business-to-business software customers; much of the literature examines social value-based drivers and relationship quality (Powell & Swart, 2010; Ulaga & Eggert, 2006, cited by Parry et al (2012)). Lapierre (2000), cited by Parry et al (2012), identified 13 value drivers from the customer perspective, including product quality, product customisation, and flexibility. A more recent study identified functional (quality of

¹⁵ Kotabe, M, Martin, X, & Domoto, H 2003, 'GAINING FROM VERTICAL PARTNERSHIPS: KNOWLEDGE TRANSFER, RELATIONSHIP DURATION AND SUPPLIER PERFORMANCE IMPROVEMENT IN THE U.S. AND JAPANESE AUTOMOTIVE INDUSTRIES', *Strategic Management Journal*, 24, 4, p. 293, Business Source Complete, EBSCOhost, viewed 10 May 2017. Available at: <https://eds.a.ebscohost.com/eds/detail/detail?sid=32336478-f0e7-4b94-a403-06c6520e149d%40sessionmgr4008&vid=0&hid=4111&bdata=JkF1dGhUeXBIPWNvb2tpZSxpcCxzaGliLHVybCx1aWQmc2l0ZT1lZHMtbGl2ZQ%3d%3d#AN=9377355&db=bth>

¹⁶ Parry, S, Rowley, J, Jones, R, & Kupiec-Teahan, B 2012, 'Customer-perceived value in business-to-business relationships: A study of software customers', *Journal Of Marketing Management*, 28, 7-8, pp. 887-911, Business Source Complete, EBSCOhost, viewed 9 May 2017. Available at: <https://eds.b.ebscohost.com/eds/pdfviewer/pdfviewer?sid=f6e5c8a6-d397-4c27-ae7c-1a3b07581b95%40sessionmgr104&vid=1&hid=127>



the product), emotional (friendliness of the provider), and social elements (image of the provider) as important dimensions of perceived value in an industrial context (Fiol et al., 2011, cited by Parry et al (2012)).

Effective Relationship Marketing (RM) benefits the supplier through increased co-operation, a better understanding of customer requirements, and a dialogue with customers leading to a closer relationship and the co-creation of value through the development of co-created and customised products and services (Ruokonen, Nummela, Puumalainen, & Saarenketo, 2008, cited by Parry et al (2012)). Commercial benefits include reduced costs due to higher retention of customers, and increased profits because of customers' loyalty and reduced-price sensitivity (Gronroos, 1994; Reichheld & Sasser, 1990 cited by Parry et al (2012)). Proposed benefits for customers include reduced anxiety and comfort in knowing their supplier, along with social benefits because of familiarity with employees, individualised and additional services, and special treatment (Gronroos, 1994, 2007; Gummesson, 2002). Hennig-Thurau and Hansen (2000) also noted that personalised treatment within the relationship is a factor that customers value positively as they become more relaxed because they know what to expect from the supplying firm.

Numerous studies have confirmed that the presence of trust and commitment has a positive impact on relationships (Barry et al., 2008; Ivens, 2005; Melewar, Hunt, & Bridgewater, 2001; Takala & Uusitalo, 1996 cited by Parry et al (2012)). Wilson and Jantrania (1994, p.890) observe that trust is a fundamental relationship construct, and, as a result, it is included in most relationship models.

Networking is frequently cited as a means of developing relationships and is influential in the long-term sustainability of firms (Chetty & Stangl, 2010; Stokes, 2000, cited by Parry et al (2012)). Boussara and Deakins (1999) found that social networks of entrepreneurs and strategic alliances are particularly appropriate in the technology industry. Alliances also provide technology firms with the opportunity to share resources and capabilities. Customer-perceived value in B2B relationships had a positive impact on value creation in the software industry (Swaminathan & Moorman, 2009, cited by Parry et al (2012, p.891).

What is the future vision of transportation intermodal systems?

Traditionally the term inter-modal has been mostly applied to cargo with freight being transported by multiple modes with a primary focus on economic (energy) and environmental (emissions) aspects (Ison & Sagaris (2016), p.176¹⁷). In 2006, the US Government Accountability Office (GAO) viewed

¹⁷ Ison S and Sagaris L (2016). Workshop 4 report: Developing inter-modal transport systems Original Research Article Research in Transportation Economics, Volume 59, November 2016, Pages 175-178. Available at: https://extranet.cranfield.ac.uk/S0739885916301482/,DanaInfo=ac.els-cdn.com+s2.0-S0739885916301482-main.pdf?tid=e65d20e4-370a-11e7-a0e1-0000aab0f26&acdnat=1494590741_7eaf0e48f018424761918d0fb1d80106

intermodal transportation as a system connecting the various transport modes that refers to mass transit systems, road, aviation, maritime, and railroads; this is illustrated in Figure 3 below. Efficient intermodal airport provision would furnish passengers with a “seamless transfer between modes; the ability to connect to an extended transportation network; and high frequency of service among the different modes” (GAO 2006¹⁸).

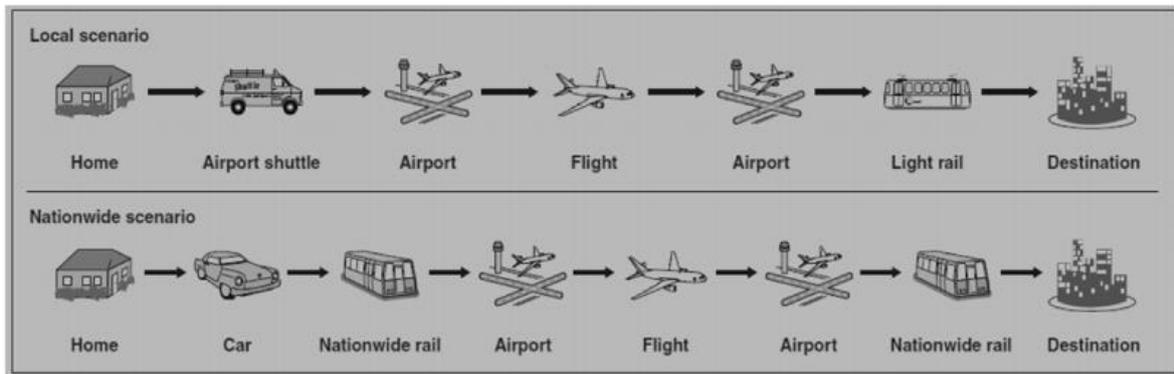


Figure 3: Two examples of intermodal connections for an airline passenger. Source: GAO (2006)

A more holistic definition is; ‘the seamless integration of diverse motorised and non-motorised transport systems that are socially, environmentally and economically sustainable - as a response to human diversity and needs (Ison & Sagaris (2016), p.176). As stated by Sagaris and Arora (2015)¹⁹, this suggests a focus on how well walking, cycling, buses, underground, trams and trains interact to ‘create better overall transport experiences’.

There are clearly challenges in terms of achieving intermodality. The GAO (2006) view the challenges as being financial, planning and a lack of specific national goals. In terms of funding, GAO sight a silo mentality in terms of specific modes of transport and the lack of hypothecated, ring-fenced funding emerge as specific issues.

In relation to accessibility and changing demand, issues of trip motivation (whether for work or leisure), impaired mobility and the ease of connections between different modes emerged, as highly relevant, in a context where social demands for mobility and access are becoming increasingly

¹⁸ United States Government Accountability Office (GAO). (2006). Intermodal Transportation: Challenges to and potential strategies for developing improved intermodal capabilities. GAO-06e855T. Available at: [https://extranet.cranfield.ac.uk/science/refhub/S0739-8859\(16\)30148-2/,DanalInfo=www.sciencedirect.com+sref9](https://extranet.cranfield.ac.uk/science/refhub/S0739-8859(16)30148-2/,DanalInfo=www.sciencedirect.com+sref9)

¹⁹ Sagaris L and Arora A (2016). Evaluating how cycle-bus integration could contribute to “sustainable” transport. Research in Transportation Economics, Volume 59, November 2016, Pages 218-227. Available at: http://www.sciencedirect.com/science?_ob=ArticleListURL&_method=list&_ArticleListID=-1199800275&_sort=r&_st=13&view=c&md5=c5f106e3ca1bb65b8d571bf2c529246a&searchtype=a

important (Sagaris & Arora, 2015, p.219). Demands are shifting and there is an increasing trend toward use of the private car for short trips. In Santiago, for example, 45% of car trips are under 5 km, generating extreme congestion, which affects bus, cycling and even walking conditions. Simply replacing one mono-mode, the car, with public transport is not sufficient to respond to diverse needs and the characteristics of passengers.

In terms of making the whole inter-modal system easy to use Budd, Ison, and Budd (2015), cited by Ison & Sagaris (2016, p.177), argue that smart and integrated ticketing initiatives made public transport easier and more intuitive to use. A good example was the Oyster pre-payment transport scheme used on London buses, the Underground and Overground rail services. For even greater convenience, at least in developed countries where most people have contactless debit or credit cards, the ability to swipe in and out of the system using a credit card eliminates the need to queue for a ticket and will reduce operators overheads.

Intermodal transport, by definition, involves several decision makers who need to work in collaboration in order for the transport system to run smoothly. Information and Communication Technologies (ICT) may particularly play an important role at the operational planning level of intermodal transport systems. During daily operations, decisions need to be made in real-time. ICT innovations increase the flow of data, improve the timeliness and quality of information and offer the possibility to control and coordinate operations in real-time (Crainic & Kim, 2007) cited by Carisa, Macharisc & Janssens, 2013²⁰).

Carisa, Macharisc & Janssens, (2013, p.110) explain that data exchange is significantly more complex in intermodal transport compared to unimodal transport. This is due to a possible incompatibility between information systems, problems with speed, manageability and volume of the information exchanged a fear of disclosure of explicit information of the companies involved. To alleviate this Dullaert et al. (2009) cited by Carisa, Macharisc & Janssens (2013) developed an agent-based, real-time expert communication platform for the intermodal barge transport chain. The communication platform serves three main purposes: to match supply and demand for barge transport, to enable tracking and tracing of shipments and to facilitate proper reactions to unexpected events.

However overall very little serious effort has been dedicated to the modelling of ICT innovations in intermodal transport, and further research is needed into fast solution approaches to provide decision support in real-time for intermodal transport problems. The inclusion of all the actors in the decision support tools is still an issue. Only looking at the problems from one point of view creates suboptimal solutions. A better understanding of all the actors that are involved and their objectives will enable to integrate them in the decision support systems (Carisa, Macharisc & Janssens, 2013, p.110).

²⁰ Carisa A, Macharisc C, Janssens G (2013). Decision support in intermodal transport: A new research agenda. Computers in Industry. Available at:

https://extranet.cranfield.ac.uk/S0166361512002047/,DanaInfo=ac.els-cdn.com+1-s2.0-S0166361512002047-main.pdf?_tid=4f40a8c8-36fd-11e7-afd7-0000aacb35f&acdnat=1494584904_a80144ffa4b5b772f8ee6a81f5ea63f5

Kreutzberger and Konings (2016²¹) paper identifies that inter-modal rail transport is to play an important role in future freight transport in Europe. CER, the Community of European Railways, supports this view and identifies inter-modal rail transport is a key opportunity for growth within the European rail sector as a more sustainable transport mode.

As the voice of European railways, CER, has published (2011) a ranking of freight customer requirements. Most important is transport reliability, followed by price, available (train) capacity, information, transport time, handling time, transport frequency and ecological aspects. Different studies produce slightly different results; but it can be said with confidence that costs and reliability rank at the top in most studies. It is also identified that customers in need of flexibility will often choose road transport.

Goetz and Vowles (2000, p.18²²) investigate the development of inter-model systems in the US; they state the vision as a seamless, integrated passenger system. They cite the fact that in Europe the transport systems are already more integrated than the US and use the examples of intercity rail stations in the lower levels of major airports, such as Charles de Gaulle and Heathrow.

The three factors Goetz and Vowles (2000, p.28) detail as being critical for a successful inter-model system are; infrastructure, information technology and cooperation, these factors are themes consistent with the majority of papers on inter-model transport systems. To make progress towards a more integrated system information sharing and cooperation between provide, particularly private and public sector to making inter-modalism a reality.

Survey Design

The management question related to the voice of customer led to discussions that boiled down to - what troubled Network Rail's customers the most. To discover this, it was important to explore insights about the customers' point of view. The decision to conduct an online mixed survey (quantitative-qualitative) was reached.

Network Rail owns and operates the railway infrastructure in England, Wales and Scotland which translates to 20,000 miles of track, 40,000 bridges and viaducts and thousands of tunnels, signals, level crossings and points. Network Rail also manages rail timetabling and 18 of the largest stations in England, Scotland and Wales. As such, there are multiple layers of customers, variety of passengers and different categories of people interacting with Network Rail on a daily basis. It was quickly decided that the survey would focus only on the following direct customers in two B2B zones:

1. TOCs responsible for passenger transport

²¹ Kreutzberger E and Konings R (2016). The challenge of appropriate hub terminal and hub-and-spoke network development for seaports and intermodal rail transport in Europe. Research in Transportation Business & Management, Volume 19, June 2016, Pages 83-96. Available at: <https://ntl.bts.gov/lib/17000/17900/17917/PB2001105079.pdf>

²² Goetz, A.R. and Vowles, T.M., (2000). Progress in intermodal passenger transportation: private sector initiatives. *Transp. LJ*, 27, p.475.

2. FOCs responsible for freight transport.

Furthermore, it was important to identify the most critical factors that affect the customer and are directly connected with Network Rail services. Several brainstorming sessions with Network Rail Capacity Planning team identified the following five factors as key:

1. Quality
2. Time (Speed)
3. Cost
4. Capacity
5. Engagement.

The Five factors



Quality:

Quality has a wide scope. With regards to Network Rail, it included:

- Producing the right quality first time and every time
- Reliability and trust on product/service
- Conformance or meeting customer expectation
- Optional extra features like customer delight, ease of understanding, service support.

Covering all these aspects required at least 10 questions on quality alone, which was not possible within our 5-10 minutes slot planned for the entire survey. So, it was decided to measure customer's response on the most important aspect of quality, i.e. customer's perception of timetables delivered on D-0. We also identified an open-ended question on overall customer's perception about quality.

Time (Speed):

Second factor was the time taken by Network Rail to deliver a product or service. Network rail provides different services and the time taken to provide these services varies from 2 to 180 days. But it was not appropriate to restrict survey towards on-time delivery schedule validation alone. Timeliness had to be from the customer's view point. It was not enough if Network Rail delivered on promised time, as the promised time could be a negotiated time between when the customer really wants the item



and the capability of Network Rail to 'deliver the service' (Management, 2011). So, we added a quantitative and a qualitative question to the survey to capture the feedback on lead time.

Cost:

Cost gives a competitive advantage. Even though Network Rail is the only infrastructure company for rail transport, it is created for the larger benefits of common people to make public transport affordable for common people. Cost is from the perspective of value for money and not in relation to an alternative. One quantitative question was asked on product/service cost along with one general question to understand if there were any unknown knowns in the process that could substantially reduce product/service cost of Network Rail.

Capacity:

Network rail is committed to increase its infrastructure capacity thereby transforming and improving performance. (UK, 2017). Network Rail contributes to:

- £1.6 billion per year in productivity gains for UK businesses
- Reduced road congestion
- Environmental benefits planned to be reducing 57% automobile emissions by 2032 compared to projections of 1990 levels.

This increase in capacity is going to affect the product cost and help the service to an increased level. However, to understand the customer's perspective better, a specific quantitative question followed by a generic qualitative question focussed on Network Rail capacity was decided.

Engagement:

Last but not the least, it was significant to know the extent of engagement of Network Rail with their customers. How often do they interact? How participative are they with their customers? It was possible that Network Rail was providing an excellent product which was not effective in its delivery due to poor customer engagement. Network Rail was highly interested in this factor and wanted to know specific areas of engagement issues and so three specific questions were included on customer service for handling feedback while specifying and delivering product/service.

After multiple iterations, a total of 18 questions, a uniform mix of quantitative and qualitative analysis was finalized. To ensure data homogeneity 189 members were selected from 53 different customers and 83 members from internal Network Rail team. There was 27% response. Whole data is summarised below:

Survey Results



65 Unique Responses

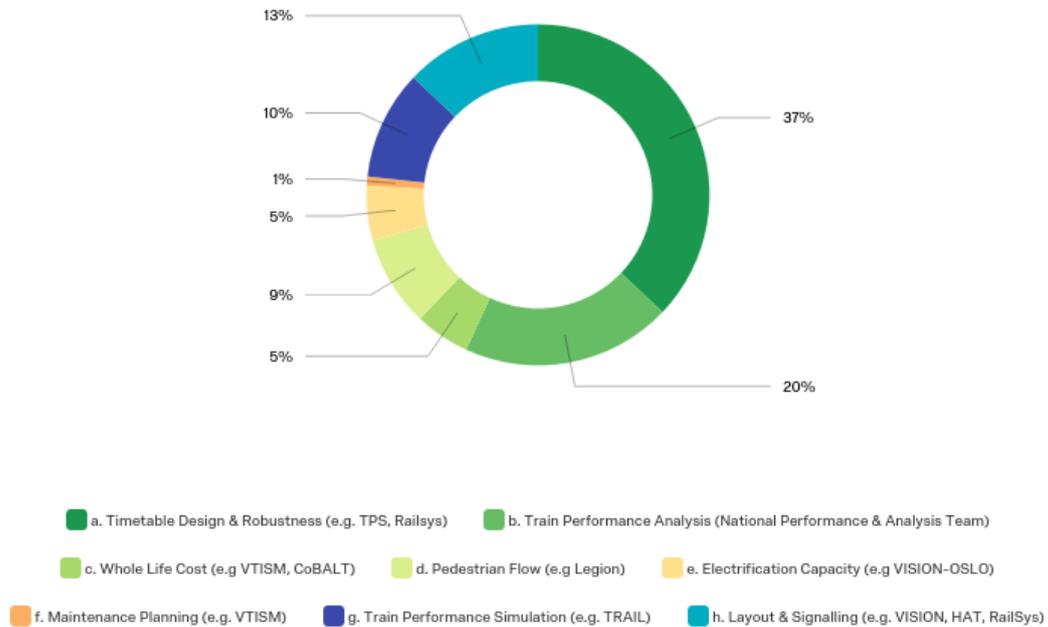
This section describes the results of each question that was part of the survey. Each description is followed by a basic interpretation. The results are then analysed together in later sections to offer meaningful insights. Dataset consists of two major segments. Internal and external customers. The first way to look at data was to take the answers directly on face value. Most of the questions were around a specific area of concern as can be seen from the table below.

For the complete list of questions, see appendix 2.

Quantitative Questions

Out of the 18 questions, 12 were quantitative in nature. The responses were usually on a five-point scale. Quantitative questions are listed in order below. There maybe a few skipped question, and the reason is they are qualitative text entry question which are discussed in the next section.

Question 1 was directed towards finding the split between 12 different modelling services.



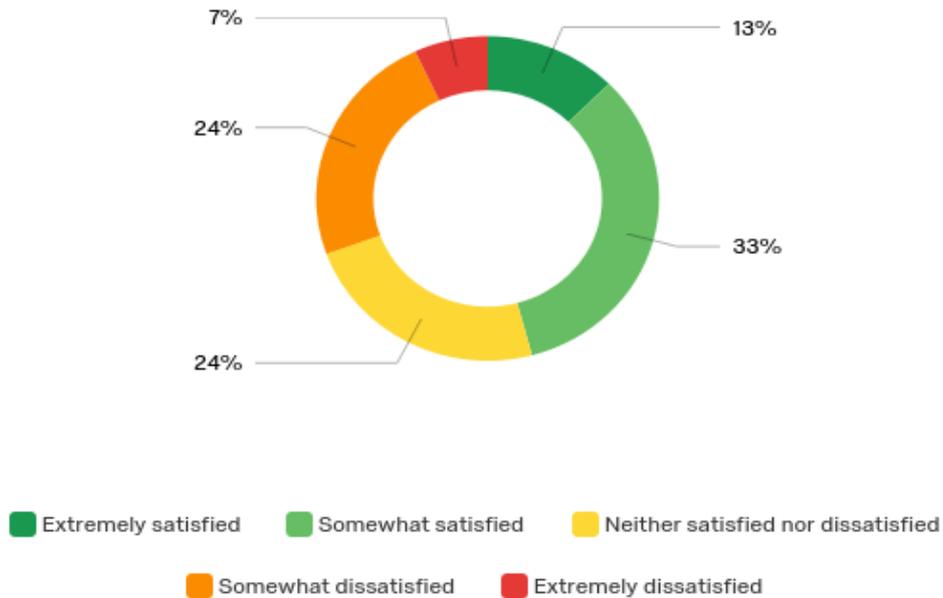
Users of different modelling software

Most users are split between two modelling services, namely Timetable Design & Robustness (37%) and Train Performance Analysis (20%). Followed by Layout & Signalling (13%) and Train Performance Simulation (10%).

The demographic data collected is around the specific modelling system being used as part of the services offered by Network Rail.

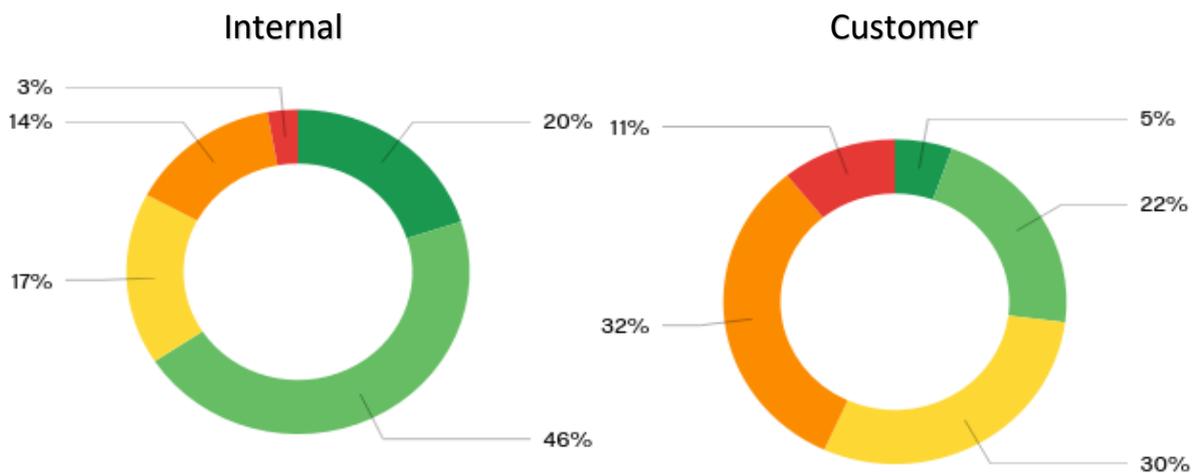
Question 2 was intended to find the overall satisfaction with Network Rails modelling and simulation services.

The below figure shows that of all the respondents, a majority were either satisfied or have reported a “neither satisfied nor unsatisfied” response.



Overall satisfaction Score

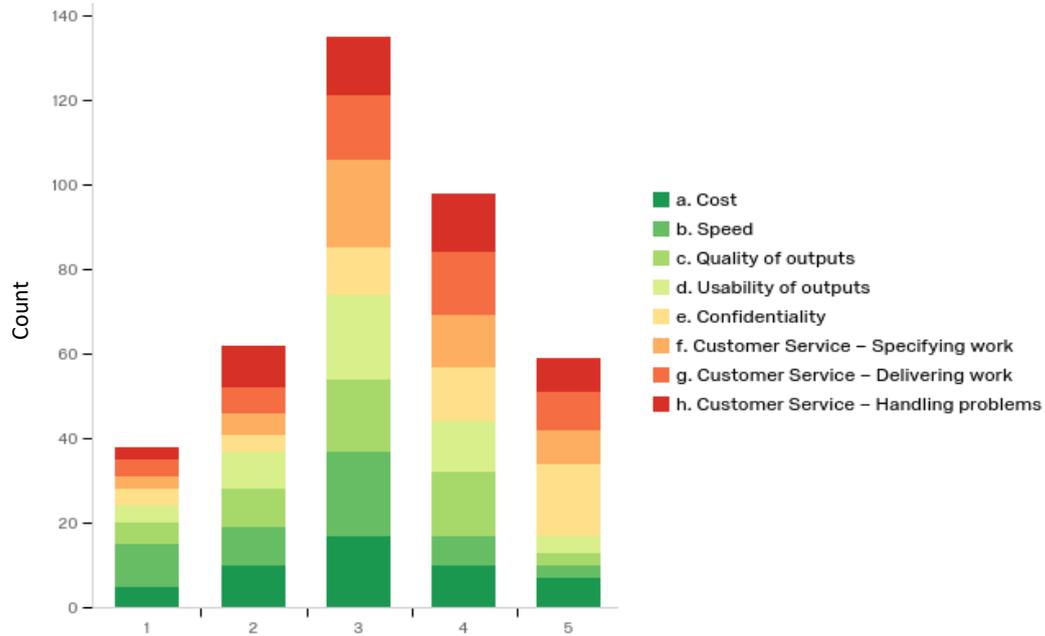
However, looking at the response by splitting the responses from external customers and those from within the organisation reveals that external customers have reported lower scores of satisfaction.



Internal & Customer Overall Satisfaction Scores

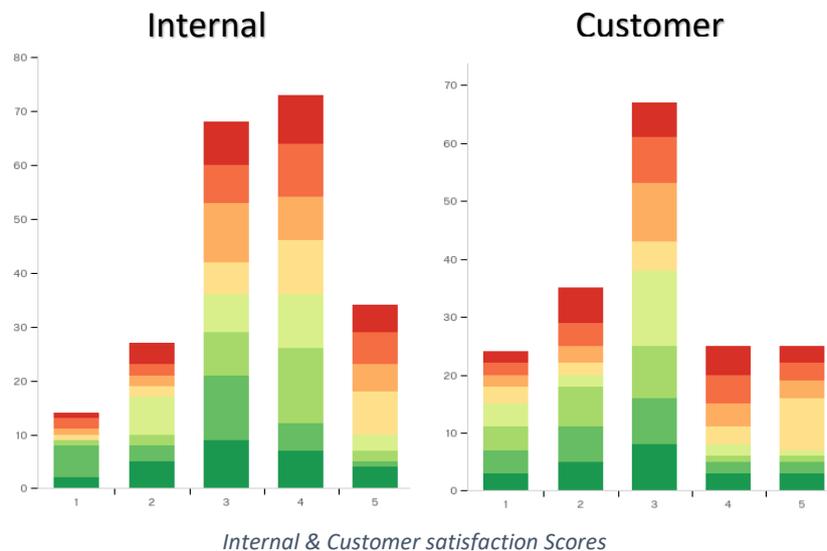
This raises a question that if internal users are happy with the services, why external users are not reporting similar scores.

Question 4 was a matrixed table question which asked respondents to rate various aspects of the Network Rail service on a scale of 1 to 5 (5 being most satisfied)



Ratings (5 beings most satisfied)

Overall most respondents have reported moderate to high satisfaction. Below is the graph of the same question with a split of internal and external customer responses.



Internal & Customer satisfaction Scores

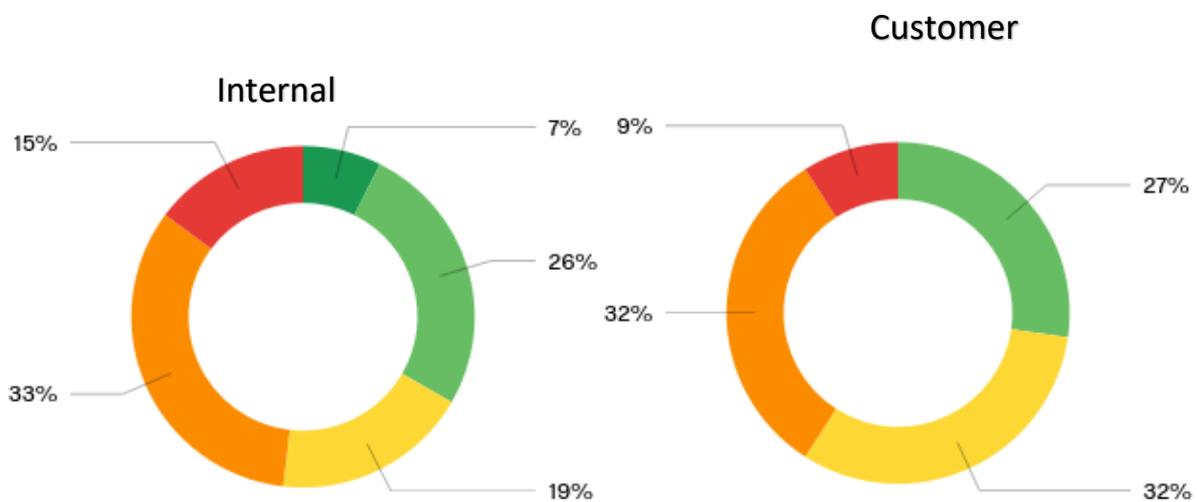
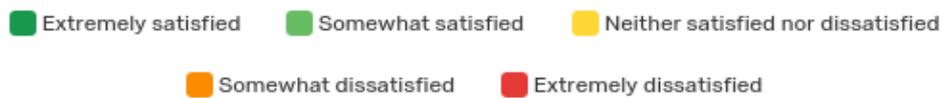
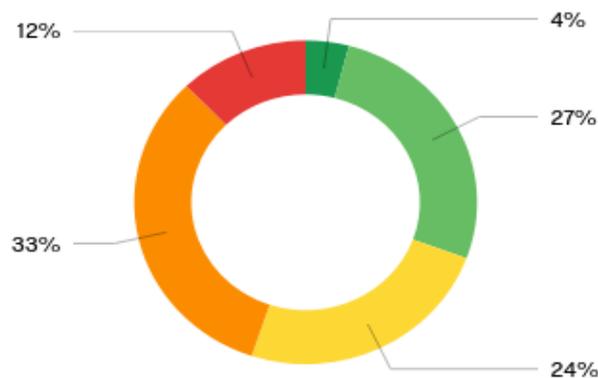
We observe from the above graphs that in the case of the customer response:

$$\sum n(\text{Score of } 1 \text{ \& } 2) > \sum n(\text{Scores of } 3 \text{ \& } 4)$$

This is in line with the observation on question 2 where the overall satisfaction was lower for external customer responses.

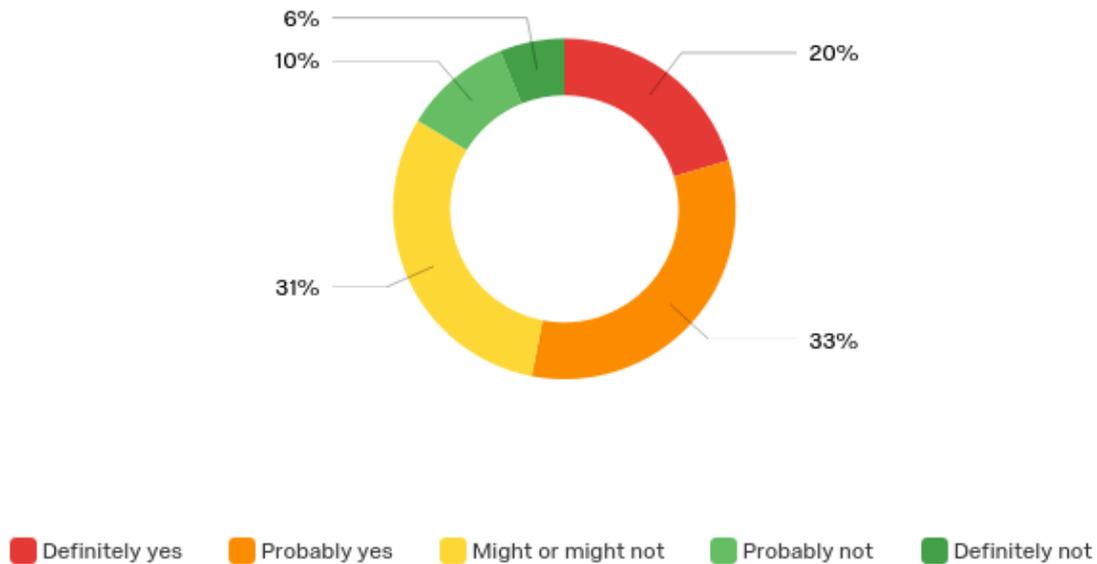
Question 5 was to find the overall satisfaction with the time required to model the requirements.

Overall satisfaction with time required to model is moderate with 45% not satisfied.

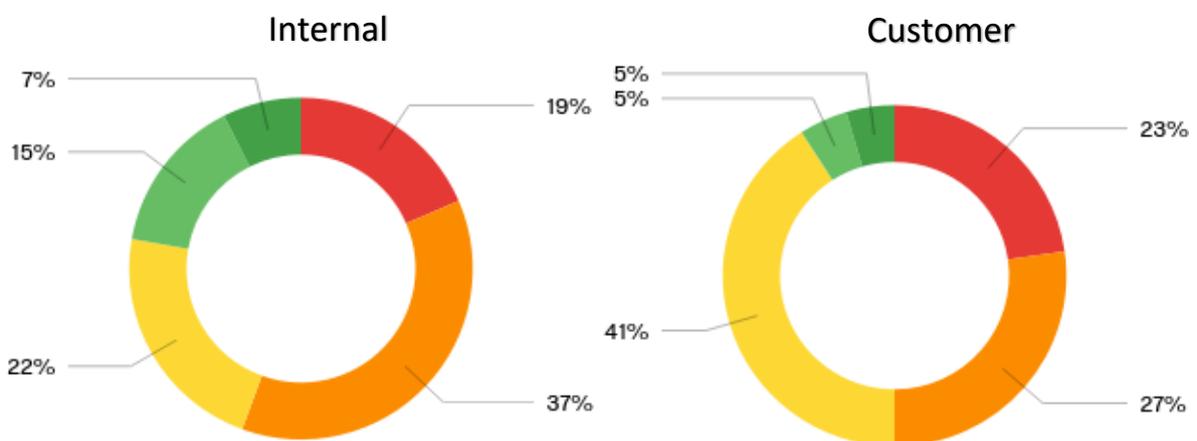


It is to be noted that there was high similarity between the response of internal and external customers for this question.

Question 6 was to find if the modelling required re-work in the eyes of the respondents.



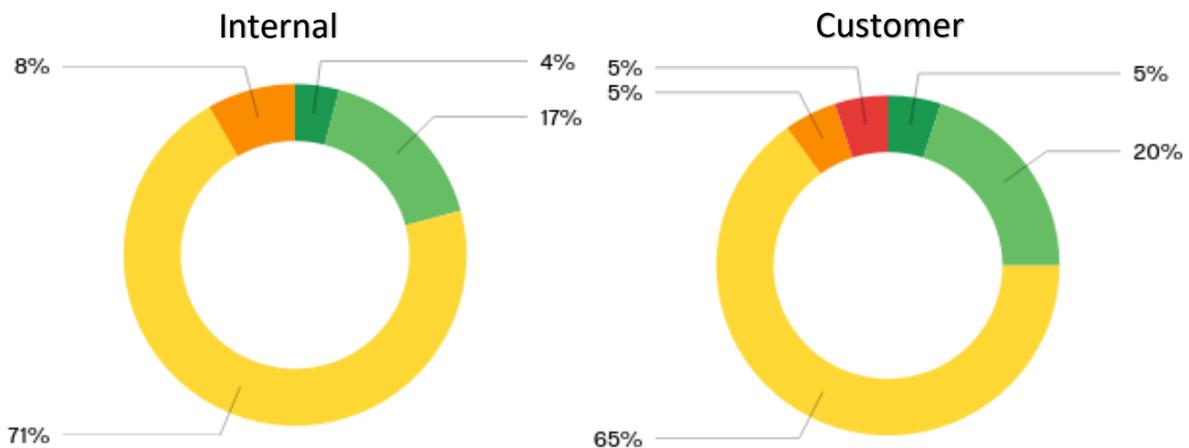
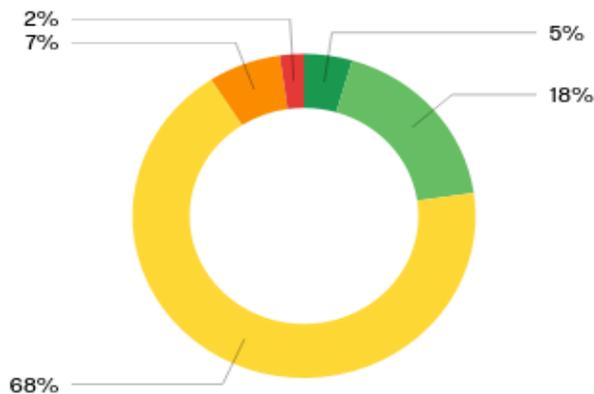
Only 16% respondents believe the modelling work does not require rework. Since rework affects all parties involved, understandably, this question has low satisfaction response from both internal and external respondents.



An important take-away from this point is that rework is a symptom. The cause of rework could be for various reasons such as poor input data, lack of process or coordination etc.

Question 8 was to find if they are satisfied with the first iteration of the modelled timetable, referred to as D-0.

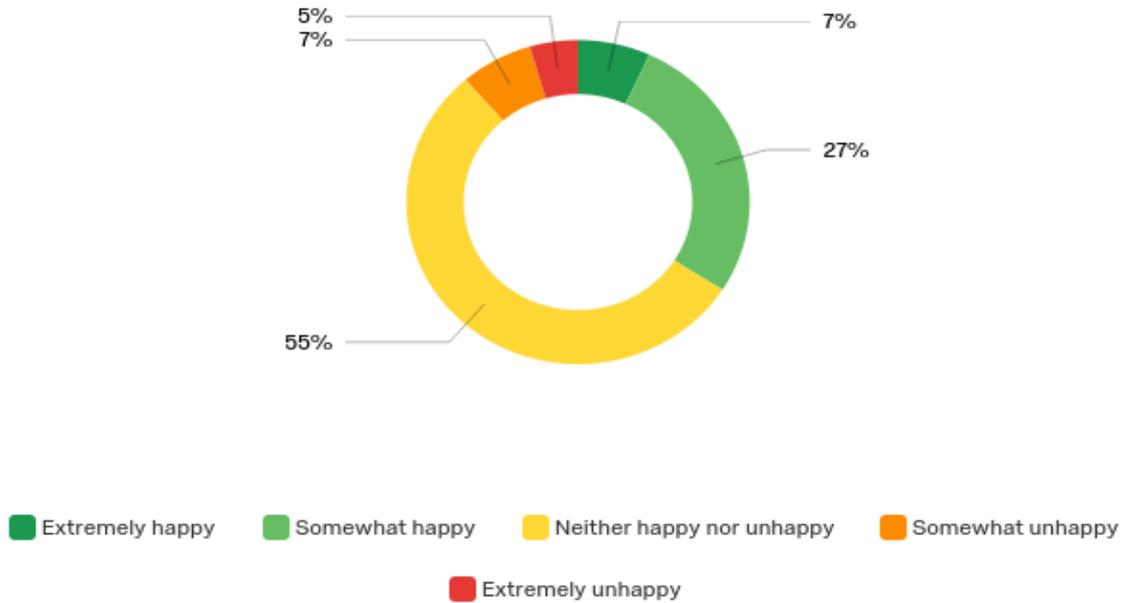
23% respondents believe that they are clearly satisfied with the output.



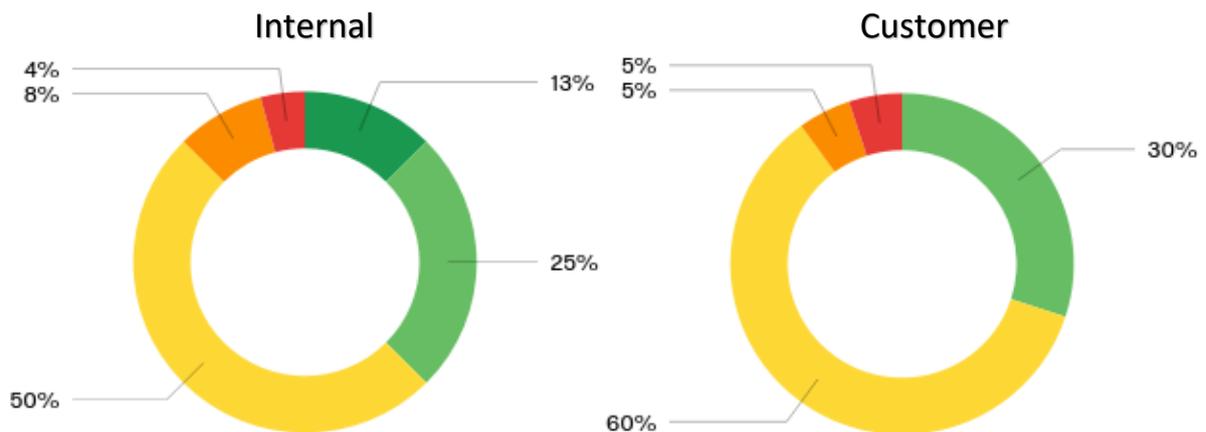
This is similar to another question, like question 5 on overall satisfaction, where respondents both internal and external have replied similar to each other.

Question 9 was to find if they are satisfied with other deliverables that are part of the modelling process other than the timetable.

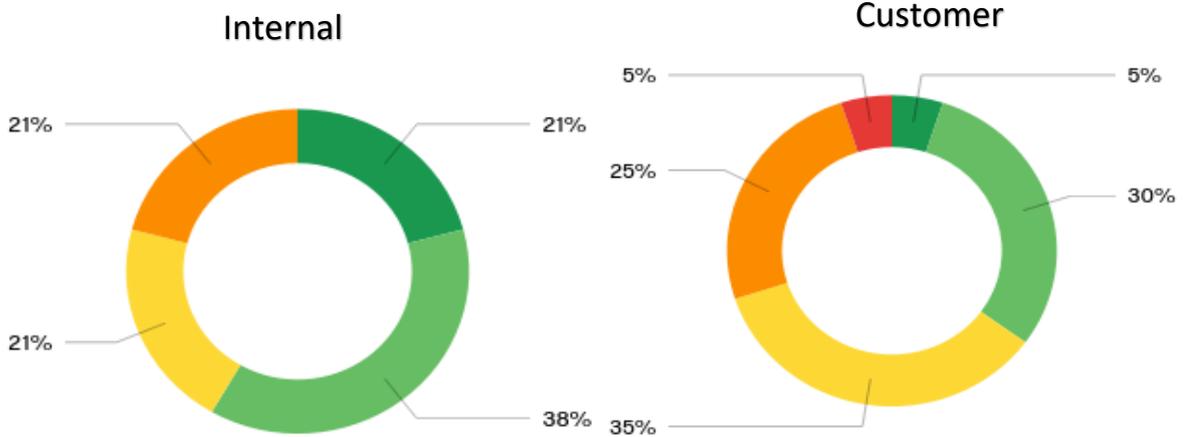
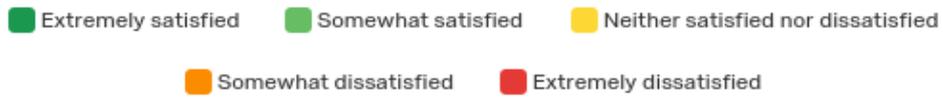
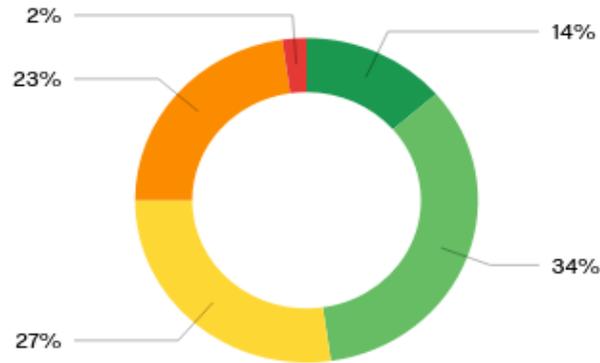
It can be seen that 34% of respondents have clearly reported a satisfied score. In addition, the majority has responded in the middle with over 55% choosing that option.



The significantly large number of “in the middle” response could also be due to the open-ended nature of the question. During the survey, if the respondent was not able to think of any exact good or bad situation, then the obvious choice will be the middle option.



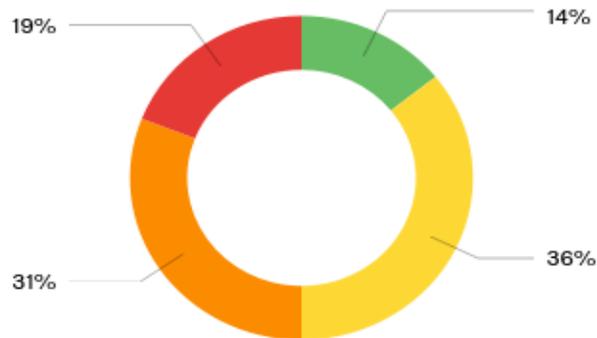
Question 10 was to find if respondents are satisfied with the issue resolution by Network Rail.



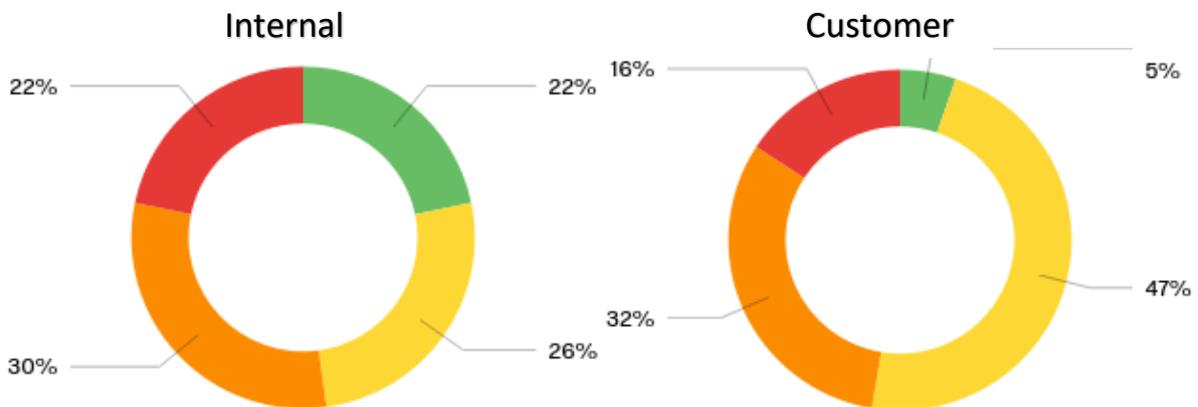
The above charts show that 35% customers reported satisfied score with 35% in the middle. Also, that there is a major difference in responses between internal and external respondents.

Question 12 was to find out if respondents believe that the modelling solution allows management of uncertainty.

Major observation is that there are no responses under “Extremely well”. 50% have answered in the negative. The balance 50% is comprised of “moderately” and “slightly well”.



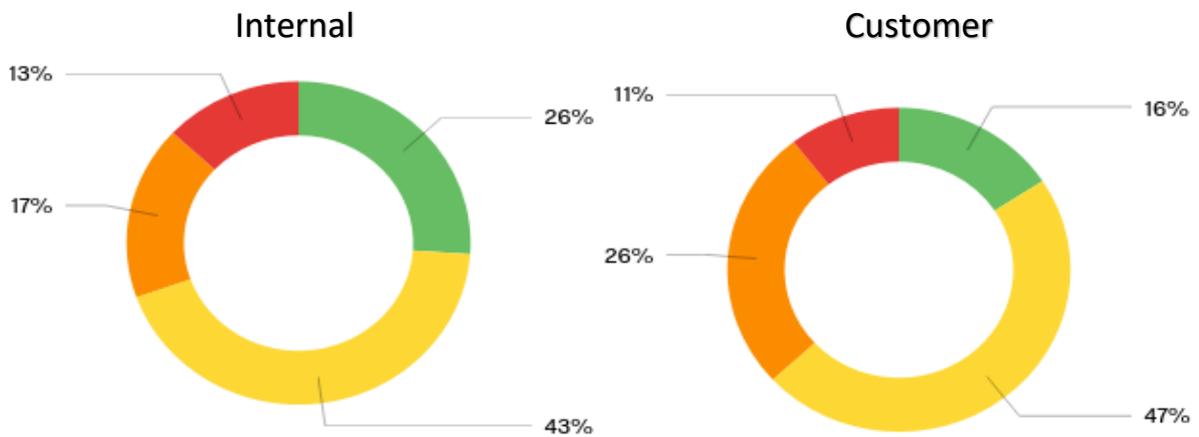
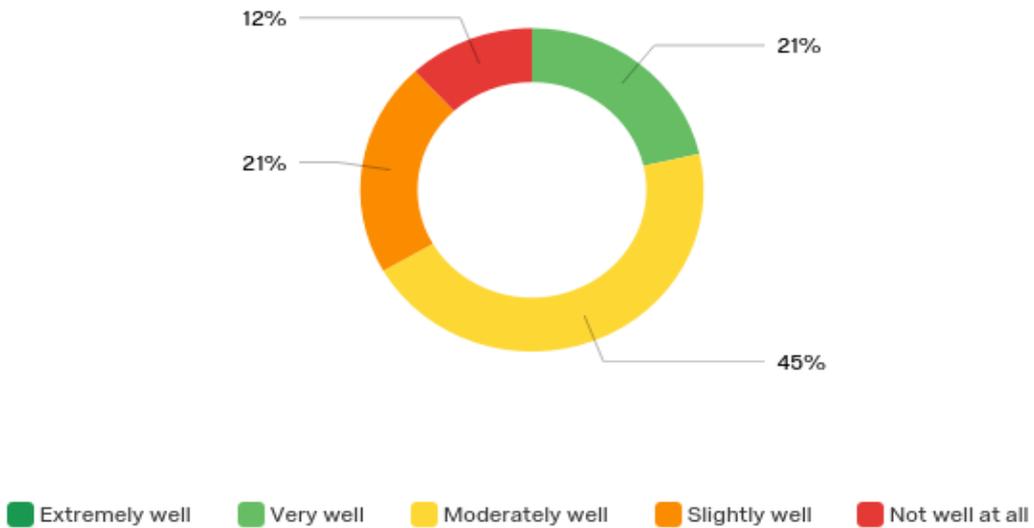
■ Extremely well
 ■ Very well
 ■ Moderately well
 ■ Slightly well
 ■ Not well at all



A very low count of customers answered in the positive. Even though the positive response is only 5%, the majority of customers responded with less than well ratings.

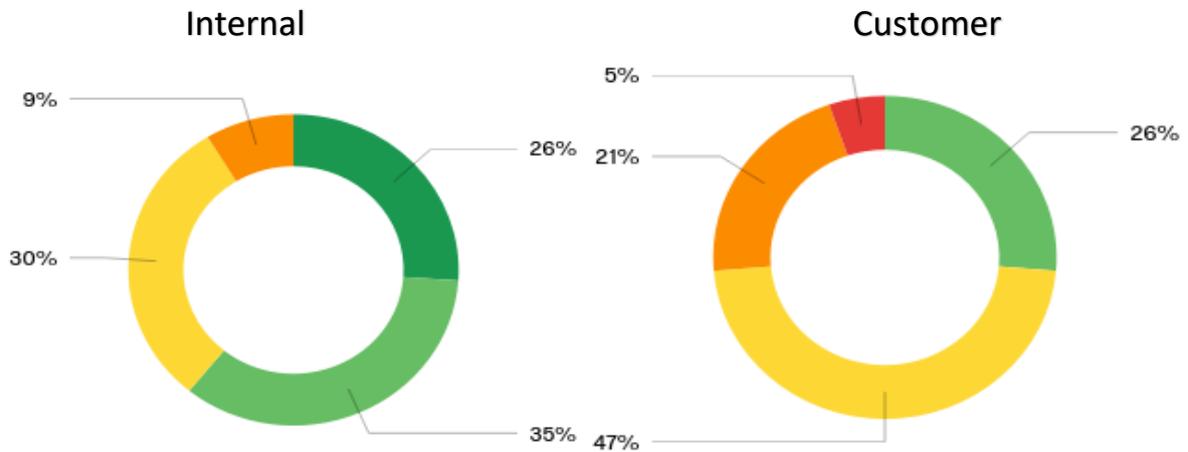
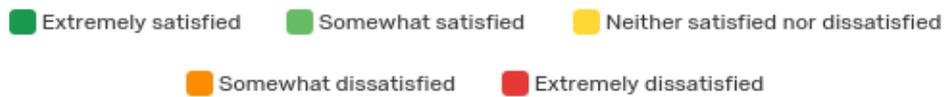
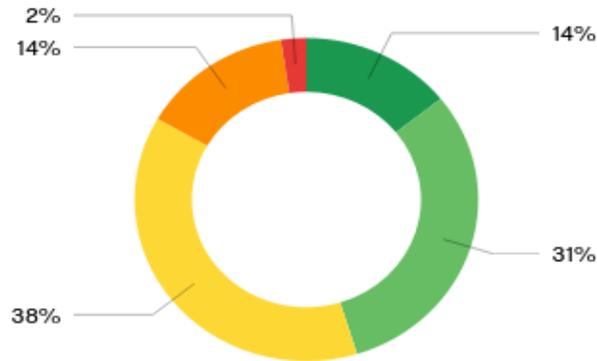
Question 13 was to find out if respondents believe that the modelling solution helps with decision support.

33% of respondents said they do not think that the modelling solution helps decision support.



It could be argued that unlike many responses, both sections of the respondents have very similar spread among the answer choices.

Question 15 was to find if respondents are satisfied with the ease of doing business with Network Rail.

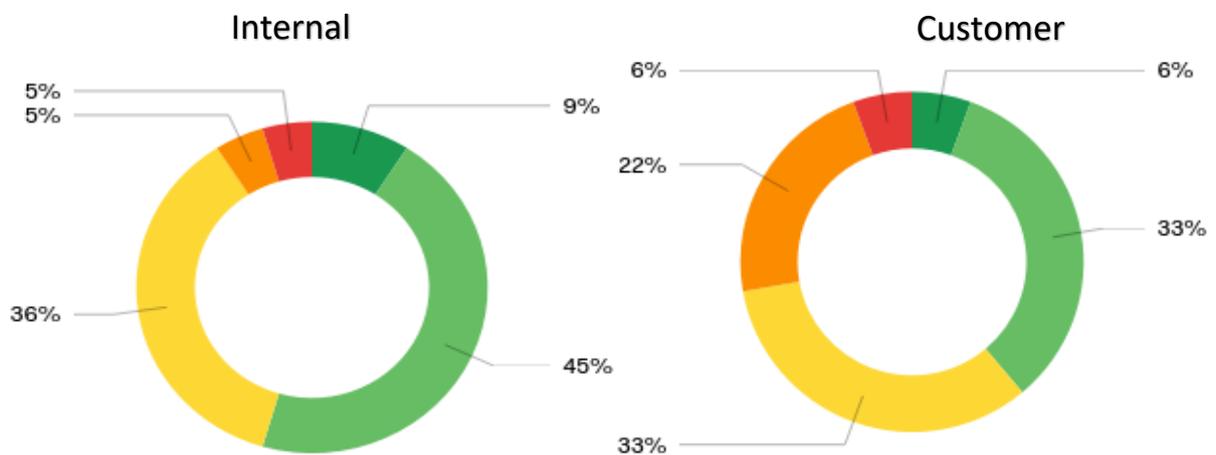
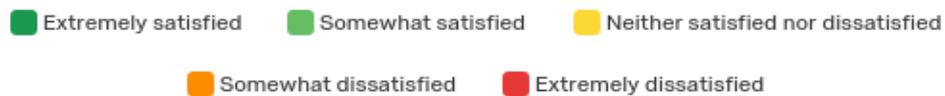
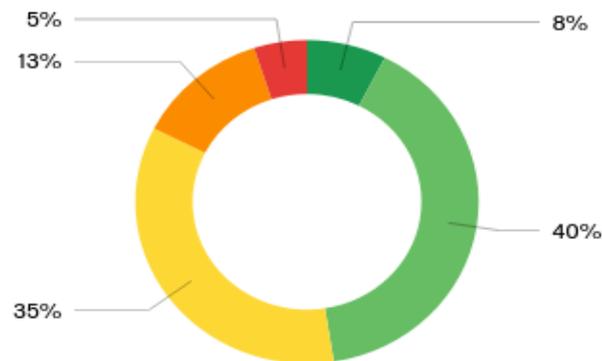


As this question is focussed towards the external customer, it is to be noted that 26% replied in a negative. The majority, almost 50% were in the middle. Only 26% of the customers responded that they are happy with the ease of doing business with Network Rail.

In this case, the response from the internal customers may not be entirely relevant and hence has been kept out of analysis.

Question 16 was to find if respondents are satisfied communicating with Network Rail.

We can see that a significant majority, on the overall, say that they are satisfied with the communications. Only 18% responded as somewhat or extremely dissatisfied.



25% of customers responded that they are unsatisfied with the communication with Network Rail.

Qualitative Questions

The qualitative questions were open ended and requested for suggestions and ideas on how to make the service better. Like the quantitative questions, these questions focussed mainly on the five factors of Cost, Quality, Time, Capacity and Engagement.

Respondents reacted with valuable suggestions and feedback. Some responses encompassed more than one factor. Each response was then coded into smaller sentences and then again into single factors that the respondents felt most strongly about.

To remove bias, three members of the team carried out the coding. The three different scores were then averaged.

The resulting coding table is as below.

<i>Questions</i>	<i>Cost</i>	<i>Quality</i>	<i>Time</i>	<i>Capacity</i>	<i>Engagement</i>	<i>Process</i>
<i>Q3</i>	<i>0</i>	<i>3</i>	<i>5</i>	<i>17</i>	<i>8</i>	<i>21</i>
<i>Q7</i>	<i>0</i>	<i>6</i>	<i>0</i>	<i>10</i>	<i>10</i>	<i>6</i>
<i>Q11</i>	<i>0</i>	<i>1</i>	<i>1</i>	<i>7</i>	<i>5</i>	<i>2</i>
<i>Q17</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>15</i>	<i>5</i>
<i>Q18</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>6</i>	<i>4</i>	<i>3</i>
<i>Total</i>	<i>0</i>	<i>10</i>	<i>6</i>	<i>40</i>	<i>42</i>	<i>37</i>

Qualitative Question Coding Table

Very clearly three parameters stand out. Interestingly, the third highest parameter is not directly among the original list of factors that were being considered.

This process was important as there were about 37 different instances during which it was mentioned by users. This is very close the second highest factor of Capacity which featured 40 times. While some of the instances maybe positive and some negative, the coding table helps in identifying the importance of any one factor as compared to another.

The scope under which a factor qualifies to be counted in the table is intentionally kept broad so as to discover trends rather than identify exact issue at this stage.

The top three factors that are most important to the users of the modelling service should be further explored in detail in future survey and analysis. It can be assumed at this stage that various interconnected reasons may be to be blame for the high importance

Expected Findings

Based on the frequency with which each factor appeared in the responses, the factors were rearranged in order of its importance to the respondents.

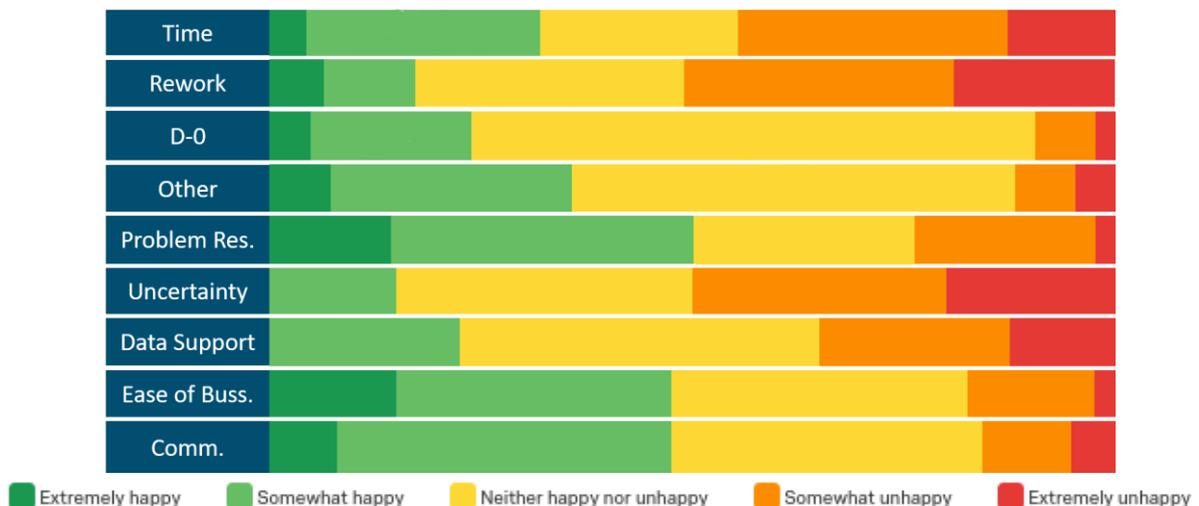
The most important factor is engagement, which is evident by the high scores in the coding table across all qualitative question. Even in the quantitative questions numbers 10, 15 and 16, it is easy to observe that a big portion is in the middle (neutral responses), hence it can be assumed that it is these respondents who have made the maximum comments towards improving engagement.

The second most important factor, identified consistently by both internal and external respondents, is Capacity. During analysis of the responses, it was discovered that respondents have made some clear comments on various aspects of capacity. These aspects are discussed in the following section.



Unexpected Findings

Due to the complexity of the modelling process, it was expected that responses would be highly polarised with respondents picking sides on the satisfied to unsatisfied spectrum. However, the same reason could be implicated for a high “in the middle” response as is evident with the high YELLOW colour bars in the graph below. Due to this, all quantitative response were looked at in conjunction with qualitative answers to avoid misinterpretation of responses.



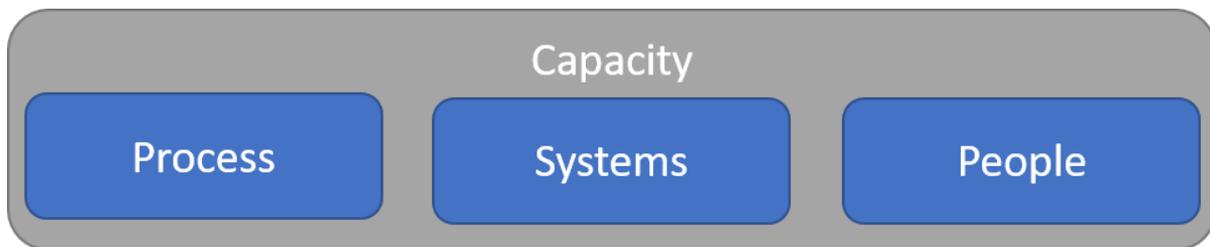
Customer perspectives on current processes and models

There were significant insights during the analysis. Clearly, customers wanted improved communication system, more transparent results and regular updates on their work process.

In addition, a good number of external customers sought Network Rail resources as areas of concern. The common themes gathered from customer comments suggested:

- Improve Network Rail resource for better turn around
- Better understanding of customer need
- Understanding of local needs
- better trained personnel

Internal customers had a differing focus on the same questions. Most internal customers wanted improved capacity. They specifically complained about the speed and capacity of Timetable Performance & Analysis System, Traction Power Supply modelling, System speed, performance etc.



Clearly, both internal and external customers agreed that some aspect of delivered product/service needed improvement. While the internal customer expressed their unhappiness about the internal facility the customer clearly wanted personnel for understanding their need better.

This raises one key question. Is there a major disconnect between Network Rail internal team and the customer? There is clear possibility that the customer wants a simple to understand system but is not able to communicate it while the internal team is very technical in everything. There seems to be a substantial gap in the definition of the same problem between the internal Network Rail people and their external customers. Is there a lack of training in Network Rail to understand customer's perspective?

One very interesting comment from a customer requested for "More concise easier to understand reports, better industry knowledge, proactive approach rather than spoon fed all the time, more resources that need an apprentice as people always moving on." This begs the question is Network Rail approach too detailed, too technical for the customer?

Customer Expectations

The open ended qualitative questions provided insights into what would satisfy the customers. Some comments and feedbacks clearly indicated that the customer was not happy with the speed of response and expects more prompt response to their queries. There was a feeling that they were treated like an isolated user rather than a partner. Network Rail customers expected updates on the progress of work and any major challenges that their bespoke work or even standard request is facing.

We did not get major feedback on product failure or not-working time tables. There was no comment on cost or delivery schedule. Though we cannot rule out the possibility of their importance, the surveyed customer primary expectation is on improving responsiveness from Network Rail team.

Recommendations

To overcome the complaints about capacity, we recommend the following:

- 1) People: More training for teams working in the first phase of any modelling project. Proper data gathering and expectation management will reduce customer complaints. This recommendation stems from the comments in which incorrect understanding of requirements led to customer dissatisfaction.
- 2) Process: Network Rail should look for an independent review and benchmarking of internal processes to identify strengths and areas for improvement.
- 3) System: Technological upgrades seem imminent with the growing complexity of the transport systems as a whole. However, any system upgrade will be inefficient if the standards and data exchange methods are not streamlined across stakeholders.

The importance of communicating with the customers cannot be overstated. The same point came up multiple times during the survey. On open ended qualitative response, external customers expressed concern about the difficulty communicating with their working partners within Network Rail. Recommendations to improve customer engagement as listed below:

- 1) Identify specific guidelines that relate to customer communication and measure the actual response rates. We recommend that actual response rates to customer communication be part of Key Performance Indicators (KPIs).
- 2) Establish a customer engagement team. If such a team is already available, carry out a problem-solving exercise to ascertain effectiveness.

Acknowledging the fact that Network Rail is seeking to double its capacity by 2030, several insights can be gathered from the literature review. The 2030 plan would not be achieved without significant investment, not only in infrastructure, but also in technology. The latter which would be more costly, is also more important. China, Japan and France have been running bullet trains for quite some time; it is essential for the UK to adopt this service especially given the fact that daily journeys are operated between London and Edinburgh for instance. Advanced technology and infrastructure essentially



minimize threats/concerns such as terrorism, disruptions, and capacity resulting in cost saving not only for Network Rail, but also for the different rail users. These points are key factors towards what is known as the 'intermodality' of the transportation system. Working on maximising capacity by 2030 is essential, but realising that more can be done in terms of future vision of transportation is equally important.

Strategic Implications

The two major strategic implications of undertaking the recommendations are as follows:

- 1) Increased customer satisfaction – effective delivery of Network Rail's services would produce delighted customers, who will view Network Rail as an enabling partner empowering them to achieve their ultimate goals.
- 2) Cost optimisations: With process improvement, there will be reduced incidents of re-work and operational delays. These, as well as prompt response will help maximise the man-hours, leading to cost savings and promoting profitability.

Conclusion

As the British rail infrastructure owner, Network Rail is the largest provider of modelling and simulation services to all operators which utilise its infrastructure. As each and every operator is important, the demand to process all the various requests is challenging.

It is key for the Network Rail to understand their customers' insights in order to fulfil the mission of doubling capacity by 2030 since the demand on Network Rail for such services is only going to increase.

The data gathered and analysed during the survey serves as a starting point for the WSM team for further business development.

While customers are being served well, performance gaps exist. Network Rail is well positioned to address these gaps and satisfy its customers.



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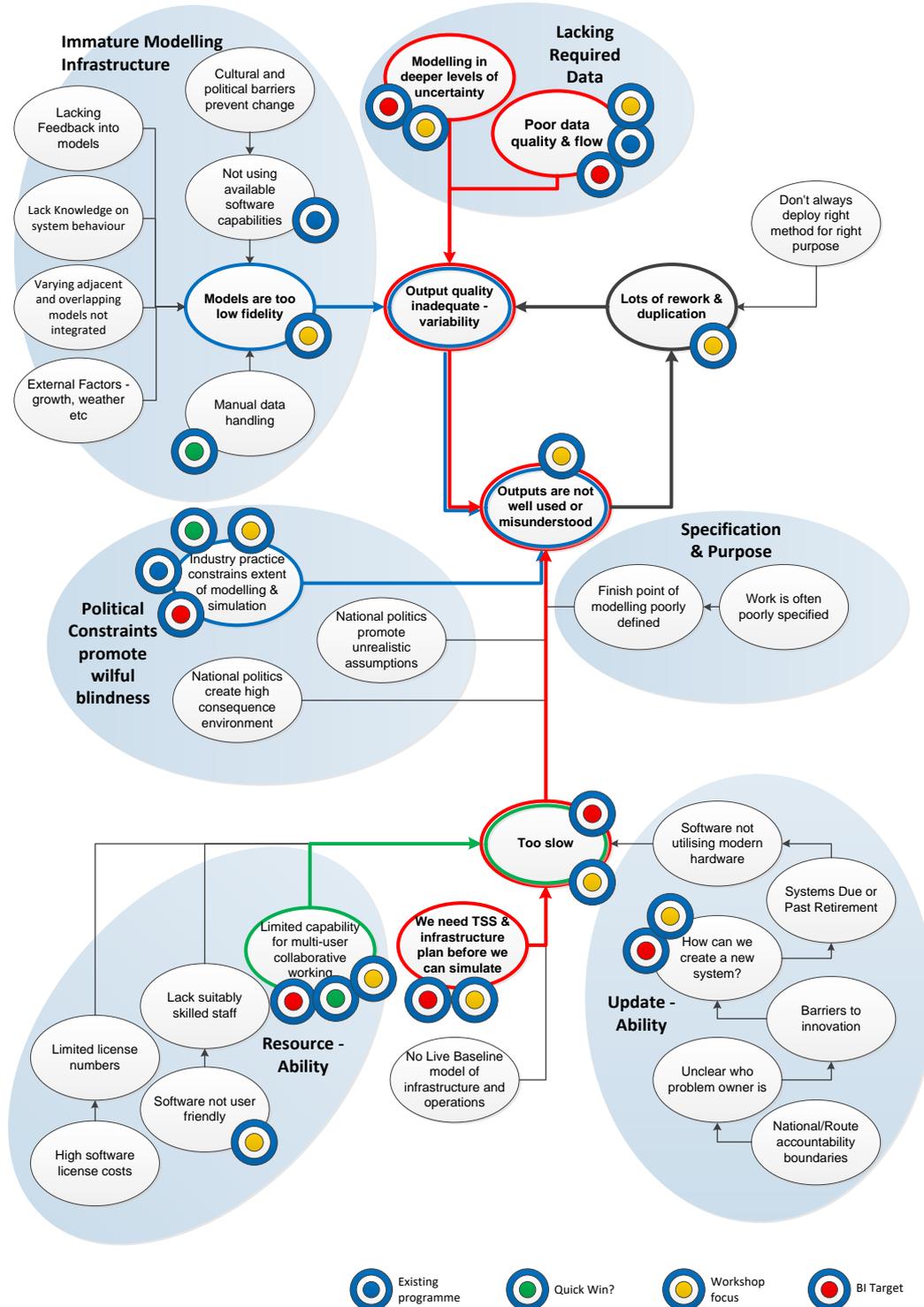
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Appendix 1 - Problem Space Map

Whole Systems Modelling – Problem Space Map - DRAFT





Appendix 2

Network Rail Survey

Improving capacity, performance, and cost at the same time means we need to use the network better, and we need to get it right first time. To do this we need to simulate changes to services and infrastructure to predict their individual and combined impact on railway operations. We are building a portfolio of work to enhance capability in this area and we want to ensure that we align our work to real needs. This is your opportunity to direct us towards solutions that will yield value for you; please fill in the questionnaire and if you can, volunteer for a follow up interview.

Your feedback is greatly appreciated!

Q1. Which of the following modelling services have you used within the past 2 years? (Tick all that apply)

Q2. How satisfied are you with Network Rail's modelling and simulation services?

Q3. Please suggest one aspect of the service that we could improve to increase your satisfaction and overall experience.

Q4. On a scale of 1 to 5 (5 being completely satisfied), how do you rate the following factors when engaging with Network Rail modelling and simulation services?

a. Cost

b. Speed

c. Quality of outputs

d. Usability of outputs

e. Confidentiality

f. Customer Service – Specifying work g. Customer Service – Delivering work h. Customer Service – Handling problems

Q5. How satisfied are you with the overall time required to model your requirements?

Q6. Do you believe your work involves rework and duplication of effort?

Q7. How do you think we could improve timeliness/ improve value for money?

Q8. How happy are you with timetables delivered on D-0?

Q9. How happy are you with other deliverables?

Q10. If a quality issue arises, how satisfied are you with how Network Rail strives to make sure it is quickly and appropriately resolved?

Q11. What do you think would help in improving deliverables or service?



- Q12. How well do the current modelling and simulation allow you to manage uncertainty?
- Q13. How well does current data sharing enable decision support?
- Q14. Are there any additional services you would like to have available in the modelling and simulation area?
- Q15. How satisfied are you with the ease of doing business with modelling and simulation functions within Network Rail?
- Q16. How satisfied are you with Network Rail's overall communications?
- Q17. What one thing can help us improve our communication with you?
- Q18. Is there anything else you would like to tell us?
- Q19. If you are willing to be contacted by a member of the survey team for a 15 minute phone interview, kindly leave your contact details.



Appendix 3

Question 3
Please suggest one aspect of the service that we could improve to increase your satisfaction and overall experience.
Quicker, more agile - timescales are generally pretty long and unable to do anything with a fast turnaround.
Better baseline information on SRTs
Standardised reporting across routes
Resourcing available to turn around queries. Quality is good but limited resource makes it difficult to engage quickly.
As an external user of TPS it would be appreciated if we could be notified when there are outages/problems with the TPS system as we are not normally notified and have to ring the IT helpdesk for an idea of what problems there are.
There continue to be issues providing Traction power Supply modelling. The availability of resource to model is insufficient, it costs too much and takes too long.
The bespoke Weed Killer requires to carry out reverse moves at locations which are in the sectional appendix and at signal numbers. Too often the validated offers will only process Tiplocs within ITPS . This in turn increases circuit lengths, unnecessary Transit moves to the next Reversal point and wastes Fuel which is not environmentally friendly. Each time we request a new RM to be created to match the infrastructure we are told that it is too costly. This can apply to all bespoke SCO services like the UTU, Track recorder and Sandite.
Actually have staff that know what they are doing in Train Planning, and concentrate on what they are supposed to be doing instead of pie in the sky.
Modelling is often de-scoped and doesn't outputs quick enough or detailed enough
poor attention to detail , lacked information or evidence to support outputs and most of all was inaccurate due to lack of geography.
Links between systems are absent and therefore a lot of time is wasted transitioning between systems. Therefore a way of reducing the wasted time would improve my satisfaction
To be more responsive to the customer . It feels like it takes ages to try and get some information. e.g. new infrastructure being available - but not being able to time trains until 6 months after.
More timely and accurate outputs for capacity studies
Speed of the TPS system
A better understanding how data is transferred to TRAIL to ensure that data is provided in a correct way.



Qualitative analysis of capacity is excellent and quantitative analysis of timetable planning rules is good but find data to answer questions about how we should allocate capacity when making trade-offs between capacity and performance is nearly impossible.

Better resource levels to meet **quicker turnaround**

Resource in some of the teams needs to be **increased** to allow work to start faster rather than a long wait period.

Engage with operators more about the detailed subject matter, at an early stage, so that we know what is going on and can comment on the data being used and the assumptions being made. It is frustrating when many hours are spent doing a piece of work that adds little value because it does not reflect actual operations or actual TOC aspirations.

More local knowledge

The modelling has all been done in connection with the Thameslink Programme and much of this is undertaken by the in-house team. Whilst the modelling is done well and robustly it is a common theme that the current industry modelling tools require full and perfect information to be fed in. This means for instance that perfect, de-conflicted timetables are needed before any form of performance modelling can even be started. This leads to very long timescales (months if not years) between iterations. In schedule driven programmes this is a major constraint and timescales have and will continue to get squeezed. Some other industry sectors with similar issues have developed modelling tools that can deal with uncertainty yet still yield (80:20) outputs that can inform decision making and can inform where the pinch points are much earlier in the lifecycle.

using a survey that recognised it's own options. Why offer 'continue without answering and requiring an answer'?

We are already working on improving our models in all of the areas I ticked above. A very significant aspect that is critical to all modelling/simulation is confidence in the underlying data. When that data is captured automatically (via sensors/loggers) there is more confidence, but when it is entered manually, especially in free text fields, then that can sometimes be unreliable.

Not only do we want better models, we also want better data.

External User logging in can be time consuming

Results are **rarely delivered in a timely fashion** (within agreed timescales) and reports are not well written. There is then an extended period needed to comment and refine the output and reports into the required clarity and certainty. In a number of cases there is far too much reluctance on the part of Network Rail to definitively state what outputs are possible from infrastructure enhancements which leads to uncertainty on the value of investment and does not allow for properly evidenced decisions to be made. Furthermore, Network Rail's reliance on the TRIP process for updating Train Planning Rule values further calls into question the value and reliability of values calculated by Railsys, this can only add to the uncertainty going forward.

The expertise and understanding of network capacity and train performance in the UK is consistently below par when compared with at least some other railways. Often this is driven by the belief that greater detail in some areas delivers a more accurate result. It means that processes often take long, rely on too many detailed assumptions which are unknown at the time and therefore don't deliver sufficient evidence to robustly support decision making during option design development. There is no quick fix, but greater attempts should be made by the specialist teams to learn lessons from other railways.

More holistic modelling, rather than modelling **things in isolation**. **Possibly linking** assumptions across different modelling tasks.

System Stability

Easier access to the TPS system (i.e. much more robust Citrix portal)

Apart from the times when as an external customer I cannot access the system, when it works it is ok,

Need something to understand the **trade-off between** capacity and performance

More reliable. Suffers from intermittent connection problems and can sometimes take a considerable amount of time to connect.

New to role - unable to provide constructive criticism at this time

Further work to identify areas where **accuracy of modelling** can be improved, more specifically transfer of load data from Oslo to the integration of load with ETAP or DINIS

On many occasions we ask for modelling and capacity **information at is not forthcoming**. Requests need to be made so early and then there is no mechanism for feedback back on how the work is going - quite often eg Liverpool information is never received.

Having the correct IT infrastructure in place is a big must if we're to succeed modelling the railway as a system and start linking some of the areas above. This means having more powerful computers for employees running models and doing technical work on a daily basis as well as being able to get the appropriate software running on our machines as soon as possible.

There is **no link between the differing systems** which makes integration difficult and complex, a system whereby there is a streamlined way to transfer the data would improve efficiency,

Modelling, to inform potential timetables, **needs to be done far more quickly** than is currently the case.

Network Rail should engage more with the service users.

Needing **one model to assess** the impact on performance of changing assets or train services - and being able to use this model quickly and access outputs quickly

Performance modelling **takes too long and produces woolly outputs**



Better access for external users of NR systems. The ability to run/test our own simulations/plans prior to submitting them would reduce abortive work.

I'm not sure there is a really effective whole system approach to performance modelling that provides suitable assurance as to future performance that meets the needs of the industry. Performance Modelling based on 'look back' seems to automatically lead to a view that performance will worsen as a result of any changes, this can lead to stasis or paralysis in delivery to the passenger. We really need, as an industry, to be able to improve our modelling capability.

Train Performance Simulation - Speed and flexibility of service offering

We currently outsource Legion Modelling to WSP at London Bridge. Would be great if we had the technology and resource to do this in house.

Ensuring users understand the capabilities and limitations of the models. They are good servants but bad masters. There is a tendency amongst the less-experienced to consider the results absolute and not understand how they have to be carefully interpreted, allowing for both the strength and weakness of the model and its calibration.

When I used Railsys I was concerned about the validity of it's outputs.

better understanding & communication of modelling process leading to more accurate delivery estimation

Question 7

How do you think we could improve timeliness/ improve value for money?

I'm not able to say...better systems and baseline information perhaps

Again greater resource

Delivering to milestones that were agreed at the outset

The NR ROUTE PLANNING TEAMS **need to process worksites and maintenance trains by week number form cradle to grave**. Too often over several years trains which have been built into the plan by the long term team are then missed or ignored by mid term and short term teams. there is little or no continuity with in the current system. I have experienced "blame game" between the various departments at times. Also we have requested protected paths to be created and in some areas Kent and Sussex the response has been "we don't have the time or staff to do it" yet if it was visible it would prevent late possession clashes. very little accountability in some areas

Find efficiencies to delvier outputs quicker

Engage with local teams and clients more. Visit sites/locations before undertaking work.

Systems that link

A model (infrastructure etc) that underpins and supports all systems

By building and **maintaining a baseline position** from which to start most of the modelling work.



Customer updates
Better understand how the output of the work will be used or the decisions it will inform so that the analysis can be shaped to provide output that is appropriate and usable first time around. Also the quality of written reports varies somewhat.
As per an earlier answer, better up-front engagement with TOCs, so that the right thing is modelled first time, based on the right data and the right assumptions. Also, tap into the knowledge of subject matter experts, to avoid time being wasted by focussing on the irrelevant or unimportant.
See comment on Q2
I'm not sure if you are referring to timeliness in terms of train performance outcomes or of model outputs. In terms of improving train performance and customer experience you obviously have to have reliable models for capacity planning, but monitoring is critical to avoid expensive delays and cancellations by detecting and predicting potential issues so they can be fixed before they cause disruption. There is a lot of work going on in this field to look at better predict and prevent models.
The main step change would just be to deliver what they are supposed to deliver by the deadlines in a usable format rather than rushing out a report which is meaningless and needs to be re-worked merely to meet a deadline.
Resource and develop more experts rather than solely relying on training people who are completely new to the field, particularly in timetable analysis. Due to the often quick churn of people there is a risk that quality standards and knowledge are decreasing over time and work takes longer at possibly lower quality. Supporting teams should spend more time on "getting their head around the problem" and then inform what specific work is actually needed, rather than relying on standard procedures.
System stability; User experience
Getting more complete accurate outputs by asking the actual users of the information what they want. To many of the modelling outputs are of poor quality because they are either incomplete or inaccurate
increase engineering resource in EPDG to deliver the modelling workstream
Simply the modelling when appropriate. what I mean it that TRAIL is a hugely complicated model that runs a simulation over 25 years but it can only tell me if PPM is likely to improve. The PPM improvement it quotes is only a forecast so it would be better to simplify and run short with less variables and give the same indication. i.e 80% right rather than 100% wrong.
As per previous comment doing the Legion Modelling in house.



Hold and make available a library of recent work so that customers can consult previous examples of commissions similar to theirs and learn in advance what the issues and outcomes might be.

Speed is not the issue, the accuracy of the outputs is more critical.

as mentioned previously, SMEs seem to lack the understanding of requirements and learn as they deliver, inevitably incurring significant delivery delays

Question 11

What do you think would help in improving deliverables or service?

Better integration of a realistic assumption of STP freight paths with passenger bids

E mails need to be answered promptly often it can take a second follow up e mail to get an answer

Proper industry consultation

Understand the customer and their needs i.e. passengers and also funder requirements.

More **fully trained staff** who fully understand the customers requirements

Better understand the client requirement before making incorrect assumptions

Long term funding commitment for project development in order to allow careful planning and managing of required works and associated resources.
 Don't let politics get in the way of evidence which means that a lot of good work is being lost with a change in direction. There should be more push back on the risks of such an approach. The Thameslink timetable development is a good example for this.
 Both aren't necessarily issues that can be resolved by the supporting functions.

There should be more accountability within timetable development for achieving train performance. Whilst during development a lot of time and effort is spent on understanding the performance impact of change, this to my best knowledge doesn't actually happen for the timetable that is actually being implemented due to the time constraints.

Asking the right people at the outset what is required and also being **flexible** should things change

There needs to be the **correct resources** in place within the Planning & Capacity team to deliver outputs.

More resource and ability to model in house.

Can't realistically answer this as the issues vary across the **different areas modelled**.



Ease of system use.

better planning and communication, more focus and flexibility on how to meet customer's need rather than what the system delivers

Question 17

What one thing can help us improve our **communication** with you?

To be more **visible/available** in the Route

Provide communications on your capabilities to all planners and development managers in the System Operator function. Include case studies of how your work has been used in projects.

Staff answering E Mails more promptly. Phone system in quadrant poor. if the person does not answer his or her phone then it gives no option to leave a message. says this number does not subscribe to to this service. The it cuts you off! very poor

Timely comms

Keep us updated immediately there are issues.

Early identification of problems.

Regular period updates - which in the case of Thameslink-related work are provided.

Timeliness - often answers are to slow

Speak to clients and interested parties before commencing work and also during the work.

Take more ownership of the business problem analysed by the individual team, whether it's timetable, performance, ped-flow or signalling capability. Sometimes it feels like teams see them of a supplier of a service, when they should be the custodian of the right decisions within their field of expertise.

Stop hiding behind emails

Seems to be fairly joined up.

Better visibility of delivery - manage expectations

I never hear much about the modelling team as a whole. **I only interact with one member** of the modelling team so have no idea what the rest of the team or department do. Would be very interested to hear more.



The modelling teams **don't normally communicate directly** with me but go through NR colleagues. I work for the DfT, commissioning and using modelling as part of the wider rail investment strategy

Understand our business better.

modelling team **lack structure and is very reactive** - robust plan supported by clear, frequent and focused comms

Question 18
Is there anything else you would like to tell us?
No
No
Not at this time
Nothing specific
No.
Better comms on Connect please !!
no thanks
Network Rail is not fit for purpose.
None
Please be honest and transparent
no
I'd like Network Rail to be more responsive to the customer. It feels like we're obliged to accept TPR at short notice, but are unable to propose TPR at very short notice.
no
n/a
No
None
More concise easier to understand reports , better industry knowledge , proactive approach rather than spoon fed all the time, more resources that need an apprentice as people always moving on.
No
n/a
We need modelling work that is at the appropriate level of detail and is as realistic as it can be.
Not resolvable by NR modelling but it is slightly frustrating that we are so beholden to the TOCs for release of information on passenger numbers and flows.
You need to refine the database of people who use modelling.
I would need to better understand your remit. I'm answering this survey cold.



No. My interface with the team in NR was very limited
No
NA
No
No
No
No
SAT outputs from Vision and TIP have generally been of a high quality when finished and they are certain SME's on this. TRAIL is another matter. Riddles with gaps, lack of understanding and simply unworkable costs and timescales
The modeller assigned to London Bridge has been key to the success of managing flows at the station.
No
No thank you
overall experience people-rather than process driven, leading to inconsistencies (i.e. dealing with good modelling engineer generally effective, but there wasn't enough of them)