

ALSTOM notes to date (30.05.02)

Contents

INTERVIEW WITH CHRIS STOKES (EXECUTIVE DIRECTOR, RAILWAY DEVELOPMENT)	8
INTERVIEW WITH TONY COLLINS (EXECUTIVE DIRECTOR, MAJOR CONTRACTS) AT VIRGIN, 23.05.00.....	13
INTERVIEW WITH MARTYN VAUGHAN ALSTOM	18
INTERVIEW WITH PAUL GREEN (SOURCING DIRECTOR) AT ALSTOM, BIRMINGHAM, 21ST OF OCTOBER, 1999	24
PAUL GREEN	24
ALSTOM.....	24
BUSINESS SECTORS AND MARKETS	24
PRESENT KEY TRANSPORT PROJECTS	25
BUSINESS STRATEGY	26
PERFORMANCE IMPROVEMENT.....	27
DESIGN	27
DESIGN STUDIO	28
PRODUCTION	28
KEY COMMODITY MANAGEMENT (KCM).....	29
LOGISTICS	30
SUPPLY CHAIN INITIATIVES.....	30
NOTES AND THOUGHTS.....	30
MEETING AT ALSTOM (BIRMINGHAM), WED 9TH FEB, WITH PAUL GREEN	31
ISSUES DISCUSSED	31
INTERVIEW WITH RON TEMPLE, WCTC DIRECTOR, AT ALSTOM, 29.06.00	35
THE BUSINESS.....	35
MAINTENANCE STRATEGIES	35
WCTC SUCCESSES	35
THE WCML CONTRACT.....	35
WCTC CULTURAL CHANGE.....	36
NEW APPROACHES TO MAINTENANCE.....	37
REGULATORY AND COMMERCIAL CONTEXT	38
DESIGN FOR MAINTENANCE.....	38
THE SUPPLY CONTEXT	40
TMS.....	40
COMPETITION	41
THE WCML CONTRACT	41
VIRGIN AND ANGEL.....	42
OTHER INTERACTIONS	42
INTERVIEW WITH KEN MCBEAN (STRETCH 30 MANAGER), 22.03.00 AT ALSTOM, BIRMINGHAM.....	43
SOURCING STRUCTURE.....	43
CONCURRENT ENGINEERING AND MAINTENANCE-CENTRED DESIGN.....	44
VALUE ENGINEERING	45
DEALING WITH VALUE ENGINEERING IN THE SUPPLY CHAIN	46
FIRST TIER SUPPLIERS SHOULD BECOME A 'ONE-STOP SHOP'	46
IN-GROUP SUPPLIERS	47
LONG TERM VISION V SHORT TERM ACHIEVEMENTS	47
INNOVATION.....	48
MECHANISMS OF KNOWLEDGE CAPTURE	49

RE: ENGINEERING PROCUREMENT.....	49
THE SUPPLY BASE.....	50
WHO IS THE CUSTOMER?	51
STRETCH 30.....	51
MEETING WITH CHRIS HOLT AT ALSTOM (BIRMINGHAM), 12.04.00	53
ALSTOM / FIAT.....	53
THE ZONES	53
THE INTERDEPENDENCY OF ZONES	54
A STEP BACK FROM ZONES	54
THE RETREAT TO CORE COMPETENCE	55
PENALTIES SYSTEM	56
DOCUMENTATION.....	56
CONTRACTS APPROACH	56
CONTRACT TYPES	57
RELIABILITY TARGETS.....	57
SAFETY CASE.....	58
INTERVIEW WITH PETER SIZER, WCML PROJECT DIRECTOR, AT ALSTOM, 13.06.00.	59
INTRODUCTION – PETER SIZER	59
THE BID	59
THE CONTRACT	59
THE VIRGIN FRANCHISE	60
THE SUPPLY BASE.....	61
INTEGRATOR ROLE	61
CRITICAL KNOWLEDGE.....	61
INTERFACES.....	62
THE DESIGN PROCESS	63
PROJECT RISKS	63
THE ZONES	64
PROJECT MANAGEMENT	64
THE CONTRACT ORGANISATION.....	66
REGULATION AND CERTIFICATION.....	66
GETTING THE TRAIN ‘SIGNED-OFF’	67
INTERVIEW WITH NEIL HARWOOD (ENGINEERING MANAGER) AT ALSTOM BIRMINGHAM, 29.06.00.....	68
CENTRE OF ENGINEERING.....	68
ALSTOM PROJECT STRUCTURE – THE ZONES	68
ALSTOM AND FIAT	68
ZONE DETAILS	69
EXTRA ZONE GROUPS	69
THE DESIGN PROCESS	69
TECHNOLOGY TRANSFER.....	69
ROUTE MOD - TECHNICAL FORUM INTERFACE.....	70
TILT TECHNOLOGY AND PUG1	70
THE DESIGN PROCESS (AGAIN).....	71
FINANCE AND DESIGN.....	71
EXTENDED FORMATION	71
INFRASTRUCTURAL LIMITS	71
THE ONIX 800 DRIVE.....	72
DESIGN FOR RELIABILITY AND MAINTAINABILITY	72
INTERVIEW WITH AMOI NAGRA (PROJECT MANAGER) AT ALSTOM, BIRMINGHAM (16.05.00).	74
FIAT COLLABORATION	74
INTERFACES BETWEEN ALSTOM AND FIAT.....	75
VIRGIN INTERFACE.....	75
PROJECT MANAGEMENT	76

THE VIRGIN TEAM	76
CHANGING DESIGN DRIVERS	76
DESIGN CULTURE	77
SUPPLY CHAIN MANAGEMENT	77
STRETCH 30.....	78
LONG LEAD ITEMS	78
INTERNAL SUPPLIERS.....	78
TESTING	79
PROJECT MANAGEMENT	79
LEARNING	79
MEETING WITH KEN KING AT ALSTOM (BIRMINGHAM), 12.04.00	81
KK'S ROLE.....	81
DESIGN PROCESS PROCEDURES.....	81
INTERFACES.....	82
SUPPLIERS	82
ZONES	82
CENTRE OF ENGINEERING.....	83
RISK	83
PROJECT PERFORMANCE	83
THE PROJECT	84
ZONE SYSTEM – CULTURAL HISTORY	84
LESSONS FROM OTHER PROJECTS.....	84
MEETING WITH JONATHAN JONES AT ALSTOM (BIRMINGHAM), 25.05.00	86
FINANCE.....	86
LEARNING	86
RISK MANAGEMENT.....	87
PROJECT MANAGEMENT	87
CULTURE.....	87
COST SAVINGS	88
LEARNING	89
SOME FINANCIAL IMPACTS	89
AWARENESS, CULTURE.....	89
RISK REPORTING AND ESTIMATION	90
RISK DISTRIBUTION	90
ZONES AND PROJECT MANAGEMENT.....	91
CHANGE	91
CONTROL.....	91
MEETING WITH JOHN REELY (ASSEMBLY MANAGER), 08.06.00 AT ALSTOM, BIRMINGHAM.....	93
BACKGROUND	93
DESIGN FOR ASSEMBLY	93
WORK PLAN	93
THE TRAIN MARKET.....	94
WORK PLAN (CONTINUED).....	94
THE DESIGN PROCESS	94
SLAM DOOR MARKET	95
RELIABILITY AND MAINTAINABILITY	95
R&D	96
OUTSOURCING STRATEGY	96
PRE-SERIES – DESIGN AND ASSEMBLY	96
SUPPLIER MANAGEMENT	97
CULTURE.....	97
WORKFORCE	98
DESIGN CHANGE PROCESS IN DETAIL	98
UNDERFRAME ZONE AND SUPPLIERS	99

INTERVIEW WITH GARY FREETH (UNDER-FRAME ZONE LEADER) AT ALSTOM TRANSPORT, 29.01.01.	99
NEW MANAGEMENT.....	99
DESIGN ISSUES	99
SOURCES OF CHANGE AND CHANGE MANAGEMENT	100
SOURCES OF CHANGE AND COMPLEXITY.....	100
DESIGN AND CONFIGURATION FREEZES	101
MANAGING LIMITED DESIGN RESOURCES	101
CONTRACTORS	101
DESIGN CHANGES	102
ZONES AND CONTROL.....	102
NEW SUPPLIERS ON WCML.....	102
NEW MANAGEMENT (AGAIN).....	102
PROJECT STRATEGY	103
KNOWLEDGE MANAGEMENT	103
ZONE INTERACTION	104
BANNERS.....	104
TOLERANCES	104
INTERVIEW WITH JOHN INNET (UNDERFRAMES SOURCING ANALYST) AT ALSTOM (09.08.00).	105
THE UNDERFRAME ZONE.....	105
ZONE SUPPLIER INTERFACE	105
MGC CADMAN.....	106
HYDRAPOWER DYNAMICS.....	106
CONTRACTING.....	106
DESIGN PROCESS	107
THE CONTRACT	107
ZONES	107
JI – HISTORY	107
SUPPLY BASE.....	108
COMMAND STRUCTURE	108
MEETING WITH PAUL CADMAN AND ROB BARRETT AT MGC FABRICATIONS, 22.08.00, BIRMINGHAM.	109
INTRO AND BACKGROUND	109
DESIGN COORDINATION	109
DESIGN CREEP	110
INFORMAL SUPPLY.....	111
THE DIS-BENEFITS OF THE ‘ONE STOP SHOP’	111
SUPPLIER DEVELOPMENT.....	111
CREATING TRUST IN THE SUPPLY CHAIN	111
STRETCH 30.....	112
INTER-COMPETITION COLLABORATION.....	112
ZONES	112
OPEN BOOK	112
‘KIT’ FOR DELIVERY VERSES INDIVIDUAL ORDER PURCHASE NUMBERS.....	112
BARN	113
STAFF	113
POOR ALIGNMENT	113
COST SAVINGS	113
SHOP FLOOR CONTACT.....	114
INFORMAL DESIGN CHANGE REQUESTS.....	114
TRAINEES	114
HIDDEN COSTS.....	114
INTERVIEW WITH BOB ARNOLD (DESIGN MANAGER) AT TRANSYS ON THE 23.08.2000.	115
INTRODUCTION.....	115
TRANSYS’S SUPPLY CHAIN STRATEGY	115

BUILDABILITY AND SUPPLY CHAIN MANAGEMENT	116
DESIGN	116
CONTRACTUAL ISSUES.....	117
CONTRACT CONTROL.....	117
THE DESIGN PROCESS	118
LEARNING	120
INTERNAL DESIGN MANAGEMENT AT TRANSYS	120
GLOBALISATION OF DESIGN SERVICES?	120
OTHER WORK	120
COMPETITIVENESS.....	120
SANDERS	120
INTERVIEW WITH GARRY WILLIAMS AT HYDRAPOWER (TECHNICAL DIRECTOR), 07.07.00.....	122
PROMOTING CLIENT ACCEPTANCE OF INNOVATION	123
SCOPE OF SUPPLY	123
CORE COMPETENCE	123
INNOVATION.....	124
SUPPLY INNOVATION	125
DESIGN FOR MAINTENANCE.....	125
INFORMAL SUPPLY CHAIN ARRANGEMENTS.....	126
COMPETITION	127
OTHER STRATEGIES	127
RELIABILITY CONFERENCE	127
OUTSOURCING.....	127
LEARNING	128
INTERIOR ZONE AND SUPPLIERS	129
INTERVIEW WITH LYNNE GODDARD (LG), ALSTOM TRANSPORT, SOURCING ANALYST, 30TH JANUARY 2001.	129
SUPPLIER SELECTION	129
INTERIOR DESIGN	129
SUPPLIER CAPABILITY	130
PROCEDURALISATION.....	130
INTERIOR DESIGN CHANGE ON WEST COAST MAIN LINE.....	130
CONTRACTUAL ARRANGEMENTS	131
SUPPLIER KNOWLEDGE.....	131
PROJECT MANAGEMENT	131
THE RED BOOK	132
CENTRE OF ENGINEERING	132
PRE-SERIES AND SERIES BUILD	133
APPROVALS PROCESS.....	133
IMPROVEMENT TO PROCUREMENT.....	133
INTERVIEW WITH MIKE THOMPSON (MD) AT AVE (07.09.2000)	135
AVE.....	135
INDUSTRY STAFFING PROBLEMS	135
SUPPLY CHAIN RELATIONS.....	136
SUPPLIER CONTROL OF THE DESIGN PROCESS	136
RELIABILITY CONFERENCE	137
ALSTOM DON'T TALK TO THEIR OWN SHOP FLOOR	137
FURTHER PROBLEMS WITH ALSTOM'S SUPPLY CHAIN MANAGEMENT	137
INTERIORS SUPPLY.....	138
SUPPLIER INTERACTION IN THE DESIGN PROCESS.....	138
STAFF	139
COMMERCIAL STRATEGY.....	139
MEETING WITH SHAWN DOYLE (CONTRACTS MANAGER) AT JONES GARRARD, 17.07.00.....	140

JG HISTORY AND COMPETENCE	140
CONTRACTUAL ARRANGEMENTS	141
INTERACTIONS.....	141
CONTRACTS WITH SUPPLIERS	142
ZONE INTERACTIONS	142
RISK LIABILITY	143
COST	143
SUPPLIER RELATIONSHIPS.....	143
INTERACTION IN DESIGN	143
REGULATION ISSUES.....	144
RELIABILITY CONFERENCE.....	144
PROBLEM FOR INDUSTRY – HOW DO YOU MANAGE LCCs?.....	145
SUPPLIER INVOLVEMENT	145
OUTSOURCING DESIGN	146
LEARNING PROCESS.....	146
CONTINUITY OF LINK WITH ALSTOM.....	146
SUMMARY	146
JG – COMPETITORS.....	147
INTERVIEW WITH PHIL O’LEARY, PROJECT MANAGER, AT EXCIL FOR WCML CONTRACT (31.08.00).....	148
EXCIL	148
ADVANCED LIGHTING DRIVER TECHNOLOGY	148
EXCIL CONTRACT	149
SUPPLIERS	149
THE DESIGN PROCESS	149
EXCIL’S SUPPLY CHAIN MANAGEMENT	151
Risk	152
IT’S NOT JUST A QUESTION OF SUPPLYING FLUORESCENT TUBES!	152
THE SERIES BUILD.....	152
ALSTOM SUPPLIER MANAGEMENT.....	152
LONG TERM SUPPLY.....	153
STRETCH 30.....	153
IMPROVEMENTS ALSTOM COULD MAKE.....	153
ENERGY EFFICIENCY.....	153
LEARNING	153
THE BENEFITS OF BEING CUSTOMER DRIVEN?	154
RELIABILITY CONFERENCE	154
INTERNAL SUPPLIERS	155
INTERVIEW WITH RICHARD SIMPSON, ALSTOM TRACTION 070201	155
RICHARD SIMPSON	155
ALSTOM MOBILITY SCHEME	155
ALSTOM TRACTION	155
WEST COAST MAINLINE POWER UNIT	155
EXTERNAL SUPPLIERS	156
CUSTOMER SPECIFICATION.....	156
INTERFACE MANAGEMENT	157
DESIGN FIXES.....	157
CONTRACT	157
MAINTAINABILITY.....	158
STRETCH 30 AND LONG TERM COSTS	159
DELIVERY SCHEDULES	160
THE PERSPECTIVE OF THE ROSCO.....	161
INTERVIEW WITH IAN KNIGHTS - PROJECT MANAGER WEST COAST, ANGEL TRAINS.....	161
BACKGROUND	161

DEVELOPMENT OF THE WCML CONTRACT	161
PROJECT MANAGEMENT	163
ENGINEERING OVERVIEW	164
ACCEPTANCE.....	164
MAINTAINABILITY.....	165
HUMAN RESOURCES	165
INNOVATION.....	166
LESSONS LEARNED	166
ANNEX : EXTRACTS FROM “THE PROCUREMENT, FINANCING AND LEASING OF ADVANCED TILTING TRAINS FOR VIRGIN RAIL GROUP’S USE ON BRITAIN’S WEST COAST MAIN LINE”, STUDIES IN LEASING, LAW AND TAX, JOHN VALE, ANGEL TRAIN CONTRACTS LTD	166

Interview with CHRIS STOKES (Executive Director, Railway Development)

Shadow Strategic Rail Authority (Summer - 2000).

Present – RV and IM

Relationship between Virgin and ALSTOM started with the transfer of the maintenance of the existing kit.

The notion that don't just want to buy the kit but something quite intangible to the kit which the ultimate consumer wishes to buy is central to the auto industry. What is the locus of SRA in the environment affecting these contracts.

The privatisation of the rail industry was much more successful than expected. Presumption was of steady state in volumes but there is a structural change in the market. The econometric models for rail travel had been a positive relationship with GDP and a negative relationship with time trend. The hypothesis was that increasing car ownership in a steady state market would eat into the volume of train travel. We now know that the negative time trend does not exist and that there is sustained growth. Passengers on inter city routes and London commuters are ABCs who already have access to cars. Rail travel is a choice not a distressed purchase and the road network is getting worse and more congested.

David Humphrey arrives.

Structural change in the market coincided with privatisation. Business dynamics are different it is enormously important for the rail franchises to grow their income whereas for BR it was the cash limit which was important. Telephone inquiry centres under BR were a cost centre so to shave costs you closed a few phone lines. Now they are not only a regulated activity but a major generator of growth so response time is improved and the access to information through that and the Railtrack web site is going through the roof.

TOCs can not control their rolling stock or rail access charges significantly and so they must raise their income. The joint impact of the structural market effect and the new business dynamic have given sustained growth as against continuous decline. Privatisation wasn't carried out on the basis, Treasury wouldn't have permitted it.

There is also a degree of plurality that wasn't there under BR, franchise bidders are looking for their USP. The Virgin ALSTOM deal grows out of this environment. Private sector operators want their suppliers to give them very complex packages and SRA is trying to deliver more of that through the re-franchising process. SRA is involved inter alia in two major projects, the upgrading of passenger services on the East Coast mainline and our themselves procuring £1.5 billion of new rolling stock tranches of which will be peeled off and novated as the franchises are replaced. This is to prevent SRA being held to ransom during the franchise replacement process by prospective franchisees. ("Agree the deal on our terms or we won't do anything about the Mk I rolling stock"). Have to be seen to be prepared to do it. All of the rolling

stock contracts since privatisation have direct agreements attached with a call option on the price for three years to protect their public duty in the event of default by a franchise. SRA has a statutory duty to keep the trains running. SRA sees every deal and as a result the best view of the market for rolling stock.

In their procurement of the MK I replacement SRA are not adopting a detailed specification but a functional specification. Light procurement - description of options they want suppliers to price. SRA does not want to be the ultimate operator and therefore seek priced options for what the ultimate operator might require. How an operator decides on 2+2 or 2+3 seating or first class options or the number of vehicles to meet the required service is up to them.

A GNER or a Virgin may have their own view of how customers might relate to fit out and SRA is trying to step right back from that. The specification therefore concentrates on the engineering design of the vehicles rather than the livery and the artistic impression of the train. Virgin and GNER will assign the same importance to retail and catering but their design approach will be very different. ROSCOs also have a view because they may have to re-lease the train at the end of a franchise and don't want to see the cost of refurbishment so high that its cheaper to build a new train. STRA now sees the market moving in the direction described in the paper. Now see manufacturers moving in the direction of 'whole life cost' building on a series of standard platforms with standard traction packages, partly to avoid the problems experienced in achieving the safety case. (BR would have treated itself to a new design of train.) Manufacturers are increasingly focused on making their money through maintenance rather than construction. Making a virtue out of what the market is forcing them to do.

How does the issue of the demand for an improving passenger experience become articulated in a way that the manufacturer can understand? Virgin will have a pretty specific statement of the passenger interface - they are not going to let ALSTOM do the internal design. The manufacturers will therefore, as in the aerospace industry, provide a shell which can be fitted out to suit the requirements of the customer. This has even been seen in refurbishment. When the Circle Line trains were refurbished passengers thought they were new trains. The MK III coaches have been refurbished very successfully and interestingly is a better coach for operators, *and pasengers*, than the Mk IV coaches. BR treated themselves to a new design of coach but came up with one that was less good for the passenger than the Mk III.

Following the one-off experience of the SRA procurement exercise of the Mk I replacements SRA will be watching the TOCs procure. Residual value will be a matter for the ROSCOs. SRA will not take the risk back. Following privatisation one of the ROSCOs wanted a very cheap safety lead modification for a fleet but said they would only do it if they had whole life underwriting. SRA said no. From that SRA have gone on refusing to take risk. Now have a position where on the WC train deal (where in confidence Virgin thought they had them in a corner) SRA refuses to budge. The lessors of the rolling stock backed up by manufacturers standard products have formed a robust view of residual value which has lead to a situation where rolling stock is moving around the system. TOCs can get as short as a three year lease at relatively competitive rates which have reduced significantly. SRA has never lost its nerve. On the issue of a high degree of risk transfer.

If the bidders for South West or South Central do not want to go down the SRA route of Mk I replacement procurement they have to prove that they can offer better value for money. SRA is in fact encouraging standard products indirectly through the need of ROSCOs to protect residual value refresh the trains and present them as new in the case of short leases. Trains have to last a long time. Taking a broad definition of ROSCOs they have financed all new rolling stock procurement to date keeping the financing off balance sheet. Manufacturers periodically think about whether they want to go down the route of financing whole train procurement (as per GE Capital who are entering the market). This may be the way in which the market develops - they would however, carry the residual risk. Bombardier Capital is as big a company as Bombardier Transportation. If you are the size of for example ALSTOM worldwide then they have the balance sheet capacity though they may not be able to meet the financing capabilities of a bank. The financing would have to be done arms length because SRA will still not be held to ransom. The one development not seen yet, but its only been four years since privatisation, is the development of a spot market in rolling stock as there is for aircraft though its a different market.

The three year call option allows SRA the achieve a period of grace with a new franchisee allowing them either to reach a market price with the ROSCO or to provide new rolling stock. SRA also achieved this call option on the old BR stock.

Having established the playing field SRA is rather neutral in regulating rolling stock market except don't like anything other than flat rental profiles ie it doesn't like back loaded lease deals.

GAP

Generally speaking SRA does not interfere in the market. Some franchises did their own maintenance some didn't. Don't intend to buck the market. SRA does loosely satisfy themselves that the maintenance is carried out satisfactorily via penalties if the trains don't run or through safety regulation. If the TOC transfers the maintenance to a third party then again SRA will have the ability to call that contract if the TOC goes bump. If whatever reason the TOC goes under then SRA must be able to run the trains and so identifies 'Key' contracts - including agreements with Railtrack. When MTL (Northern Spirit) looked shaky SRA got themselves ready to run them. Arriva took the company on including running the franchise on the current franchise profile for a year as a condition of the franchise.

SRA does not have a strategic remit for innovation or technology in the railway. There is a high level statement - looking for a better, growing railway carrying more passengers and freight. Franchise replacement is not best price but best value of output plus price. The best results come from competition within franchises through meeting customer demand, for the franchises and as a last resort achieving a series of outputs through prescription by SRA in the contract. *SRA does not run the trains clean or dirty, late or punctual.* They do not drive the technology but the plurality of ideas. Not going for East Coast upgrade on the basis of a high speed line. GNER bid a respectable step upgrade and Virgin felt they could take it further. The competition is being used to raise aspirations and this is proving very successful.

Signaling technology is one example of where the development of technology from around the world is available to the UK. The West Coast upgrade has been a disaster and signaling especially. Railtrack wanted to put cutting edge technology on a complex mainline - it worked on the Jubilee line - but didn't work on WCML. SRA will not dictate to Railtrack but will discuss with them the idea that they stop covering themselves in the Union Jack but will buy the best from Europe. In terms of regulation outputs are heavily regulated (step change in quality and performance and resilience of timetable) but not mandated. Operating outputs summary are in the public domain. SRA focusses on outputs and seek to lead the industry through that focus. Glass ceiling on rail performance suggested by TOCs is on a different planet than Japan.

SSRA is a combination of the statutory powers of the old BR Board and the statutory powers of the Franchising Director under the 1993 Railways Act. Must remember under whose powers they are operating. OPRAF was a non ministerial appointment. SRA will be a NDPB- non departmental public body. A Quango. Theoretically separate from government but not. Transport Bill sets out the duties of the SRA. Employees will not be civil servants. SRA will have a Board. Non executives on the BRB will transfer to the SRA Board of 17(?). The Rail Regulator will not be a part of SRA but its consumer protection functions will transfer.

This is not different from Teesside case where the company acts within a framework set by a regulator. In this case ALSTOM is acting commercially but behind Virgin is a Government agency setting the framework. The procurement team at Virgin did have a very strategic view for a train service provision contract. Interested to know if they would do it again. Virgin's view is that a TOC is not in the business of maintaining trains but they have come to the view since, that it is nearly as hard work managing the contract and the contractor who is providing the maintenance as maintaining the trains themselves. There are parallels with OPRAF pre and post privatisation with Virgin moving maintenance out to Bombardier and ATOM. OPRAF thought that they would be able to halve their employment but actually saw an increase. The big permanent job of OPRAF is managing the contracts.

In the case of strategic procurement doesn't finish with procurement. There are different forms of contract out there from no train no pay to full provision and the jury is out to see how the process will involve. Its not a single structural solution which will win but the relationships between the teams. WCML now have a project manager who is absolutely focused and is taking a grip of the project which is now happening. The man may be more important than the structure in this area.

The risk issue is a factor in the other cases the way in which the location of risk is changing together with the contract management issue - what is the core? Is corism a fad? It used to be conglomerates! Contract management may become more trouble than its worth. How far can it be pushed before the costs outway the benefits.

One of the TOCs is proposing to take maintenance back in house. WCML, Virgin taking an aggressive stance on revenue growth but Railtrack isn't delivering (*note before Railtrack admitted they can't deliver PUG2.*) There are bound to be some renegotiations down the line in big contracts like this. But, Virgin are not masters of their own house because Virgin owe a premium line to SRA and so SRA may not be

happy about the renegotiation. SRA also concerned about intervening in a situation where they may be considered shadow directors. Because there is a payment to HMG at the end of this it is more complex than a market situation. SRA are then in the loop - will Virgin make their contract with HMG. HMG doesn't need to step in to support the mobile phone market!

Chris leaves.

OPRAF set up contracts where both parties were very clear on their responsibilities but the contract was managed in a non confrontational way. If something goes wrong you inevitably are left with a choice of two alternatives either a 'hug in' or a 'partnership model' or trench warfare where you stand behind the contract and lob grenades at each other and see each other in court. There is a middle way - these are long term contracts you need a good contract but also mutual respect so it comes down to the quality of the people. Quality of people in SRA is very high - the success of a contract is the investment in the quality of the people managing the contract. This is enshrined as a corporate value, an intangible rather than a written policy. SRA does have written core values about dealing with each other and the outside world with openness, honesty and integrity. (Copy available)

Often things do go wrong - late rolling stock deliveries - contracts well managed to being appalling. Needs to look at the cultural professional and process skills to manage these contracts and deliver to time. They are very complex with lots of interfaces and the stresses are huge. A strong leader is needed who can see their way through them. None of this is a surprise. There is a COLLECTIVE AMNESIA WHEN IT COMES TO CONTRACT MANAGEMENT. Dangers from turnover of staff. Common lessons are not disseminated through the organisation say lessons to be picked up from HSE or from Railtrack.

End of disk

Discussion about MoD, collective amnesia in military engagements etc.

Interview with TONY COLLINS (Executive Director, Major Contracts) at Virgin, 23.05.00

Present – RV and IM

Disk – yes

Tony, who is an accountant by profession, worked for ALSTOM for six years before working for Virgin Trains (Virgin 51% Stagecoach 49%), where he negotiated the Northern Line contract financing on behalf of ALSTOM. This led to a redesign of the whole procurement process - buying equipment for the lowest price, relying on the warranty for protection and running for cover towards long term maintenance together with performance quotation. The UK rolling stock group, in particular Metro Cammell, would have been involved in 1 / 2 bids each year but this has risen to 12. These bids involve complete train supply, maintenance, finance. For the last 6 months working for ALSTOM he led the negotiating team for the Virgin Train contract which was signed in February 1999. He was head hunted by Virgin after the deal was signed.

Virgin bid for a number of franchises. The evaluation criteria (against which Virgin were measured) were the length of the franchise, the investment to be made and the subsidy/revenue profile offered. In other words what value could be offered to Government fore taking on the franchise. In order to pay a premium for the franchise Virgin need to raise the number of passengers demanding more investment justifying a longer franchise.

Virgin took a hard look at PUG1 - an increase in capacity and speed from 5 paths/hour to 6/7. To compete with air travel Virgin need to win on speed and frequency. If it is possible to say to a passenger in Glasgow that there is a train every 15 minutes to London taking under 4 hours this would generate rising passengers. Glasgow to London < 4 hours and Manchester to London < 2 hours are the threshold times. If speed and frequency right what will happen to passenger loads over 15 years?

Virgin modelled speed/frequency/ stopping patterns to develop the business plan which targeted a doubling of passengers over the period taking account of the WCML upgrade period of 5 years. As a reality check it was noted that the last years of InterCity showed a decline in passengers of 30% - the doubling was less in real terms especially against actual growth in overall traffic from all forms of transport and car traffic. The 30% loss has already been reinstated. To compete head on with car transport it is necessary to create the right level of comfort in comparison with the car - air conditioning, retail and on-board entertainment and catering - to attract passengers away from their cars. In other words the hassle of travelling by train has to be removed. The competition is for:

- Speed - against airlines
- Frequency - against airlines and cars

- Onboard comfort - against cars

There were two strategic problems to be solved:

- Acquire a new fleet of trains.
- Issues with the current fleet which was 30% below the InterCity fleet. Reliability and punctuality were both lower because IC had had a younger fleet with better track. The current fleet has been refurbished and on-board services of meals improved. Virgin has worked hard with Railtrack on the track blackspots, reliability has been raised by 10 - 15% and punctuality by 10 - 15% (measured by impact minutes) on last year and the company has invested in the train crews. Passenger growth is on target to double by 2012. Virgin knew that the growth potential was there, the problem has been how to penetrate especially with the current fleet - can't affect speed yet but have improved frequency and comfort. The next 2/3 years is the period of transition management and Railtrack rebuilding the line so the problems get harder.

The Northern Line bid had been a very technical document, in contrast the Virgin invitation to tender was very slim. It was outputs based (this is what we want to do) - timetable, journey times, stopping patterns, dwell times at stations, frequency, passenger profiles and the required travel environment. Virgin knew the train had to tilt but everything else was left to the supplier. The Red Book defined the comfort specification. West Coast Train Care (a 50/50 joint venture between Fiat and ALSTOM) were required to offer a service provision. Virgin wish to manage the passenger and rent the diagrams (not trains) - rising from 42/day at 125 mph in 2005 and thereafter 47 at 140 mph. WCTC had to decide the number and configuration of trains and cost the service provision. Virgin demanded a regime in which there were bonuses/penalties against the critical criteria.

Virgin ran the competitions for financing, and manufacture and maintain, together. Each one was beaten down and then they were jointly beaten down. The financing competition was around the residual value which affects the re-leasing. (ROSCOs take a 30 year view of financing. When the ROSCO gets the train back after 10 years there must be 20 years life left.) The fact that the manufacturer was going to maintain the trains and was therefore responsible for the return condition at the end of the franchise underpinned the confidence of the of the ROSCO (Angel Trains) in the achieving high residual values. Aligning the finance and manufacturer brought an agreement for a maintained train meeting the performance criteria of 140 mph operation with 50000 miles between failure. (Compare with the Hong Kong subway at 750000 b/f). Novel technical features were tilting, air-conditioning and train management (which will log defects).

WCTC offered 53 trains to run the 42 diagrams prior to 2005 and to achieve 47 afterwards at the higher speed of 140 mph. They realised that there will in the future be no such thing as a 'heavy overhaul' of train sets. The maximum outage will be two weeks but most maintenance will be by replacement with the defective unit being maintained off-line. This has affected the design of the trainsets for ease of removal - traction units are attached by 8 bolts, air-conditioning by 4 bolts. The trains will

therefore work a lot harder requiring a complete revision of the maintenance regime. 1 failure a day is acceptable - for now. The reliability of trains will increase as OPRAF drives the penalties.

Virgin has paid a premium to the service provider to take the reliability risk off their hands - they did not wish to become maintenance experts. The manufacturer has been put in the position of an operator.

If the manufacturer makes the maintenance base line the contract revenue effect is neutral, if 5 - 10% worse it 'hurts' but conversely if they achieve 5 - 10 % better they 'do well'. More by good luck than judgement there is, overall, a balanced regime including regulatory penalties without impact on passenger loads. In the base agreement allowance is made for more than planned usage of the trains. If the train mileage increase above +7.5% then there is an additional payment of up to +20%. Above this point the contract revenue is re-negotiated. Likewise, if mileage falls, Virgin can get a reduction.

WCTC is maintaining the existing fleet. The defect records of the trains are jointly monitored - e.g. broken windows, air conditioning faults, vandalism and damaged windscreens which sometimes fail because of fitting.. If there is a repeated defect then the penalties ramp up. The responsibility for 99% of defects is agreed. The joint monitoring scheme will run for twelve months initially. In the first month, out of £230k penalties, £30k is in dispute. On Cross Country there are many more arguments. On the new trains there will be on-board monitoring of train defects and Virgin will have a line in.

Is there a Mega risk in the overall contractual arrangements? The railway has suffered from being engineering led. BR had big engineering operations to be fed. Manufacturing was never involved in maintenance and so there was no feedback into design. Privatisation gave manufacturing the opportunity to get into the 'after market' and so they bought maintenance businesses. (In other businesses this after market generates more revenue than the original equipment supply.) The question for manufacturers is how to inject this maintenance experience into design - this is a big issue. Profit will be generated through his through life support and the service provision contracts exposes the risk/reward equation. Knitting together design/build/maintenance is the issue which is not always resolved even on the WCML e.g. a fork lift truck will be needed to extract the battery on the pre-series build of the new trains. Manufacturers offering train service provision contracts need big balance sheets to handle the risk.

At the moment, the financier does not wish to take the asset performance risk to back that of the manufacturer. Systems integration as defined by 'getting the train to work on the track' is the next big problem. Again manufacturers could make profit from this activity. Note gauge problems and electronic interfaces with signalling. Virgin trains are project managing the train procurement as agent for Angel because they are in the best position to ensure systems integration. Virgin are also project managing the delivery of PUG2 (8??? to 11??? paths per hour out of Euston at 125 mph and then 140 mph) on behalf of Railtrack to ensure that disruption is controlled.. (Tony's team is now 32 strong.)

Railtrack takes its view over 30 years. Virgin has to deliver the finance through a revenue share deal from passenger growth from which railtrack fund the upgrade. The project is the most complex rail project in Europe. Virgin Trains shares the railway with 16 other TOCs.

Virgin Trains are involved in two other projects:

- Cross Country - new train fleet, developed and controlled in the same way supplied by Bombardier. The Voyager trains are a significant improvement.
- Project managing the track possession for upgrading (£30-40m) the track access for Cross Country involving clock face regular frequency of 100 - 200 trains per day.

Virgin will carry the risks in the Safety Case for the new WCML trains. A particular area of attention is the fact that passengers will be carried at >100 mph in the leading vehicle although the kitchen will be forward of this compartment. Impact testing has been undertaken. Another issue is the means of escape. The train control system and data recorders will not be a problem on the new trains as wiring provision is being made now. i.e. Virgin Trains as a complete system integration is assisted by the total procurement process involving both the manufacturer and the finance house. Note that WCTC bears the cost of any changes in the legal requirements surrounding safety until September 2001. There are some 'get outs' in the franchise agreement.

The sources of complexity arise from interaction between:

- financial engineering
- OPRAF
- Railtrack
- TOCs
- Safety authorities

Tony Collins' Team consists of:

- accountants - business analysts and financial engineers
- project managers from civil engineering and train builders
- lawyer
- electrical and mechanical engineers
- project planners
- administrative staff

e.g. come from train makers, civils, permanent way, project managers from the Northern Line project, rail oriented legal - no exclusion of non railway people.

There are links with both Great Western Trains and the Institute of Project Management to share experience and Tony spends time in the City talking to his contacts and has brought in people from other industries. The size of these projects

can be gauged from the spectrum with Eurofighter costing £35 billion. The next clutch of about 20 projects, of which WCML is one, at £6-7 billion. Cross Country is £1.3 billion. There is nothing particularly to learn from European contracts, the framework in the UK is definitely private industry.

Angel is financing the trains through a bond issue so sought 'AA' credit rating for Virgin and ALSTOM. They achieved a mixture of AA and A. The package is not unique but asset financing is not the same as project financing. The asset performance risk goes back to the manufacturer so re-leasing and underlying franchise drives WCML project. Looking through Virgin to 2012 what to do with 53 trains if there are no takers - could someone else come up with alternative trains to displace the fleet - that is the real risk. However, the WCML is pretty unique so difficult to slot a new fleet in.

Much also depends on the competence of SSRA, which is the mouthpiece of DETR and set the rules and context, who really need train operators, manufacturers and financial engineers on their staff.

Interview with Martyn Vaughan ALSTOM

03 July 2001

Roger Vaughan

Martyn joined ALSTOM two and a half years ago. Career started with the manufacture of diesel engines with Perkins then making tractors with CASE, New Holland, and then Bostrom a seat supplier to the agricultural and construction industries. Headhunted specifically to bring know-how of other manufacturing and industries to Washwood Heath. Since privatisation there has been an interesting challenge for the railway industry.

Until recently there has been little flow of expertise across the Channel, because ALSTOM was organised on a geographic basis so the plants in the UK, France, Spain and Germany were stand alone – all doing their own thing. His might have been fine but looking forward it was seen that they were doing everything six times. No standard components or standard systems (e.g. air conditioning) as a result the trains that came out were unreliable one-offs. Six months ago the organisation was changed and now there are European product units. For example there is now a head of EMUs who will trade to maximise the revenue from EMUs and will swap ideas around the plants. Similarly there are DMU and High Speed Train Groups the latter including the TGV and Pendolino. Ultimately, there will be a Tilting Train product group when the Fiat acquisition is integrated.

This has already shown advantages. The Pendolino was put into the High-Speed product group six months ago and now uses the TGV floor instead of the Italian Pendolino floor which didn't meet the noise specification at 140mph. (This was just caught in time. The body shell complete with floor comes from Italy but for expediency the new floor was fitted in Birmingham.) Without this reorganisation this would have taken much longer to achieve. This has been quite a change for ALSTOM – ADTRANZ did it two or three years ago.

The Virgin approach to specification of service levels or outputs based on the Red Book differs from other customers who either specified 'inputs' (Corradia) or weren't sure about what they wanted at all (Porterbrook/SWT). The SWT trains were initially ordered by Porterbrook and then passed on to SWT - hence the lack of clarity on the specification. ALSTOM has had the whole raft of possibilities. Last Friday we produced the first example of the interior following the Red Book using production components. All the Virgin comments (109) are input related! The acid test will be when the train is presented for acceptance. In the case of SWT acceptance was affected by their not knowing what they wanted. Everyone knows the problems of getting trains accepted. Even the Voyager had ten pages of 'defects'.

Virgin and Angel wanted to learn from the lessons of Juniper etc. In order to be more practical they have introduced the notion of the QTOC – Qualified Take-Over Certificate – as opposed to a TOC. Taking Corradia as an example with Angel title passes when there is a TOC a formal point in time, it is difficult to get the train through the TOC because after that ALSTOM could say 'its your problem'. Lots of time and money was wasted going round the acceptance loop. The train may be

clearly acceptable for passenger service but ALSTOM weren't getting paid. The industry tied itself in a knot searching for the unattainable. Virgin have a QTOC for each train set that means that the train can go into service with work outstanding and then the TOC can be achieved later. This is separate from the VAB certificate or Engineering Acceptance Certificate and is about meeting the customer's specification – showing that the toilets work for example. Achieving noise levels, speed, acceleration and braking would be handled through type testing.

The only place where 140mph running can be type tested is on the ECML. The idea is to go into service with the QTOC at 110 mph and then the TOC will come after the type test. Even the QTOC can be on a phased basis. The assembly line is based on 9 stages of work so there can be 9 stages of QTOC, so it's like continuous assessment rather than sitting a final exam. In the case of Corradia we didn't know the questions! This is one of the major lessons learnt. Martyn discussed the situation with Haydn Abbot of Angel six months ago. They had bought Turbostars some years ago – they were the first post privatisation trains and were accepted very much in the way of the old BR days. There were pages and pages of modifications needed so Angel decided not to repeat the experience but as a result the pendulum swung too far the other way in pursuit of perfection. The QTOC represents a middle way that avoids accepting rubbish but also avoids the search for perfection. ALSTOM is still in this process of course.

As far as manufacturing strategy is concerned we now have an assembly line – it isn't continuously moving but it moves once a week now - and will move twice a week. There are currently four lines. There is a view in the industry that there is too much auto technology coming in and that you can never make a train that way. The principles of TACT time, keeping things moving, pre-kiting and lean manufacture or leaner manufacture is valid for building trains. Cycle times may be longer – days rather than minutes. In the beginning auto technology was perhaps rammed down peoples' throats and pushed as the answer to everything - which of course it's not. But Martyn does now hear his managers talking about TACT time and keeping the line moving. Everything that is static attracts cost. There was no pace or heartbeat in the factory. They have spent £10million on the changes to the plant and even guys on the line think about how long they have to do a job and staged sign off rather than saving all the problems to the end. The principles are beginning to sink in.

There has been a lot of training of team leaders. The biggest challenge in the industry is over turning the expectation of failure, of late supply, of designs not working first time. There is an expectation from top to bottom that things won't work first time, that the train won't work out of the box and that that's the way it is and that you can't do anything about it. The expectation was that post- privatisation everything would suddenly change. Martyn looked at Washwood Heath carefully – all manufacturers were build-to-print, if it was unreliable or didn't work first time that wasn't your problem. They didn't design a train pre privatisation. They had to move from being a sub contractor to owning the design and being responsible for maintenance, which meant a concentration on life cycle costing. Now we own the trains on LUL Northern Line!

Moving from being a sub contractor where the old BR inspector made sure you did everything right to a brave new world of having to do everything means a huge

change. The expectation post privatisation was unreal. Nothing had fundamentally changed in ALSTOM or for that matter ADTRANZ (not to mention Railtrack!). If we had really understood what had to happen in the famous three years of no orders you would have re-engineered the company to taking account of 'owning' the trains needing different processes, procedures and people. Nobody really got themselves geared up as a world class train designer, builder and maintainer.

When we were a sub contractor we bought the cheapest components we could – we didn't have a maintainability objective. Now you have the classic case of choosing between components with different first costs and with different reliabilities and costs of maintenance. We now have to choose the lowest lifecycle cost even if the first cost is higher because you know you have to live with it. This has been a significant change on WCML. Our maintenance contract is bigger than the contract to supply the trains. There is a difficulty in maintenance engineers articulating requirements. We have had a team of ten maintenance engineers in the design studio, from day one. You would have thought that if they had done their job properly their input to the design would mean that they wouldn't complain about how difficult the train is to maintain but that's exactly what they did on the 'glass case train' on Friday! Martyn said "look you guys don't come now and say that panels difficult to get off or that micro switch is difficult to get at. That's exactly why you were there!" They have made steps forward but haven't made it into the perfect maintenance world.

Most of us are in the same boat. Siemens is interesting – the blue eyed boys at the moment but the train they are selling is a paper train – they haven't produced it yet. The contracts they have are design and make but there is a perception in the UK that Siemens have better processes and procedures. ALSTOM and ADTRANZ have come through all the problems as the bad boys – all the trains are late. Siemens have said 'we are the new kids on the block' and everyone has rushed over following the ball and said we'll buy trains off you. But there are no trains yet. The jury is out - Siemens have promised all the things we have had problems with and if they really have got better procedures and engineering management processes it will show. Its early days but they have a healthy order book.

The Japanese have dipped a toe. They achieve very high levels of reliability but very high levels of redundancy in the design. The Shinkansen is a very reliable train but it has a huge number sitting in the sidings waiting for problems – as has the TGV. We operate much more leanly we don't routinely duplicate or triplicate systems or have a lot of spare trains. The big change we will see is the move from locomotive hauled to multiple drive trains – there are 14 drives on the Pendolino it will achieve full speed with 9 so there's some redundancy. If a loco goes you are dead so we do have spare locos up and down the WCML. We have tried to design so that there won't be catastrophic failure. The multiple unit will be the best contribution to overall reliability.

We have had unexpected problems on the Corradia with equipment that has its own protective system. For example on very hot days if the battery charger over heats it shuts the whole train down. That is stupid. This is a system integration problem. Individual systems stand-alone well but the integration of all the protection systems can be a difficult design problem. We need to model more with less trial and error. It

comes down to shortened lead-time. There is also a problem in finding good engineers who understand systems engineering.

There are a certain number of people around the industry, they are known by name and they are poached. There is a worrying trend for us as manufacturers that the AEAs or WS Akins of this world looking for staff will pay over the odds. We lost our best braking engineer recently – he was phoned with an offer that “whatever they are paying you we will double”. Then they charge them back at three times. It is also an issue for younger engineers who may not gain experience first. It is an issue for ALSTOM across Europe, we can’t find engineers. We have a real shortage of engineers.

25% of my engineers are contractors, it’s too many. Historically we had a workload that went up and down for years and years. We used to recruit people then lay them off and so on. They set themselves up as contractors so they could even out their own workload. We are now trying to convert contractors to full-time employees, but when he can go to AEA and get £70k for the £35k job he does for us and it is exactly the same job and we have then to buy him back, it’s difficult. There is a general problem in the UK. You need good engineers for the product to sell itself but we are not there yet. I’m sure if you looked at the AEA business plan – they want to be the technical experts. You can see why they are doing it but it is worrying for us.

The Zone system in ALSTOM originated from a visit to the states to look at a bus company. My experience is that it hasn’t been 100% successful. The position of the zone manager has been very difficult to fill. Not only has the zone to work, it has to meet all the objectives of cost and reliability. What we have had is a lot of sub optimisation from the zones and the zone managers are in effect project managers so getting the right level of person has been difficult. Putting the chief engineer type person in has not worked. When Martyn ran Bostrom he had a group of small companies £2-3million turnover and he could not recruit general managers and it’s the same problem – we don’t train for these roles in the UK we make them engineers or accountants but we don’t give them the all round experience. We wanted rounded off people for zone managers and couldn’t find them. The zones ended up being engineering biased or sourcing biased depending on the bent of the manager.

We didn’t integrate the zones properly where they touched each other. We did learn from the French who have a position known as ‘ensemblier’ his role is like the glue that binds all the zones together and makes sure that the whole train works. We didn’t do that at the beginning – we do now. Our experience with zones has been mixed. We would do it again but differently. We will measure its success by the number of design changes. At this stage in the game we have many fewer design changes (50% less) but we don’t yet know where we will end up – perhaps 30-40% less which would be a vindication of the zone/studio system.

Successes on the programme are that we are actually on time – complicated by contractual variations but we are actually doing what we said we would do. We have two pre series trains built and being tested at the new test facility and they are running pretty well. In theory most of the big bits are proven technology but we are impressed by the way the whole train is running. We did 125mph yesterday with tilt – quite a milestone - a first in the UK. We built the test track! You do need somewhere to test

these trains without going near Railtrack. Building Old Dalby has been a nightmare of planning permissions yet we have rebuilt and electrified a railway within twelve months of getting going. The trainbuilder built it but it is owned by WCTC who run it and have the safety case for it, we rent it by the hour. We have very good relationships with WCTC. When I arrived it was like two separate companies, I tried to put politics on one side I like to get things done and so does Ron Temple. We have learned the lessons of “I build them – somebody else commissions them”. We changed the organisation at the beginning of the year so we commission the trains. It used to be like two different companies but not anymore. Because Ron will be the ultimate operator he presents the trains to Virgin/Angel – I sell them to Ron. We won’t replicate what we had with First Group and Corradia. We have all learned a lot about maintaining trains. In the case of Northern Line we have over 45000 km between failure – unheard of on trains especially for that train duty. We have done it the hard way through trial and error but we have got there.

Project integration? It is symptomatic of the way this industry is structured, you’re right. A good example on safety cases is the TASS system (tilt authorisation and speed supervision system) which covers everybody Virgin, us as ATL, power and signals, heavily involves Railtrack because of bits of kit on their infrastructure, HMRI, HSE, Angel – everybody and yet nobody is responsible for getting everything together. Everyone has a bit of it but nobody has it all, there is no systems authority. Chris Green chairs meetings, everybody round the table has a piece of it but nobody owns it all. In meetings with Railtrack to talk about gauging, to discuss mutual benefits, everybody knows the contract is lurking which hampers progress somewhat. Voltage resonance is another issue – all the predictions say that these trains will suffer from voltage resonance. Railtrack’s current plan is to suck it and see. Railtrack have just announced that they will not install 50kv auto transformers. The customer won’t see where the problem is.

Re-nationalisation won’t work but neither will the present set of untenable factions. The answer is somewhere between the two but I’m not sure where. We all resort to lawyers now!

TASS is a good example. HMRI or HSE will not provide or approve a specification. You never quite know where you are. We don’t have approval to take the train to test site A, Carlisle, where we can travel at 110mph without tilt but we have already done 125mph with tilt! The French think we are crazy – they can’t conceive of what we have to go through. We could have decided that Old Dalby was our railway so we could do what we like but since we wanted it to be like the railway we decided to go through the safety case process. In the UK we do brake tests at 10mph intervals but the French can’t understand why we don’t just put our foot down and test at high speed.

This train has all sorts of nasties – tilt at 140mph, passengers in the leading car, the train management system and so it is more complicated to get through the approvals but we are getting there.

I think a UK based rail industry will survive – I have organised myself out of a job. We will be part of the European industry – we have a very poor supply base in the UK. We will see a more standardised product in the UK. Every train in ALSTOM

plants throughout Europe has a different HVAC system. We will see one world class supplier, likewise doors and brakes – good volume good R&D.

ALSTOM would be interested in collaborating further with Newcastle on the project integration front. I will talk to Roger MacDonald rather than Mike Lloyd.

10 Oct 2001

Interview with Paul Green (Sourcing Director) at ALSTOM, Birmingham, 21st of October, 1999

Present, NA, AT and RV

Tape - no

Paul Green

Paul Green hails from Toyota, where he spent five years, charged with managing general expenses, including non-core items such as telephones, and from Rolls Royce (aero engines), where he headed their capital equipment purchases (i.e. construction). At ALSTOM Paul manages sourcing (procurement), logistics, expediting of suppliers, materials movement (internal and external to the production lines) and storage.

Paul is keenly aware of the project focus of ALSTOM and of the tension between centralised and de-centralised procurement.

ALSTOM

The company was floated in June 1998 with a share-holding structure of 24% GEC, 24% Alcatel, 50% general and 2% employee. - a £4.3 bn capitalisation. This gave the company the freedom to act independently of the previous joint venture owners.

Business sectors and markets

ALSTOM operates in sixty countries in a number of engineering based business areas. They are presently involved in energy, rail transport, luxury liners, electrical contracting in construction and industrial infrastructure. The firm's sales world wide are in the order of 14bn. World wide ALSTOM employs 92,000 people with a further 58,000 employed by ABB ALSTOM (see below). In the UK, the firm's operation accounts for 40 business units, 20,000 employees and is worth 20 billion Euros.

Energy is a recent joint venture between ALSTOM and ABB power . At present the venture commands 18% of the market.

Transmission and distribution (principally switchgear and transformers) has a 14.5% market share.

In the rail transportation sector ALSTOM assembles passenger trains, locomotives and manufacture related equipment, wheels, bogies, body shells and heavy traction equipment, for a wide range of transport needs - including mass transit and high speed TGV trains. They also provide servicing, maintenance, spares and after sales support. In mass transport ALSTOM is world number two but in the high speed train market they are the market leader. Overall transport commands a 16% market share and in the current year have just pipped Adtranz in terms of sales.

Their construction or bespoke engineering business focuses upon contracting for electrical services. Recent contracts have included the suspension bridge linking Denmark and Sweden and a baggage handling facility for BAA. This is currently being divested over a period of 12-18 months.

Their marine activities (France) are based in the luxury liner market – a small but growing market in which they have a 32% share.

Power conversion supplies to industry the company supplies automated systems, process controls, electric drives, diesel engines and fluid systems with a 10% market share.

As a general trend the company has moved away from energy and toward transport - energy being identified as an area with a high business turnover and, therefore, high risk¹. It was claimed ALSTOM contracting has the largest local network in Europe. This provides a sort of brokerage service and promotes turnkey system provision. Service provision in rail transport now represents 23% of sales. On the Northern Line ALSTOM has a 36 year service contract.

Regionally sales are 60% in Europe at present of which France takes 24%. The Americas account for 18% of sales but this has significant growth prospects for ALSTOM.

Organisationally, ALSTOM has a presence in 60 countries around the world, with 40 units in the UK. The UK country network is headed by Mike Connor, the UK President, responsible for the identification of the best interests to ALSTOM at country level, the consolidation and coordination of UK general expenses and locational issues and synergies.

ALSTOM Transport is headed by its President, Michel Moreau, who sits on the Executive Committee of ALSTOM SA. Senior Vice President for Passenger Transport is Mike Lloyd.² Vice President of Sourcing is Xavier Loefel.

Present key transport projects

Arlanda Airportlink. City to airport train service. 7 4 car sets. Difficult customer – extensive trials.

London Underground. Including 106 6 car train sets for the Northern line, 50 6 car sets for the Jubilee line.

Coradia Juniper. Juniper is the electric powered version of ALSTOM's 'generic train'. The train is delivered in the required liveries and interiors and is offered with a choice of front ends. The choices are cosmetic allowing a standardised product (albeit

¹ Some information from world wide web: <http://www.ALSTOM.co.uk>

² Organisational structures in ALSTOM are not static so these positions are correct at time of interview, but may in some cases have changed subsequently.

at low-volume). Current contracts are for the Gatwick Express, South West Trains and ScotRail.

Coradia 1000 is a diesel train set to replace the existing 125mph High Speed Train (HST). This train is powered by a new range of Cummins diesel engines.

West Coast Mail Line (WCML) for Virgin Trains. A £592m contract for 53 high speed tilting electric multiple units. Fiat is a 45% partner in the venture. Fiat is providing the body shell, bogies and doors. ALSTOM are responsible for the interior design, assembly and remaining integration. The contract itself, although regarded as a reputation building milestone for the company, is high risk. Contract requirements include the following:

140mph maximum commercial operating speed

Availability of 47 trains per day

Reliability – 50,000 miles between failures

Ride quality – 30% better than a (specific) loco-hauled train.

Interior noise – 65dBA max.

Moreover, Virgin has thus far proven to be a tough customer. The contract has required some re-organisation of the company, with part of this reorganisation involving design staff being housed in a single open-plan converted warehouse.³

Although there is an anticipated lull in the market in 2000, a major tranche of contracts are coming up as franchises are due for renewal. The main players, ALSTOM, Adtranz and Bombardier may not be able to take all the available business, opening the door for more efficient Far Eastern producers to enter the UK market. There is therefore a desire to seek an evening out of the pattern of franchise renewal.

Business strategy

ALSTOM sees itself as a management contractor: “*we want to deal with an agent – to pull all of the bits together*” (interview 1). ALSTOM also sells a complete service package, rather than simply a manufactured product. The firm believes that the greatest profits are to be found in ‘turnkey packages’ rather than in manufacturing per se. In this sense the product becomes “*the hook*” (interview 1.) by which a host of support services are also sold. This strategy, arguably, is also driven by customer pressure. Virgin, for instance, no longer wants to buy trains – rather they want to buy ‘seat miles’. Prior to interview, ALSTOM had signed a 12-year contract with Virgin Trains worth £1.2bn (1.8bn Euros). Of this figure £550 million was accounted for by the rolling stock while the remainder was taken up by the service aspect of the deal (maintenance and spare parts). It is worth noting that the cost penalties are greatest on the maintenance part of the Virgin contract, but potentially occur over the longer term. Note also that, whilst the WCML contract is a key project from the perspective of ability to win future contracts, because it is so demanding, it is small in relation to the core business of the Juniper and Coradia trains.

³ This occupies space released through the reduction of storage and inventory.

Performance Improvement

At present ALSTOM is looking for a partner who will be able to analyse their activities, in particular their customer focus, in order to seek improvements in it. As yet, however, they have been unable to find anyone to accept the business.

Paul has been attempting to establish sourcing as a strategic function using “stretch 30” through the Boston Consulting Group. “Stretch 30” is so named because it aims to achieve 30% reductions in costs over three years. The programme involves: the rationalisation of the supply base, an increase in E-commerce; redesigning for cost (i.e. simplification of specifications), inter-group training (40% of ALSTOM’s spend is with its own companies); make or buy (at present the only aspect of its trains ALSTOM actually manufactures are the wiring looms⁴ and it only makes these in-house because of the pace of change⁵) and adopting a quality focus (sourcing to good suppliers for quality and quality accounting). Savings of 200m Euros were achieved in 1998/99.

Design

The design process has a high degree of customer involvement. Virgin, for instance, has spent vast amounts of time involving themselves in the design and re-design of the lighting inside the new HST carriages. Virgin, claimed Paul, had aspirations for the design which had pushed ALSTOM beyond that which they were previously capable. Customer interaction with the design process has meant that seventy (mock ups?) sets have had to be produced before the design was stabilised.

A major problem on contracts is late design stabilisation, leading to a lot of retrofit work. Therefore a couple of pre-series sets are being built early to enable debugging before assembly starts in earnest. Designs have to comply with very stringent regulations, some of which are effectively retrospective, which introduces additional cost.

Major design issues on WCML include crash worthiness (partly because passengers will be seated (rear facing) in the lead vehicle travelling at 140mph), the kitchen and the disabled toilets, which has to be fitted in a tight spatial envelope whilst complying with access and turning regulations. Paul Green also indicated that the wiper blades on the driver’s cab were a major issue, since the regulations state they must remain in contact with the windscreen surface at all times, although the reality on most vehicles is that at speed this does not happen.

Another major change facing the industry is the pressure from the customer, due primarily to the short franchise period, for the train to ‘work out of the box’. The

⁴ Carriage shells for instance are out-sourced to Spain (Barcelona) and Hungary (Budapest), the former being an in-house plant, the latter external.

⁵ Part of the reason for this is that suppliers would be unable to respond to late changes rapidly enough. The intention is to outsource this in due course, although an in-house capability would be retained in order to deal with production issues up to the part at which the design stabilises.

customer is no longer willing to wait while the train goes through a 3-6 month commissioning process, whereby the train is dead hauled from the factory to a depot where it undergoes further testing. In future train sets will have to 'drive out of the site'.

Design Studio

The creation of the design studio is a conscious attempt to create a concurrent engineering environment where multi-functional teams responsible for different zones of the train are co-located and where the customer and suppliers are able to come in to interact.

Efforts have been made to ensure that all design staff are fully cognisant of the costs of failure, to ALSTOM, of not meeting targets agreed with the customer. Along the walls of the design room the financial costs of missed deadlines, along with key targets, are displayed in bold graphics. Design is clearly viewed as a key area in which final costs can be controlled.

Production

Production (more correctly assembly) is carried out on a sort of flow line basis. Testing is done in-line - "*testing as we go*" (interview 1.). Originally testing was done after each unit was completed and, as a consequence, further problems would often be created as the unit was pulled apart in search of the original problem.

Other improvements in production have included the introduction of Kaisen approaches on the shop floor in conjunction with the consultancy TBM⁶. The ScotRail contract was chosen for this approach. A particular aspect of production to be earmarked for improvement has been 'material presentation'. This has involved re-designing the layout of the production line - in particular to create more space between the lines in order to improve online storage and parts accessibility. Previously workers on the line were forced to "*root around in boxes*" (interview 1.) to find the parts they needed. Some of the lines have been allowed to remain as they are in order to facilitate performance comparison⁷. A week course in Kaisen is being planned for workers. Attempts are also planned to move the Kaisen system up-stream to suppliers.

Non-project supply chains

Attempts are being made within the company to co-ordinate the purchase of 'general' goods. The firm's structure has a regional and a functional dimension and it is recognised that different regions do not communicate well. This has led to

⁶ Total Business Management (?) – a consultancy Paul Green had worked with in his Toyota days.

⁷ A key question is whether there is a good datum for this exercise. Ken McBean during a subsequent visit also asked about benchmarking and who ALSTOM should ideally be benchmarking against. Can the savings be captured?

unnecessary multiple-sourcing for same items. The problem has given rise, subsequently, to a new co-ordinating role within the firm. The role of the co-ordinator is to seek the best possible efficiency at country level by creating synergy between similar activities. A key means of achieving this has been the sourcing of common expenditures to a limited number of global suppliers (say 2-3). This leads to increases in the efficiency of making such purchases and to increases in ALSTOM's leverage in its supply chains.

Project supply chains

The pressure on train service providers like Virgin to meet safety and performance targets has, to a large extent, been passed on to train suppliers like ALSTOM. Because ALSTOM undertakes to deliver seat miles to Virgin the demands placed on the firm range from reliability, measured in *"kilometres between failures"*, to a precise specification for a braking system. These specifications are themselves passed on by ALSTOM to its suppliers who are expected to deliver black-box solutions. ALSTOM translates customer requirements into precise technical specifications and requirements. In terms of the braking system, for instance, as well as a specific braking performance, a weight limit and compatibility with specified bogie was demanded of the suppliers. On the WCML project supplier engineers will locate at Washwood Heath to discuss interface issues. Other than this, the supplier is totally responsible for meeting the performance specification.

Managing design and production in this way has created new challenges for management at ALSTOM. Previously, managing supply chains had been a sequential 'crisis management' process. As Paul Green described *"First, locate a supplier and then relax. When it gets closer to the delivery - get anxious and send a manager - too late"*. In the light of these sorts of problems ALSTOM has begun to change the way in which it interacts with key suppliers. ALSTOM now sends a 'manufacturing technical support manager' on planned visits to the supplier from an early stage. The engineer looks at the supplier's plans, tooling and produced items and gives any support and advice that is required. The engineer can also co-ordinate help if it is needed, whether in manufacturing or design. In some cases ALSTOM engineers have helped suppliers arrive at an early design solution.

This on-going and more 'interactive' way of managing supply chains may also prevent more costly changes being made later. According to Paul, design engineers at ALSTOM have never allowed themselves to be shut out of any aspect of the design process – not least black-box solutions delivered by suppliers. Typically, claimed Paul, the engineer *"pokes around, says he doesn't like this and wants changes – so it goes it back to the supplier"* (Interview 1).

Key Commodity Management (KCM)

At present a major sourcing initiative is underway to attempt to move the organisation away from project-based structures. The old structure has a different sourcing team for each project, which reports to the project director not the sourcing director. A sourcing structure that reflects the commodity base and serves the whole business is being created. But there is resistance from project directors and within the matrix structure thus created there are arguments between project directors that stem from the

fact that they are responsible for profit and therefore need to see some control over the sourcing team.

The KCM concept creates the potential for establishing centres of excellence. Key commodity managers will be established with responsibility for key commodities such as the HVAC, brakes, interiors etc.

The target is to produce a standard product although there will be some variation e.g. on Juniper there are three brake variants possible. Procurement will need to work closely with both engineers and suppliers to reduce costs. This implies a specialist function compared to the current generalists.

Logistics

At peak production on the WCML project the plant should be putting through 8 cars per week with no planned storage. ALSTOM is considering a third party logistics partner – needs to be a big player with a pre-existing competence. There is also a massive service function which involves moving parts around the country. A large logistics partner could even look to cross-European integration.

Supply Chain Initiatives

These are in their early days. CIPS has just launched a supply chain initiative for the rail industry and PG sits on its steering committee. The Railway Industry Association is also launching its own supply chain initiative, seeking DTI funding with a view to copying the SMMT initiative in the automotive sector. PG has been nominated to this as well, thereby providing a link between RIA and CIPS.⁸

Notes and thoughts

A key part of ALSTOM's competence lies in the selection of suppliers and in the subsequent management of those suppliers. Quality, technological competence, reliability and cost are clearly key features for procurement - indeed at present, efforts are being made to raise the profile and 'calibre' of the procurement function at ALSTOM (interview 1.)

Arguably, ALSTOMs 'intelligent' interaction with its supply base offers opportunities to prevent the loss of tacit and codified knowledge. Indeed, maintaining the interaction itself creates an imperative to maintain a high level of in-house expertise. In order to manage their suppliers intelligently, and in particular to be able to intervene in their activities, it is clearly essential for engineers at ALSTOM to maintain high levels of expertise and knowledge.

⁸ Subsequent events, with Paul Green relocating to Paris may change this representation perhaps?

Meeting at ALSTOM (Birmingham), Wed 9th Feb, with Paul Green

Present – NA, CI and RV

No tape

Issues discussed

- There are two pre-series models, the first of which is now in production. Building the final train will begin at the end of the year. At present ALSTOM Birmingham is “*Drowned by change*”(interview 4) – in a process in which you are “*designing while you are trying to build*” (interview 4). Changing parts mid-design adds costs and disrupts supply. Pre-series 2 will be begun in May / end of April.
- Currently ALSTOM is trying to make sure that the selected suppliers are ready. The technical support people have started visiting suppliers as of the beginning of February to check that tooling is being prepared and that the supplier’s capacity to produce the required product is in place.
- All suppliers will have been scheduled by the end of March. ALSTOM will be visiting suppliers for pre-series 2 at the end of March.
- Some aspects of the design are box-standard while others are more problematic.
- The bogie is a standard Pendolino – tried and tested design. The body shell is also standard, but the floor, which is actually part of Fiat’s scope, is being assembled at Washwood Heath on the pre-series in order to iron out any assembly difficulties. The main changes are in terms of interiors and electricals.
- The floors ordered from ALUSWISS are highly problematic. ALUSWISS do not consider ALSTOM an important customer. Moreover, because of the large size of the floors the work is specialist and limited to few suppliers (ALUSWISS and one other US company). They, ALSTOM reported, have “*gone to the wire*” (interview 4) in terms of poor servicing of the contract. ALSTOM are looking at ways to divide up the floor into smaller sections to allow them to broaden the supply base.
- Train wiring harnesses change continually throughout the design process. Such is fallibility of these harnesses that engineers will delay completion of the electrical schematics as long as possible to increase the chances of their functioning properly. Ideally, the hope is that the first train in the series will capture all of the design errors. Problematically those errors are often multiplied by attempts to fix them. Harnesses are long and complex and are easy to damage through trapping and pulling. A software solution is being considered – though it is predicted by ALSTOM that the industry’s change resistant culture will make this difficult to introduce.
- Future change will revolve around maintenance contracts and it is expected that this focus will drive change toward new technologies. ALSTOM is now including in their search criteria for suppliers the readiness to adopt to new technologies. Technical support also monitors this readiness.
- The railway industry is relatively archaic and has proved unwilling to accept modern databus technology for example, preferring to stick with electro-

mechanical designs. The maintenance side of the business is behind in this respect, partly because it is still maintaining old rolling stock.

- ALSTOM's delivery programme is tight – 15 months in which to deliver 54 new trains. At the height of the production schedule there will be no room for error.
- Every future project will benefit from this one.
- ALSTOM uses the Catia CAD system to send files to its key suppliers. All of the latest suppliers are adopting the system although none, including ALSTOM, claim to be using efficiently yet. Ultimately ALSTOM want to be able to interrogate their suppliers production systems and track the progress of orders. Kanban delivers such a capability and eventually all ALSTOM suppliers will use it for category A parts⁹.
- The ALSTOM design process is itself being re-designed. Programmes (including value engineering) to look at costs have so far resulted in savings of 20 million ECU (30 million is the target). The pre-series builds are the present target. A fuller interaction with suppliers early in the design process is viewed as key to cost reduction. Savings are achieved through '*big stick negotiation*'. The design is broken down into packages and a more cautious approach taken to supplier selection.
- By illustration, ALSTOM reported that one Finnish supplier visiting the site had got out their drawings and literally pointed to design areas where savings could be made. A further illustration concerned two waste bins on the virgin trains. Minor and unnecessary differences in the design of the bins required extra tooling and cutting by the supplier and so incurred extra costs. ALSTOM's objective is now to allow suppliers to be more proactive in spotting areas where cost savings could be made. However, resistance from engineers, who may perceive any suggested changes as a criticism of their work, is expected. Early release of technical information is the target.
- Another key driver in the ALSTOM design process is safety. Because passengers will be seated at the front of the train, and because the body shell is aluminium, the crash worthiness of the carriage will have to be twice that of present standards. The kitchen, located right at the front of the train, will present a buffer for passengers in a crash. Passengers will also face backwards. A key safety feature of the train is a sophisticated automatic breaking system. However, rather than being driven by the recent 'breaking system controversy' arising out of the Paddington disaster, the system has in fact been driven by predicted increases train volumes. It is predicted that such systems will soon be essential to stop trains hitting one another.
- The Birmingham unit is one of the few in ALSTOM not to make its own body shells. ALSTOM Birmingham sources mainly in-group from a Spanish unit. Intra group relationships can be less straight forward than those forged outside the company. For the Scot Rail project, shells were sourced from Hungary. Although ALSTOM Birmingham was forced to support the firm, by buying materials in for them (sourced in-company from Spain) to prevent them going bankrupt, it was felt that the savings made justified the action. It created the opportunity for very close supplier management. ALSTOM is now fighting off competition from in-group and from Siemens to use the supplier. It remains difficult to establish a long

⁹ Kanban is a Japanese inventory control technique - the literal meaning is "visible record". Katia is an IBM design programme - it is (now quite an old) CAD system. (many thanks PB)

term strategy with the supplier because of potential conflict with strategy at group level. It was suggested that there is no corporate strategy regarding the body shells at present.

- Current restructuring to a commodity structure to, mirror the commodity teams being led by Xavier Loefel at corporate level. These corporate teams have responsibility for around 40 business units compared to just 8 or 9 in the passenger business. The Birmingham plant will probably become responsible for interiors. The company needs to erode the traditional project management structure to create strategic commodity purchasing.
- Train companies are increasingly being replaced by bus companies and this is forcing companies like ALSTOM to adapt to a new commercial culture. From ALSTOM's perspective bus company directors do not 'understand' the technological, organisational and logistical difficulties involved in manufacturing bespoke products like trains – rather, they are used to ordering standardised buses. Consequently, these new customers are seen as over-demanding and even abrasive. They have a very different style of relationship and are quick to '*blow the whistle to the top*'. This has sometimes resulted in weekly conference calls to the customer on the part of the MD. The ability to react to these customers is critical.
- ALSTOM plans to use a logistics partner to help them manage their materials flows. Support with sequencing, "kitting", buffering and storing (pre-production line) is envisaged.
- ALSTOM envisages the creation of a "*suppliers village*" through site redevelopment. Suppliers will be able to assemble units on site (e.g. toilet units from Sweden). Because many suppliers will have interfaces between their units, a social interface to compliment this was seen as likely to be valuable. Moreover, designers from suppliers visiting ALSTOM will hold meetings and do work in an area physically within the assembly shed. Consequently, they can either walk a few paces over to the point of assembly, or literally lean over the railing separating the two areas, and interact directly with those involved in the assembly process.
- Deliveries will operate a two-day track time. Consequently, if ALSTOM Birmingham is unable to use those parts in that time they will be "*buried*" under parts. As one respondent put it: "*The chain is fully stocked, if you pull it down there is quite some inertia*" (interview 4). Our interviewee was unsure if the culture was in place to cope with inventory push from suppliers. In the car industry, the culture supports the JIT process – there is only the 'Toyota way'. The rail industry, argued our interviewee, is different – moreover, it is a "*brown field site with brown field people*".
- Most rail suppliers can not understand the principles that Paul Green wants to instigate. TBM are introducing alternative site visits to involve suppliers in seeing the systems in practice.
- Credibility, as well as demand leverage, is an important part of successful supply chain management. Units such as ALSTOM Birmingham must be able to demonstrate that they can accept an agreed supply of materials if they want good service from suppliers – particularly from those that don't need their business.
- Buyers need high levels of technical knowledge to deal properly with suppliers. Unless they know how long it should take to produce a particular item then they have no way of pushing for a shorter lead-time. PG - How do you deal with cross border (cultural issues)?

Interview with Ron Temple, WCTC Director, at ALSTOM, 29.06.00

Present – AT and CI

Editors (CI, last edit 30.11.00)

Disk - yes

The business

Sixteen months ago ALSTOM created a service business out of its existing transport business. This was developed out of activities with AVE in Spain, on the back of the London Underground contracts (the same people who negotiated the Virgin deal had previously worked on the Jubilee line contract) and through the Eastly facility (which ALSTOM bought in 1999 when it was Wessex Train Care - itself previously a management buy out of BR). The group undertakes overhaul /renovation, parts supply (a business selling parts to the rail industry) and maintenance work. WEST Coast Train Care (WCTC) is part of the maintenance business.

During the research, ALSTOM acquired a majority share in Fiat F. ALSTOM had recognised that world market leadership requires the production of VHS trains based on electric power units and with tilt technology. Acquiring Fiat F. gave ALSTOM the tilting technology it needed to pursue VHS contracts in Europe.

Maintenance strategies

Train Operating Companies (TOCs) have different strategies for ensuring the serviceability of their trains. For example, while GNER works alongside it's rolling stock's manufacturer (ALSTOM) and keeps the maintenance function in-house, Virgin has preferred to outsource the whole activity to the original manufacturer (ALSTOM). Both companies frame the problem quite differently, while GNER sees maintenance as a key strategic aspect of its own service delivery, Virgin views the matter as a business risk.

WCTC successes

A 33% reduction in discrete failure and defects (such as air conditioning and lighting) has been achieved by WCTC over the last year.

The WCML Contract

Contractually, Virgin is WCTC's customer.

The maintenance of Virgin's existing WCML rolling stock was transferred to ALSTOM on the 20th of Feb 1999. Virgin wanted to transfer the business to WCTC

as early as possible in order to ensure that the centres were ready for the new Pendolinos. The train care centres are now preparing for the first prototypes (due at the end of 2000 – now delayed).

Performance penalties are heavy and, accordingly, keep WCTC *“focussed”*. The contract structure also leaves WCTC responsible for delivery. This has raised the profile of train service provision in the company to the point where it is no longer seen as a *“...necessary evil”*.

WCTC cultural change

WCTC have built on existing capability to deliver a viable service network for WCML. However, as a result WCTC has absorbed much of the existing disrepair and poor culture underpinning the poor performance of the WCML. These problems stem from chronic under investment in the past. Longsight in Manchester, for example, has been allowed to become a *“black hole”* into which trains *“go and never come out”*. The shed has cobbled stone floors and no doors making it *“freezing”* in winter. The centres also lack a common sense of the company’s overall goals. In Glasgow, for example, staff had previously focussed on what they regarded as *their* trains. While *their* trains had a white numbered card, pink cards indicated trains regarded as alien – as being from *other* depots.

ALSTOM, however, brings a positive learning history in maintenance from its experiences with AVE’s HS train in Spain and SAP R3 implementation. At the heart of the change process for WCTC is cultural change.

“Centres need to feel cared about and they need strong leadership”.

WCTC has formulated its HR policy on the principle that *“people want to work”*. Depot names have been changed and re-branded, (for example: ‘Manchester Train Care Centre’ and ‘Glasgow Train Care Centre’). There has also been an emphasis on staff associating with the manufacturer rather than particular TOCs. The workforce was also re-moulded in 1999 to create empowered, multi-skilled teams. Each team now has its own team leader and service delivery manager. (This structure will remain until it is felt that the team leaders are ready to take over that level responsibility).

In order to encourage ownership of maintenance problems, the way in which information about failures is disseminated to the maintenance workforce has also been improved. The WCTC’s contract with Virgin stipulates penalties for ‘discrete’ failures while Virgin’s own performance is measured in ‘minutes delay’. These minutes include those lost by trains held up by the failures of trains in front of them. It has now been agreed with Virgin that WCTC will receive information on delays in impact minutes. These figures are passed to the depots each morning so that teams can grasp the ‘real’ impacts of failures.

Not all culture is easily shifted, however. For example, although the Wilsden depot may be at risk due to a lack of work, primarily because Wilsden is a loco-only shop and these are becoming less important with the advent of DMUs and EMUs, Wilsden staff are resisting moving to Wembley and what they regard as a *“... carriage depot”*.

New approaches to maintenance

Balanced exams

Traditionally, essential routine maintenance has been carried out by delivering a train to a depot for a given period – therefore taking it out of service. However, Virgin has as a rising stock availability requirement¹⁰ which makes this an increasingly difficult and untenable approach. WCTC has determined that the only possibility to achieve these new targets is to move maintenance to night shift and to take a ‘balanced exam’ approach. The balanced exam breaks down each train’s overhaul and spreads it over a number of sessions and centres. As trains are no longer allocated to particular TC centres they can have their scheduled maintenance done in chunks alongside emergency services. Specialist aspects of the service, in particular those that require lifting the train off the tracks, are done at Manchester¹¹.

(£45 –£50 million spent by bombardier on cross-country maintenance.)

Other shifts in maintenance routines

1. 680 engineering staff were transferred into Train Care activities. TC put in management experience also.
2. **Operation Impact.** The aim of Operation Impact has been to improve the condition of existing rolling stock. Two approaches have been taken – re-designing the maintenance routines and “*baselining*” loco condition.

Repeat defects account for 65 – 70 % of all loco problems. However, at the depot there is often no time (2 hours) to find the cause, with the consequence that locos are often returned to service without the fault being diagnosed. New working process now determine that once the same fault has been recorded more than once on the same loco by a fitter then a technician must attend the loco. If the train fails again it is taken out of service until repaired.

Base-lining locos involves bringing the loco up to a higher level of basic condition (by cleaning out electrical boxes and so on). The process has taken worst performing class 90 and made it the best performing class 90.

It is also recognised that there is little benefit to having a skilled mechanics ‘visually inspect’ trains (i.e. looking at break pads and so on). Instead, semi-skilled workers are having their responsibilities increased (to include visual train inspection) while skilled staff are increasingly employed analysing faults 'by laptop'.

¹⁰ During to contract Virgin increased the number of trains it wanted available from 39 to 42 per day and to 44 at weekends.

¹¹ On each train, on average, every 10 months a major maintenance job needs doing. Every two years the train will need to be lifted off the track.

Regulatory and commercial context

Maintenance sheds are leased from Railtrack¹² and as such are regulated. As a consequence, WCTC find themselves working for other TOCs and for other manufacturers other than ALSTOM (Bombardier at Manchester; ScotRail at Wembley and Glasgow; and First North Western at Manchester). WCTC cannot give preferential access to Virgin services. Moreover, if there is capacity to take trains Railtrack will ensure that they take them.

When other operators put maintenance work into WCTC centres the regulator will take a view on the price that is offered. The details of that arrangement remain the concern of the TOC and the TC centre, however.

Any operator using a TC centre also has voting rights in accordance with the amount of work they have being done.

Bombardier will also benefit from the changes made for new WCML trains.

The separation of design and build

Up until the late Seventies most trains were designed and built in-house by British Rail. BR were expected, by government, to build to a specification for the lowest cost possible. Even trains built by private companies were usually designed in-house by BR engineers to this end. This created a ‘best solution for the money available’ approach to design and kept the customer in close contact with the design process.

Privatisation in the mid-to-late 1980s began with a shift toward ‘procurement contracts’. The need for competition meant that trains were designed and built by a manufacturer according to a performance criteria set by BR. This had the effect of separating the manufacturer and the train operator. The ‘performance contract’, as it was known, thus meant that trains were now designed according to the preferences of the manufacturer (and their suppliers) with a more limited input from the operator. The break up of BR into Railtrack and numerous TOCs increased this fragmentation. Whether this ‘distance’ is felt in terms of dis-connectivity or poor co-ordination between activities is unclear.

Design for maintenance

Reliability can be specified in a contract and can be responded to in design. However, ‘maintainability’ is more difficult for engineers to grasp in detail than more narrowly defined train performance. As RT pointed out “*Maintainable - what does that mean to someone who has never been in a maintenance depot*”.

¹² Though WCTC must pay for their refurbishment (£30 million is being spent at present).

That maintainability has failed to be central design heuristic in train building is evidenced by numerous features on existing trains. On the class 91, for instance, removing the cab air conditioning packs for servicing necessitates the removal of the entire roof. Similarly, checking the rear break stack over-heat thermostat (this shuts down and vents the break if it over-heats), though in itself “...a two minute job”, necessitates removing the whole break stack. In another instance, designers placed a compressor laterally across the under-frame of the train. Mounted this way makes it impossible to remove using a folk lift. The battery box on the Pendolino, furnishes a more recent example. The battery was designed to be removed by a fork lift at the maintenance depot. However, it has become apparent that there is not enough space in the maintenance shed for a folk lift to do so.

The need to design with maintenance in mind has led to the development of new design strategies. On the Northern Line maintenance staff were brought into the design studio while the design process was on-going. The success of this was limited, due in part to the late involvement of maintenance staff and because engineers regarded the presence of maintenance staff as ‘big-brotherish’.

Different TC centre team leaders from around the country have also been made responsible for different aspects of the train design (e.g. traction at Manchester and toilets in Glasgow). Designers are also now expected to spend time in these train care centres developing an awareness of maintenance problems. RT is at present implementing a programme of two-week visits, including time on the night shift, for designers.

(Surprisingly, WCTC has as much risk tied to customer interface aspects of the train (kitchen equipment) as it does if the train fails to run.

Organisation changes

It is recognised by ALSTOM that the existing interaction between ALSTOM and WCTC could be improved; at present “...one team is policing the other”. A solution to this has been to create a ‘Fleet Development Director’ responsible for the outputs of both teams. Under him there is a ‘New Trains Build Manager’ who looks at design for maintenance and reliability and the production of manuals and other materials.

There have also been changes in the deployment of finance. Money, once set-aside for penalty payments, is now re-deployed to help improve train life-costs.

It is now generally recognised at directorial level, that the imperative for trains to be delivered on-time and to cost, must now be balanced against a longer-term view of maintainability and reliability. However, “...engineers find the adjustment difficult” and although the needs of maintainability have made some in-roads into the design process, the industry remains an essentially ‘product performance’ led one. “Big and strong” has historically been the key heuristic in train design. While there are good reasons for this – arguably the train is perhaps one of the worst environments in which to operate sophisticated equipment – it remains that customer demands are forcing a broadening of the focus of train design.

The role of suppliers

RT felt that suppliers should also be involved earlier in the project and design conferences were set up to encourage their input. Arguably, in the event the design conferences were held too late to make full use of suppliers. RT also felt, in retrospect, that there should have been a supplier presence (to form inter-company teams) in the design studio. A considerable barrier to this, however, has been the IP issues arising from the use of the 'Red Book'. In some cases consultant designers have only been allowed to see the proportion of the red book that is directly relevant to them.

From the suppliers perspective, changes made after the design has been stabilised serve merely to increase their costs. It is essential from their perspective, therefore, that they be involved early in the design process. Concept stage change allows changes without adding cost.

More generally, ALSTOM have encouraged suppliers to become more pro-active in making changes post design - a position that is beginning to yield results. Westinghouse has, for example, improved their contribution to the Northern Line by suggesting a screw compressor in place of the existing reciprocating compressor. Although more expensive it is more reliable - something which ALSTOM has shown a growing willingness to pay for.

ALSTOM depend on suppliers for long term parts supply. This is not a new problem (as trains last for 35 years or longer) but the nature of the relationship is changing. Contracts now extend beyond a set warrantee period and include rewards for good performance and penalties for poor performance. Suppliers no longer expect to supply spares at a profit unless their equipment has performed as agreed (see CH notes).

The supply context

The rail industry has a small supply base - there are only, for example, three or four brake suppliers in Europe.

TMS and traction are in-house. It is more difficult to work with internal suppliers as the relationship is *"invariably more political"*.

TMS

TMS technology oversees the performance of the train and allows faults to be identified before a train arrives at its maintenance centre. Traditionally, maintenance has been reactive - such that faults are only identified once the train is in the centre. This is highly inefficient for planning work; while managers may have a work-plan at beginning of the shift, 'emergent' faults will invariably overtake the plan causing disruption and 'fire fighting' later on. TMS technology helps relieve exactly these problems.

Traction control, made essential by push-pull train sets, forms the basis of the innovation. The early 1990's saw the first push-pull locomotives - an innovation which depended upon automatic communication and co-ordination (i.e. between

locomotives). Sliding doors have also formed a part of, and have driven the development of the control system. As computer technology has become more solid state TMS has also grown with that. From the manufacturer's perspective: *"If a train has a management chip it is may as well carry a diagnostics package"*.

This is not a new technology and the first full diagnostics capability was available on the TGV Atlantique; now 12 years old. However, the system has since advanced to the point where it allows the train to be diagnosed remotely, meaning that the train operator and driver can be assisted, conceivably by the manufacturer, while the train is on route.

The TMS cannot extend into all areas of train maintenance supervision. For these roles, AEA technologies in Derby, in partnership with ALSTOM, provide ground-based equipment which 'view' wheel treads, brake pad thickness and 'pan head' (i.e. pantograph) thickness each time the train goes through a TC centre. If there is a shift in the expected wear pattern this is taken to be indicative of a problem.

Competition

WCTC must compete with other maintenance providers for business. MainTrain have franchises including Midland Main Line, Scot Rail and Central and WCTC compete with them directly for Bombardier trains. EWS (freight) also compete with WCTC. The Pendolinos are contracted to WCTC unless they fall below their service agreement.

The WCML contract

The WCML contract covers three companies (WCTC, West Coast Service Provision and Virgin West Coast). ALSTOM have a Train Service Agreement (TSA) for the design, building and maintenance of new stock and for the maintenance of Virgin's existing WCML stock. Because agreements are necessarily with regulated maintenance centres they are public domain documents. For this reason, Virgin did not want a formal service contract direct with WCTC. Instead ALSTOM created West Coast Service Provision to hold the depot access agreements.

A further organisation, WCTC Holdings Limited, was created for tax purposes. Share ownership is also located here. ALSTOM and Fiat staff sit as non-exec members of the board.

There is also a 'Manufacturers Supply Agreement' (MSA). The MSA guarantees WCTC all of their materials and parts within the life costs predicted by each of the partners (i.e. Fiat and ALSTOM).

Together ALSTOM and Fiat act as WCTC's contractor. WCTC staff have learned to deal with ALSTOM *"diplomatically"* in order to get what they need from them.

Managing a contracting JV which is effectively perceived as a 50 / 50 split (it is actually a 45 / 65 split) has proven difficult.

Virgin and Angel

Ultimately, Virgin does not own the trains - rather Angel does. However, Virgin did not want to get into a situation whereby Angel had procured the trains and then simply handed them over in a leasing arrangement. Virgin wanted to get involved in the procurement process directly "*...to ensure that they got exactly what they wanted*".

Other interactions

WCTC have people in Virgin's operations centre at Birmingham. The operations centre houses engineers and planners who interface with Railtrack. In the event of a service failure, the first priority for all parties is to get services back up and running. Having done that, the second is to ensure that any service re-start is planned around maintenance needs. Operations and maintenance are often therefore in conflict; the existence of penalties for delays also promote argument as to who should take responsibility. External arbitration is provided to the centre if needed, though "*...generally it works fine*".

Interview with Ken McBean (Stretch 30 Manager), 22.03.00 at ALSTOM, Birmingham.

Present – NA, AT and CI

Minidisc – 3AL

Eds. – CI, NA

[K McBean used to work for Adtranz - for 15 years]

Sourcing Structure

Paul Green - Under his jurisdiction are the Juniper (David Forman), Coradia (Ian Burgess), Inter-City / WCML (Chris Holt). They have a dotted line to PG and a continuous line to the project director. Operationally, each will report directly to the project director. Functionally, they will report to PG (KM felt that they tended to look more to PG for guidance than project directors).

Also in the structure:

Central procurement - chairs, desks, PC's- (Chris Nelson)

Material Control (Peter Jakes)

Stores (Tony Hawker)

Stretch 30 (Ken McBean)

Central and Key Commodities - Manager (Chris Holt). This marks an attempt to move away from project buying and toward 'commodity sourcing'. Under the stretch 30 "*banner*" this may be re-named "*sourcing for quality*".

Stretch 30 was initiated by Paris eighteen months previously. ALSTOM Birmingham were the guinea pigs for this. 6-9 months ago the "*quality focus*" initiative was begun (this is a larger initiative than stretch 30). Stretch 30 is embedded within the "*sourcing for quality*" focus.

Sourcing will focus upon six main commodities: interiors, brakes, air conditioning, engines, (will give us some slides), fittings and electrical panels.

Zones relate to areas of the train. For example, the cab zone was identified as a distinct entity because of its relationship with approval (including the driver's union) and the need for early build. The zones also relate to the way in which the train is put together to allow for concurrent engineering.

Train production is divided into six zones (originally there were six, then five, then six again six months ago). Each zone comprises a zone leader; engineering; design; production and purchasing. This is ALSTOM's first attempt to 'zone' work in this way. The set up was supported by the Computer Sciences Corporation (1998).

Concurrent engineering and maintenance-centred design

Engineers would in the past sign-off a design but this has been made more complex. Drawings would come for approval and an engineer would sign them off. Now there are 4-6 boxes to be signed off by different functions. In the past the assembly manager would not be able to veto the design until the equipment had arrived on the shop floor. It would be at this time that he found whether or not it fitted together. It remains that each designed item is considered separately in terms of its engineering, cost, weight, assembly and, now, maintainability.

Engineering, assembly and maintainability are the key functions to sign off : *“It is no longer a case of building a train and chucking it over the wall with two years warranty; we will be maintaining these trains for 12 years”* That is part of ATSL (the services side) rather than ATL. There are perhaps a dozen people in the various zones working for ATSL rather than ATL. They are involved in signing off the project and are looking to ensure that it is maintenance friendly. As this has rarely been considered in the past it is a considerable source of conflict.

However, justifying spending in search of long term returns has proven difficult to justify. To support this ALSTOM use a product life cycle model. However, the model has to be used cautiously: *“prices change”*.

‘Reliability Centred Maintenance’ is a technique used to attack unreliable products. Design must decide upon cost and durability against ease of removal (which may add design and manufacture cost). If cheaper items have a shorter life then they must be easy to remove and replace. Alternatively, the spec can be raised to ensure negligible maintenance/ replacement – in which case it does not need to be designed for ease of removal. Inevitably, design trade offs with other equipment demanding ease of removal will have to be made. Typically, engineers want to design ease of removal and specify long-life

A particular innovation in this regard is the Train Management System (TMS) installed to ensure that maintenance is planned through the provision of early warning of potential failures etc.. The system is accessed between visits to the depot and the depot can be advised as to what work needs doing and where, in advance.

One of the biggest maintenance issues on the train is cleaning (for which ALSTOM via WCTC, is responsible). Seat covers have been designed to be quickly removable and dry-cleanable. There can, however, be an over-focus on building for maintainability. Figures for these models are not particularly reliable.

The calculations and arguments surrounding cost savings can become complex. The EP break units on Juniper, for example, were originally installed at a two per vehicle - one per bogie. Stretch-30 argued that because both units were not necessarily involved in every breaking episode that one should be deleted (KM had also observed that their competitors only used one unit). Consequently, on Juniper2, one of these units was deleted. Initially engineering had argued that there is substantially less pad wear using two units – and therefore a cost saving in the long term. However, it transpires that this saving is lost because of the habit of the practice of replacing all of the break pads at the same time to save maintenance time.

Design choices for troublesome items include: re-design, source to higher quality, design in easy access for regular replacement and to question if that part is actually needed. The last question is the stretch 30 approach.

Information about wear and performance comes from the maintenance depots (ALSTOM now owns these depots). The depots identify the major maintenance problem areas and pass that information back to ALSTOM. Lighting is a major issue that is emerging. Information is compiled by people at ATSL. Procurement does not have access to this information.

Value Engineering

Value engineering tends not to be brought in at the design stage. In the interiors design and assembly plan there were 6 to 8 weeks for value engineering activities. The programme was slowly pushed out as pressures to complete increased. Some work was done. Ideally, every drawing would be studied from a value engineering perspective.

In 1998 designers 'Jones-Garrard' spent a week in a hotel with ALSTOM staff looking at value engineering issues. In one exercise stainless steel grab-rails were eliminated from the design. Essential 3D shapes were replaced using super-formed aluminium (vacuum formed aluminium - very thin). *"That is probably the only true value engineering we have done"*. The only way to get consistent savings is for value engineering to become part of a designers second-nature or for an industrial engineer to *"sit behind them"*. Designers don't know how to design with cost in mind.

Value engineering opportunities on WCML have now been missed - *"...we are now into value reviewing"*. As these activities are viewed adding time and cost to their work, zones resist. While this is partly due to being 'outside' the design process, being within it, as part of the zone team, would also bring its own problems as once within teams zone leaders would be able to suppress their input. In some respects it is easier to intervene from outside. At present, all bar two zone leaders have an engineering background and they were interviewed for this role. Ideally they need managerial capability. Typically, the engineer's focus is to provide the 'best' solution. However, the 'best solution' tends to result in over-engineering. Engineers are interested in solving problems such as weight; safety, performance or maintainability but not cost. Cost is not viewed as an engineering problem.

"If the engineering people did their work properly you could almost get rid of sourcing people". Sourcing can only negotiate between 1-10%. Designers/ Engineers could work with at least 50% of the cost.

It was argued that zone leaders do not necessarily need to be engineers with the implication that these could profitably be replaced with commercially minded managers. Mike Lloyd (Head of all passenger units) is reported to have said *"this is a great opportunity missed"*. There are, nevertheless, some moves toward replacing engineers by with commercial managers.

Graduates entering the company are given a two to three year programme which involves spending some time in each of the different sections. However, in each position they are used as “gophers”. Moreover, the graduates themselves tend to have been trained to focus on engineering design rather than cost consciousness. *[In higher Ed. the emphasis tends not to be on business environment. Moreover, the better students tend to go and work in the City rather than in Engineering (NA).]*

Dealing with value engineering in the supply chain

An externally produced technology is difficult to manage in terms of value engineering. Many suppliers deliver ‘black boxes’ which ALSTOM want to look inside (to ensure and to improve upon reliability, maintainability and cost). Some suppliers, tempted by 50 / 50 shared savings and repeat business will work with them. Westinghouse, for example, has agreed to delete one of the EP break units as part of this process. ALSTOM try to avoid suppliers who will not work with them. The industry is presently also buoyant¹³, allowing them to offer repeat business in return for supplier involvement in cost reduction.

ALSTOM does not attack the value of supplier’s margin. Cost savings may thus lead to an increase in the supplier’s margin. However, ALSTOM does seek to capture future cost reductions within present contracts. ALSTOM’s way of doing this is to ask for the end portion of any order to be delivered free of charge. In the case of the Juniper Scotrail project, one supplier will supply the last 9 vehicles worth of equipment free of charge (constituting 3% of the value of the existing order). ALSTOM will then pay for that as part of the next contract. However, the new contract will only be awarded on the basis of continuous improvement from the supplier. Thus, ALSTOM is taking 3% of a predicted 10% saving. Westinghouse offered £¼ million of free equipment solely on the basis of sharing cost savings 50 / 50.

To date, only two suppliers have resisted these approaches. Suppliers who resist do so because of the leverage they have. Knorr-Bremse can afford to say no as the rail industry is only 5% of its business; Westinghouse cannot. KM has offered NB future tenders to tempt them but has been unsuccessful. Westinghouse is not supplying WCML because their relationship prior to the contract being awarded was poor. Having now improved their performance, Westinghouse would be the preferred supplier. Westinghouse is now attacking Knorr-Bremse markets though cost reductions¹⁴.

First tier suppliers should become a ‘one-stop shop’

¹³ The year 2000 will see thousands of vehicles ordered with the SSRA acting as a purchasing agent.

¹⁴ To a large extent this discussion is superseded by events that have seen the sale of Westinghouse Brakes by Invensys to Knorr Bremse.

“The supplier will only get lazy if you let him get lazy. It’s the buyer who gets lazy”. This is also partly because of the number of suppliers that have to be managed. Reductions in supplier numbers, through a focus on first tier ‘total solutions’¹⁵ free up the buyer to focus on the management of cost, reliability and quality. Business can then be focused on those suppliers to encourage their continued co-operation. The alternative is to be dealing with the thousands of invoices generated by lower tier suppliers (e.g. for bracketalia).

First tier suppliers include critical technology packages like breaking, traction (intra-group). The existing toilet module supplier, though also regarded as critical supplier, may be moving to being a second-tier supplier. The supplier wants to divide the product into two, and deliver only the toilet and flush (which is their main competence), Alstom want to source through a first tier supplier¹⁶.

In-group suppliers

“We don’t achieve anything with our internal suppliers”. They have their own stretch 30 managers and ALSTOM Birmingham have been instructed not to interfere with that function. However, that arrangement will only produce savings if ALSTOM Birmingham have not over-specified the work they order. It is important to work together to find cost savings – ALSTOM Birmingham need to be able to re-open in-group black boxes and to re-question what was originally specified.

Delivery is a problem. Quantity problems (too many or too few) are especially typical. Although ALSTOM has asked their French supplier to deliver X number of bogies per-week, to synchronise with their production schedule, the French have ignored this and deliver them when they are ready (Mike Lloyd has stepped in to try and sort out this particular issue).

Procurement no longer tries to offer ideas to improve delivery or cost in-group. Such moves in any case tend to be ignored. A speaker supplier (in Lyon) when asked to reduce the kilowattage of a speaker from 40 to 30 (a potential saving of up to £¼ of a million), although agreeing to do so claimed it would delay the programme by 10 months. KM claimed that this was patently untrue (*“...it would not have delayed the programme by 10 days. In our opinion it was a simple change. They could not argue the cost side, so it was a 10 month delay”*). Since that particular episode, KM has instructed his stretch 30 staff not to waste their time trying to deal with internal suppliers.

Long term vision v short term achievements

Stretch 30 has a three year life-span - it is recognised that the best savings will be attained over the long term. Stretch 30 principles need to be fed into the design and procurement process. At present they lie outside them but ultimately it is hoped that

¹⁵ E.g. for interiors – the Adtranz approach.

¹⁶ This was a major point of contention in the negotiations at the time of our study and the eventual outcome was uncertain.

“it will become part of the day to day activity”. However, it is specifically a sourcing-led rather than engineering led initiative and this has lessened its impacts amongst engineers.

Cost saving targets set by the supplier tend to be vague statements to improve targets. ALSTOM have to put figures on them (usually 10%). Setting mutually arrived at targets is the long-term goal.

Sourcing will also look at increasing the value / cost of work given to the supplier in order to save money in assembly.

Suppliers work at profit margins of 7 - 10%., however, sourcing has little information on true profit. At present, sourcing is more interested in the cost than the margin. However, it is the margin that is the area of negotiation and this will be a focus of the key commodity buyers.

Innovation

Innovation is a key criteria for taking on new suppliers. ALSTOM itself conducts limited R&D and so depends on innovation from suppliers. This means effectively TESCOS (the old railway technical centre in Derby) and design houses which include Inter-fleet, WS Atkins, Engineering Link and AEA Technology. Recent innovation from here includes a fully electrically operated breaking system (no pneumatics).

Approximately only one in ten suppliers pursue what KM referred to as *“real”* innovation. In general terms *“If this was the car industry, we’d all be driving around in model T Fords.”* Suppliers are a *“hit and miss”* source of innovation.

Innovation is said (by the industry) to be a competitive driver (there is innovation in traction equipment) but in many areas it is perhaps lacking (depending on your definition – K talking about radical innovation) – you do not see many step changes in terms of the products on the train. Nevertheless, ALSTOM sells itself as an innovative market leader.

Innovation is also driven by the customer - e.g. Virgin’s entertainment system. On the Pendolino, apart from the entertainment system all of the elements of the train are well known.

Sourcing is the aspect of ALSTOM which is really dealing with innovation - it is only sourcing which is interested in what the supplier is able to offer tomorrow.

The assembly of rolling stock vehicles is the core competence at ALSTOM. As much as 80% of the design is subcontracted. Project management is therefore a key competence. Dealing with the interfaces between packages of work from suppliers is the key design activity within ALSTOM. Pipe, wire and ‘bracketalia’ are the key aspects of the design work dealt with in-house. As a consequence, design has become *“... a commodity you can buy anywhere”*. Moreover, in the UK the build up in rolling stock (and perhaps the forthcoming **RR 25 tax schedule?**) has prompted designers to set up their own companies. ALSTOM and ADtranz are forced to fight

each other, through hourly rates, to hire designers. The lowest rate ALSTOM now pays is £25 an hour. Arguably, it would be cost-effective to give people full time positions¹⁷.

‘CAD-jockeys’ are distinguished from competent ‘engineers’. “*CAD-jockeys we buy like water...Innovation comes from engineers*” (it is the latter who produce the functional specification for the supplier).

It would be possible to out-source low-level design work. This would develop contractual instead of ‘hours spent’ commitment. Jones Garrard has agreed to undertake the work at a set cost and time. They will also fit the first three vehicles to demonstrate that their design can be fitted at an agreed speed (i.e. can dovetail with ALSTOM’s manufacturing plan).

As in all procurement, failure or success should be met with shared rewards and costs.

It is important to determine what engineering competence actually needs to be kept in house. It is perhaps unnecessary to have design experts in specific areas such as brakes. Instead of just dealing with the functional specification and interfaces, they may also, through boredom, begin interfering unnecessarily with existing supplier designs. This adds cost to the whole process. [*How is unnecessary interference defined?*]

Mechanisms of Knowledge capture

Learning from projects across ALSTOM is systematised via a data base called CKT (French translation - Cost Killer Team). A key element in the Seven Levers of Stretch-30 is ‘(Re)design to cost’. The database makes available (between projects and units) ideas and solutions that have arisen elsewhere. (Xavier Loefel’s idea.) All cost reductions ideas from across ALSTOM are stored in it and zone leaders and engineers all have access it. This is the only mechanism of learning in place. However, it is clear that many units are not interested in using it or contributing to it. Production people will enquire about how things are done (Germany and France mainly) - but none from engineering.

The transfer of personnel from one project to the next is the principle mechanism of knowledge transfer. Some new staff will be coming over from Juniper and Coradia to WCML.

Re: engineering procurement

Procurement is being re-organised so that each of six key commodities will have their own buyer, key commodity engineer and cost reduction engineer (in the long term this engineer will become ‘part of the process’). These roles are not involved in particular projects. When this is in place there will also be Sourcing Analysts (day to day admin)

¹⁷ The difference between contract rates and ALSTOM’s rates of pay approximates to £10,000 p.a. for the designer so the incentive to work as a contractor is easy to see.

and Key Commodity Support Buyers (graduate calibre) who will work within the project. This connectivity across disciplines and around particular commodities may promote learning.

This re-organisation also dove-tails with the drive toward standardisation and with drives from Paris.

Potential sourcing synergies across projects are lost as zones have become micro-business units. As such they have resisted using suppliers suggested by sourcing or those which have stemmed from Juniper. Juniper is in many respects a similar product to the Pendolino - both are electric traction units, long distance travel focused (the tilting equipment is not in the sourcing scope of ATL, but of WCTC). The similarities have not been capitalised upon, however.

Juniper is the life's blood of the company. The Pendolino is a one off and unlikely to find further markets (the export market is dealt with by ALSTOM Paris). Moreover, at present ALSTOM UK is struggling to meet UK demand. Hong Kong is the only foreign market they deal with.

Much learning comes from suppliers. However, suppliers across the board are shared with competitors (including key commodities - brakes, electrical cabinets (Trolex, Stockport) and toilets (EVAC)). In one instance, Westinghouse delivered a break unit frame made for Adtranz to ALSTOM. – this was how ALSTOM found out that 'the competition' only use one EP break unit! So far as KM's objectives are concerned a shared supplier is a good supplier. They have already learned to serve the rail industry – have already gone through the pain barrier.

There is also some collaboration and learning between competitors. Although most people in ALSTOM don't want to deal with Adtranz, ALSTOM has good relations with Bombardier. There is some commonality with Bombardier. They are building 'Voyager' (the seat is the only common part) though there may be other common suppliers. There were ideas to build leverage through buying together. (For many suppliers the rail industry can be a peripheral concern). However, not much came out of this. ALSTOM also talk to their competitor's suppliers.

The supply base

For some suppliers the rail industry is 90% of their business and can constitute something akin to a "hobby" as much as a business. *"The rail industry has shrouded itself in Mystery since Stevenson built the Rocket"*. It may be helpful to look for suppliers that have no knowledge of the rail industry.

Key supplier competition is generally high. Though in some specialist areas (e.g. Electric pick-ups such as the Pantograph, third rail shoe gear couplers and electrical jumpers between carriages) there is little competition (in the UK there is only one supplier of electrical pick-ups - Brecknall Willis in Somerset). There are Czech, French and German alternatives. These are components that interface with the

infrastructure outside the vehicle and are largely outside of ALSTOM's control. Moreover, there is a 12-month approval procedure with Railtrack. This makes costly to develop close relations important. Sourcing is, however, always on the look-out to develop the competition amongst the supply base - *"ADtranz brought somebody new in and I was straight onto that"*.

(Now that 1,500 vehicles per annum are coming up in the UK the Japanese are moving into the market¹⁸.)

Who is the customer?

Our customer is WCTC (*"I don't know who our customer actually is"*).
(see workshop 1. notes for further discussion of this)

Stretch 30

There are seven key Stretch 30 levers.

1. *SPR Systematic Portfolio Review*. This resulting in the purging of the 30 - 40% of suppliers that had not been contacted for some time (some for five years or longer). Another 20% that were costly to maintain (invoice payments, quality checks) but only offered standard parts were also removed. A key aspect of SPR is to identify single suppliers in order to gain admin savings. Many supplier relations can be traced back to a *"mate of a mate of a mate"* relationship.

2. *Co-ordination Across Units* (cross fertilisation across units). As project staff are focussed on their own units, success has been limited. There have been seminars and workshops involving visits to other plants within the group.

3. *Low Labour Cost Countries (LLCC)*. LLCC should constitute 10% of the product (Paris directive) – However, as KM pointed out this does not necessarily mean a cost saving. ALSTOM have a Czech platform set up to find a deal with local suppliers. A simple, steel fabricated body shell from Budapest has saved millions (e.g. £4 million saved on Scot rail by sourcing to Budapest)¹⁹. ALSTOM does not buy the company because of their low standards in areas such as health and safety – which would be costly to correct and would in any case raise costs. LLCC's tend not contribute to the design or specification – mainly low tech fabrication. There is some political resistance within the ranks at ALSTOM to outsourcing (see AL1). On the other hand, according to Paris, Birmingham may not have been proactive enough in chasing potential Eastern block suppliers.

4. *(Re)Design to Cost*

¹⁸ Hitachi – see Modern Railways for more details.

¹⁹ There was some evidence from observations made while on the shop-floor that ALSTOM was having to become directly involved with the Hungarian supplier to pre-empt delivery problems and avoid liquidated damages for late delivery.

5. *Standardisation* Standardisation is a key lever in reducing cost. However, the idea can be misapplied. Standardising has cost ALSTOM “*millions*” but has not always gained the savings hoped for. Juniper has skirts on 64 of the 304 Gatwick express cars. This means brackets for the underframe have to be designed (drawn) for all. Standardising the design with all brackets included for all cars, while it saved 2 days drawing, cost £55,000²⁰ in assembly time and materials. Standardisation works well on mass parts (there is a ‘standard parts’ list). Cable is a good example: on WCML standardising parts has saved approx. £1.5. Standardising has been applied to the lowest spec – the lowest spec do not mean unreliability. For example, higher spec cables in terms of toxicity in fire, does not mean a robust cable – as evidenced by the cable supplied for London Underground – whose shells disintegrated and had to be replaced.

6. *Supplier Interface* all about the life cycle, delivery, line-side fitting etc.

7. *Make versus Buy*.

²⁰ NA notes say £5,000

Meeting with Chris Holt at ALSTOM (Birmingham), 12.04.00

Present – NA, AT and CI

Mini disc – 3AL

Eds. – CI, NA

ALSTOM / Fiat

Fiat's scope of supply is as follows:

- body shell
- Tilting bogies
- Exterior doors
- Auxiliary power supplies

ALSTOM provides floors and internal doors to be fitted by Fiat

Interfaces such as those between doors and body shell can take months to resolve. There are cultural differences between the two companies and although CH has limited involvement with Fiat, he noted that the main issues relate to differences in working practices. For example, the body shell design was sent to Alstom, but arrived with rather less detail than Alstom expected. No-one from Fiat is based at Washwood Heath on a full time basis.

The zones

- Cab – driver's desk, console, equipment etc
- Roof and body ends – farings, aerial, pantograph, intervehicle jumpers
- Systems (TMS, tilt inhibit, signalling interfaces and so on)
- Underframe (brakes, pipe work, anything slung under the carriage)
- Interior linings (linings on shell, luggage stacks)
- Interior equipment (e.g. kitchen equipment, seats, toilets).

The zone leader has responsibility for resource planning, team management, budgets and deliverables (i.e. design work, putting contracts in place with suppliers and so on)²¹.

Locally, the zone leader has a great deal of control, however, he or she cannot influence designs. He cannot, for example, change seat colours, curves or how catering will look – zone leaders have the Red Book to refer to. The zone is passive in this respect; the leader takes a concept and turns it into a product that is delivered to the shop floor.

²¹ Chris Holt described each zone as a mini-project , which is perhaps revealing.

The zones have technical leaders (technical issues and interfaces with other zones), product engineers, design engineers, production engineers (integration with production – there are 300 individual elements to the interiors zone and so the correct timing and ordering of assembly is essential) and a sourcing analyst (may have more than one – linked to core procurement strategies) holding a procurement budget and responsible for finding and, if necessary, developing suppliers.

The interdependency of zones

The zones are highly interdependent. The ducting (Liebher), for example, is the responsibility of the body ends, cab and roof zones. However, this impacts also upon interiors and systems (electronics, train management). Thus, if Liebher make any modifications this effects all of these zones. To manage this, the two zone leaders must get together. The system relies on personal interaction (i.e. relies on personality).

Another example – The cab design cannot be completed until the air-conditioning ducting design is finished for the whole train. This can't be done until the interiors design is finished.

Ken King has the overview of these interfaces - which should in effect resolve these issues²².

A step back from Zones

Buying strategies and policies are controlled by the central procurement manager for whole WCML project (Chris Holt). Individual sourcing analysts are responsible for identifying cost efficient suppliers. They may also help in developing the product. Chris Holt may support this activity – setting up workshops to attack costs etc.

In the interiors zone, for example, CH decided to break up the package up by taking on an individual design house (JG) and managing the suppliers direct. The reason for this being that Red Book is imprecise. ALSTOM found that the tenders coming for a complete 'design and supply package' were very high - ostensibly because of the risk. Suppliers found it very hard to know what designs would finally cost – given that they were still at the conceptual stage. However, from ALSTOM's perspective, the interior, once the design is determined, is just a collection of GRPs ("just metal bashing") and there are many suppliers that can do this (15 - 20). By contrast the level of competition pre design fix is low (perhaps 1-2 candidates). Thus, ALSTOM decided to develop the designs before going to market to get the level of detail they needed to go to broaden the competition. In this way ALSTOM mitigated risk (and therefore cost) to potential suppliers by holding off taking on suppliers until the design had been finalised.

²² This is where the term *ensemblier* was first used with reference to this overview role.

There are negative consequences to such an approach. First, there are increased management costs to be borne by ALSTOM. Second, this arrangement creates changes in motivation for the designer. If the designer is locked into a design and supply contract there are motivations to design to cost or less. There is less motivation for a contracted designer to do this – they care less about the final cost of the design as higher costs will not impact upon their margins. They may also have preferences for particular suppliers.

To combat this ALSTOM identified the suppliers as quickly as possible and then placed themselves into the design process to ensure that the best cost design solution was being adopted. ALSTOM, the supplier and the design house get together over each drawing to establish whether each one is the best solution to reach a go/no go decision. But with over 300 drawings this is less effective than using a single design/supply contract. There is a problem of a lack of a formal contract between the supplier and the design house and a reliance on informal discussions and relationships.

CH claimed that if he could do it differently he would identify the designer and suppliers and get the suppliers to contract with the designer. The design house, as lead contractor, would take responsibility for costs. Design dictates the cost so the designer is controlling the costs. That is controlled by dictating a limited budget. However, the designer does not want the risk.

In-house design would have been another solution. However, there are no in-house designers at ALSTOM. ALSTOM had discussed creating a design team for WCML. Unfortunately, this is not a core activity and so goes against company's general outsourcing strategy.

CH identifies a clear need to get to detail design more quickly and then to get suppliers to build to a cost.

The retreat to core competence

Generally, ALSTOM tend to go for 'design and supply' contracts. This is easier where the designs are less complex. The roof fairings are a good example – the suppliers do their own designs and have their own in-house manufacturing capability. However, finding design and manufacture under the same roof is becoming increasingly difficult. As companies like ALSTOM push design out design houses spring up. In face of increased competition for design, manufacturers retreat to their core activity, manufacturing. The consequence is a knock-on fragmentation of the supply base making design and supply more complex. Moreover, each player adds contingency to their own margins to cover the increasing risks which emerge from their reduced control of the 'concept-to-manufacture' process.

The trend toward focusing on core competencies is having other effects. For example, ALSTOM have become used to purchasing a complete toilet module from a single supplier. The manufacturer ALSTOM has used in the past now wants to split the module into its case and the flush mechanics. The company's competence lies in the flush unit and it no longer wants to make the module as well. This split means that ALSTOM will be faced by two suppliers; this will increase its management costs and

leave it responsible for integrating the two components. Clearly ALSTOM does not want to work with a growing number of suppliers (management costs, difficulty in controlling costs when design is unclear and so on).

The supplier who used to do the toilet will now become a second tier supplier (although the supplier would prefer to keep their direct relationship with ALSTOM) and ALSTOM will source all of the parts of the units through a single contractor. In this scenario, ALSTOM are faced with difficulty to apply performance targets for service defects. With one supplier it is clear who is responsible for its performance. Where other assemblers are involved it is not so clear.

Penalties system

ALSTOM passes on the train service defect rate agreement and associated fines, that it has signed up to with Virgin, to its suppliers. However, suppliers only pay fines if ALSTOM have to do so. Consequently, although a supplier may exceed its agreed failure rate it may not face fines if, overall, ALSTOM has not fallen under the targets it has agreed with Virgin. A poor supplier may be protected by the good performance of other suppliers involved with that element of the service. These performance regimes have to be negotiated with suppliers and it is noticed that suppliers are unwilling to accept responsibility when there is a possibility that failure may be due to errors in assembly by ALSTOM.

The toilet is a part of this service defect agreement.

[have a zone by zone map of the supply chain – will send]

Documentation

ALSTOM has tended to be poor on controlling soft deliverables (i.e. the documentation that goes with the parts supplied). In each contract there is provision for the cost of delivering documentation. Because payment is traditionally upon delivery of equipment, the suppliers have no motivation to deliver the documentation. Some percentage of the payment is now set aside (approx 20%) for its delivery. If the documentation arrives early the supplier gets that payment early. This motivates, internally and externally, chasing the documentation. This has not been applied to in-group suppliers *[laughed]*. ALSTOM tends to rely on political means to get the documentation internally.

Contracts approach

In their contracts with suppliers ALSTOM have taken clauses from their own Virgin contract and passed them to the suppliers to contract against. They have also added their own emphasis. As well as the traditional requirement to get hard deliverables ALSTOM also insists upon on-going support being written into contract. This is quite new for most suppliers and some have been reticent - though most have understood the value of a long-term contract with ALSTOM. ALSTOM agrees that, in the event

of repair or replacement requirement, within an agreed schedule for that piece of equipment, ALSTOM will use their services and pay for them.

Contract types

Type A – (C+B2+B1) +: A full service contract. This goes to supplier and includes repair work done by them, regular servicing and overhauls. This is run on the basis of a regular payment. At the same time, there are liquidated damages associated with the failure of the kit over and above a pre-agreed number. Damages will depend upon whether the failure is a service defect (a failed toilet or light) or a service failure. Liquid damages are applied when the service fails (i.e. Virgin loses money) but exclude consequential failures.

Each piece of kit has a failure allowance – e.g. brakes can fail once a year. This is calculated by ALSTOM against the every 50,000 miles between breakdowns agreed with Virgin. ALSTOM expects the brakes to fail at a certain rate and will pay the supplier to repair them (a guarantee of sales of spares).

So far as the contractor is concerned, the onus is upon ALSTOM (or Fiat) to show that any given kit failure is a particular supplier's responsibility (i.e. the windscreen did not crack because the brakes failed!). From Virgins perspective, ALSTOM and Fiat have independent responsibility for their part of the equipment supply. Responsibility is identified through WCTC. Virgin will have to identify the root cause of a failure before they approach either ALSTOM or Fiat. ALSTOM does not administer this part of the process. Virgin sees WCTC rather than ALSTOM or Fiat.

Type B1 – (C+ B2) +: The regime is passed on to the supplier. In this contract suppliers have a reliability target (a guaranteed failure rate) beyond which they pick up charges. The supplier must underwrite the failure of that component (service defect ratio performance). Covers certain areas - lights, toilets, doors and audio – if ALSTOM pay a fine they pay. CH gave the following example - over allowance payments are £60, per defect, over allowance + 50 brings a £100 per defect payment, over allowance + 200 a £200 per defect.

Type B2, - (C +): A reliability target is given which the supplier must underwrite.

Type C - They guarantee ALSTOM can buy spare parts from them over a given period. If bankrupted ALSTOM have rights to the tooling and designs. They must also give guarantees against obsolescence.

Reliability targets

If the supplier negotiates their failure rate at 15 per year ALSTOM get them to underwrite it. If greater than this the supplier will have to pay for failures (16,17 and 18). Up to 15 ALSTOM will pay. In reality, to cover themselves, the supplier will negotiate to twenty, to build in their risk. ALSTOM will negotiate to 18.

However, as the supplier improves his performance over time his sales of replacements are threatened - so there is no motivation to improve on 18. ALSTOM encourage them reach their own target (perhaps 10) by paying shared benefits – ALSTOM will pay more for each part as consumption falls below certain pre-determined levels.

Ultimately the objective is to secure ALSTOM's financial position – this is not first and foremost a lever to improve the overall reliability of the train. Targeting individual suppliers is not the best route to improving overall reliability.

There is a mechanism to get rid of suppliers (credible threat).

1. If their reliability is continually unreliable:
2. Their spare parts are not offered at competitive prices – (suppliers prices must follow the market price).

Safety case

There is a safety case team reporting direct to Peter Sizer, but each zone is responsible for the safety case material pertaining to that zone. This is supplied to the safety case team for overview and collation. Zones are responsible for identifying and closing out all hazards in the zone.

Interview with Peter Sizer, WCML Project Director, at ALSTOM, 13.06.00.

Present – AT and CI

Editors – CI (last edit: 28.11.00)

Disk – yes

Introduction – Peter Sizer

Previously PS was the Business Director of Traction UK, prior to that he was Projects Director at Preston, also ALSTOM, and prior to that he was project Manager at Eurostar (for the UK part of the project).

The bid

PS started work on the project in January 1998 just before the contract was at the preferred bidder stage. The bid was submitted two months earlier in November 97 (at which point it was felt highly likely that ALSTOM would get preferred bidder status). Preferred bidder status was awarded February 98. In February 1999, after a further year of negotiation, the contract was signed.

Project managers were not involved in the bid process – bid winning being a highly specific role.

Close contact with other organisations during the bid process may be costly. Two key members of ALSTOM staff involved were 'head hunted' during the process by Angel Trains and Virgin.

The contract

Intro

Virgin's business case depended upon getting the requisite number of trains into position at a given cost. ALSTOM's role is to deliver those trains to the platform, every morning of the year for twelve years. At the platform Virgin take over (the drivers are trained by Virgin)²³.

The WCML contract is complicated in management and financial terms. Because Virgin themselves are not a train company they rely heavily on consultants to help them draft requirements. Virgin began with a business case “...to move so many millions of people from A to B in certain time over a certain period”. ALSTOM also needed to be able to design a train that would retain a given residual value after thirty-five years in order to satisfy the train owner Angel. At the same time, the long-term

²³ ALSTOM do provide a training simulator - which Virgin have bought.

service provision aspect of the contract “...made things a little bit different in terms of the approach to design and development”.

The process

PS was not involved in the bidding processing but he was involved from time to time in the negotiations leading up to the contract being signed. Critical issues in this part of the process included: the performance of the train (noise (internally and externally) the air conditioning; the mass of the train; overall journey times; practical operating speed and so on). PS's principle tasks were to set up the team (once the funding was in place), make sure that the design was progressed as if the project had already been secured and to ensure that what was put into the contract did not compromise ALSTOM's vision of the design.

Bid winning criteria

Bid winning criteria centred on ALSTOM's decision to take a large share of the risk, an attractive financing deal and existing links with Fiat (and so tilt technology).

Tilting technology was the only possible technology choice; if the trains were to run faster on the existing West Coast Main Line. Fiat had a working technology available and ALSTOM had an ongoing relationship with them (set up mid 1997 for the express purpose of jointly bidding for certain contracts). At the time Fiat had no maintenance capacity, no UK orders and no way of getting into the UK market. ALSTOM had good links in the UK market and, key for Fiat, understood the technical arguments necessary for making safety cases. They also had a maintenance business.

Fiat is a partner rather than a supplier, not only because they have tilt technology, but because they are prepared to share the risk.

Organisational alignment at ALSTOM

Time pressures on product delivery gave rise to two organisational strategies. The project teams had to be built up quickly and they had to be larger than normal. The overall length of the contract also made inadequate existing design space and IT systems: “*We needed to do something a little bit different*”.

Up until June 1998 the WCML design studio had been a storeroom. The new accommodation was clearly a source of pride: “*There are a hundred and twenty people in this studio, there used to be a full mock up of the front end of train but that had to be moved out to accommodate more people*”.

The division between product and service in the contract was represented organisationally in the form of two separate teams. A train delivery team and a service delivery team. Ron Temple (WCTC) became involved in the contract from March 1998.

The Virgin franchise

Virgin had discussions with ALSTOM and with other potential suppliers in order to cost their intended service and put in a reasonable franchise bid. In order to win the

franchise Virgin Trains had to be able to put tilting trains into service. (They would not, however, have named ALSTOM in that bid).

The supply base

It was decided by ALSTOM, before the contract was secured, who would supply the major components. The supply base for the rail industry is small, so there are only two or three suppliers available to supply any given main component. A proportion of the components were also internally sourced (e.g. Traction). Air conditioning, brakes, all of the auxiliaries, interior equipment (kitchen, shop and toilet modules) were all procured externally.

Knowing where

Having been in the industry for a hundred and fifty years ALSTOM have an in depth knowledge of the rail industry supply base. Moreover, they are a high profile company who suppliers will approach first. Supplier researchers ascertain which manufactures are applying for what contracts and then approach them in the hope of securing preferred bidder status.

Procurement organisation

ALSTOM has endeavoured to organise its procurement into discrete packages of design and supply. Ostensibly, ALSTOM has tried to limit their interaction to the first tier of the supply base as a means of reducing management costs.

The series build period provides leverage over suppliers and so keeps the suppliers under pressure to perform.

Alongside the usual contract stipulations, contractors are held to 'turn-around' times for effecting repairs. ALSTOM are offering service contracts of twelve-year duration and this has also provided a strong negotiating lever. There are, however, some difficult suppliers (AluSwiss and the Toilet module provider for example) – largely because of their market and competitive position. *“They don’t want the business so they don’t care to much. They resist being pushed beyond what they normally do”.*

Integrator role

ALSTOM designed the control systems for the train and all of the train management software.

Critical knowledge

ALSTOM has made a conscious effort to ensure that it has the knowledge it requires to deal with technically competent suppliers. Key areas were identified by ALSTOM in which it must retain core expertise. These included: developing the safety case, systems engineering (to ensure the train will work!), railway standards in the UK, the

total certification process and the interaction of the train with the infrastructure. It must also understand how to maintain the train over a long term and how to make a profit out of doing so!

Down a level, although ALSTOM have people on-staff that understand particular systems - for example the braking systems, they nevertheless rely heavily on the suppliers for advice. What ALSTOM does need to know is whether what they are procuring will "...have the right effect... We need to know how to check [supplier] calculations to verify what they are telling us will actually work - we need to be able to validate... In the end it is our responsibility if a supplier is not adequate in terms of its product".

ALSTOM also employ specialist consultants to support the design process. Noise and environmental control in particular are key areas requiring specialist techniques. ALSTOM have their own test facilities in La Rochelle for climatic tests but they also need to use larger external facilities (to test for insulation, for example).

ALSTOM's competitive advantage revolves around retaining the knowledge it needs to organise its supplier network. *"It requires experience to know what you need to know - its easy to think it is easy but it isn't, its bloody hard"*.

Interfaces

Potentially, Virgin is only involved in the first twelve years of the train's life. Thus, the owners of the train, Angel, have a clear need to monitor the train's care to ensure it is being maintained properly. ALSTOM do not want 'two bosses' so Virgin act as the agents for Angel. Angel get their information from Virgin and Virgin handles all project management issues.

ALSTOM and Virgin hold project management and design meetings every; other meetings are held as required. Virgin have their own Project Managers.

PS's main point of contact with Virgin is through Virgin's Project Director; though there numerous other lines of communication with other levels and functions. There is an engineering link through the engineering manager; a project management link; a contracts management link; program management link; a link with the test manager and a safety case link (which tends to work through the Chief Engineer in Virgin Trains). All points of contact have formalised ALSTOM, Virgin and Fiat named principle staff bar those links which involve specialist engineers.

There are also informal links between the companies but PS discourages this. PS tries to ensure that all discussions are properly and formally recorded. Part of the project's manageability comes from the fact that only signatories are able to 'sign off' an order placement, specification or a decision over a particular issue. There are only two signatories at ALSTOM, PS and the Project Manager.

There is also a substantial amount of work relating to the transition between the old and the new stock. To facilitate this transition 'maintenance people' are working in the ALSTOM design office throughout the design phase. There are key technical

interfaces with Virgin, Fiat and the certification bodies. There are also principal zone interfaces internally and with suppliers. From PS's perspective the main areas in need of resolution is the split into two camps of Virgin and the Zones themselves.

There have only been about fifteen hundred letters issued since the beginning of the project -Virgin have issued two and a half thousand with other documents as well.

The design process

Virgin's original technical specification was regarded as extremely challenging by ALSTOM. In some areas it was deemed to be overly ambitious and ALSTOM's saw its role in the first instance as informing them what was reasonably possible, "*...your are not allowed to break the laws of physics too often*".

Virgin wanted their train to be "*...better than anything else that has ever existed, we want to build something that is the norm, so we had to meet in the middle somewhere*".

While the actual speed of the train was not in itself challenging for ALSTOM, designing a train capable of maintaining the required speed over the WCML was. The on-board facilities, in particular the seat reservation system, have also proven challenging. The way in which information is collected and processed on route is quite radical. Information has to be fed to stations and to depots via radio links from the train – allowing, for example, seat reservations to be made while the train is still on route. The details of how the reservation system will interface with the ground stations are still being worked out.

These specifications are worked out bilaterally. Virgin provide a high-level view of what they want and ALSTOM suggest what can be achieved, how and how at what cost. ALSTOM keep this dialogue open throughout the design process. Although ALSTOM are under no obligation to inform Virgin of how they are going to deliver the promised reliability and availability, they do so in order to ensure Virgin maintain their confidence in them. PS noted that product history is also important in building this relationship and trust.

Project risks

A key risk include is any change in regulation during the project which may force ALSTOM to change the design of the train. Although it is unclear who takes that risk, the risk must still be evaluated.

Meeting the safety case is always an area of risk. In the WCML project, this risk has been increased by the train crashes occurring during the project. One of those crashes involved aluminium body shells, which ALSTOM are using, and the other involved killing passengers in a leading vehicle, a design which ALSTOM are also using.

The Zones

PS introduced the zoned system on advice from consultants CSC (Computer Sciences Corporation). CSC have executed a similar project for bus production in Canada. PS was able to visit the site and determine whether or not it would be an appropriate approach for WCML.

The zone system is based on dividing up the scope of supply into logical units and then “...starting them to do the job”. Outside and above the zones there is a technical council. This comprises the co-ordinating engineering team who run across all of the zones.

Another key area is the Process Information Team. One of their main roles was to design the factory itself - including all of the IT integration and other services. The Email network and other essential software was installed by them. Without Email PS felt that it would have been impossible to run a the project.

A further group, the Program Performance Group contains the Project Management, Contract Management, Finance Management and all of the Administration.

Project management

Culture, values and direction

Each new member of staff receives an induction pack which tells them “...how to survive” in the ALSTOM design room. The document shows good practice, how they should work, the values they should hold, what their responsibilities are and so on. The document also covers stretch 30 issues and the principles of 5S. It also identifies all related staff from PS downwards, providing job titles and job descriptions. The document also outlines milestones and project dead lines. PS regarded it as fundamental to explain to people “...what they have to do and how they should do it... People should be reminded continuously of what they are supposed to do”.

Design vision

There is a reliability and maintainability group fronted by West Coast Train Care. Although their activities have a positive effect on life cycle costs they tend to increase first costs. Moreover, as engineers typically focus on short term costs – “We have to pull them back sometimes and get them to design trade-offs for the long term”. There have been two reliability seminars (another one is to be held with suppliers on the 27th June).

At present ALSTOM are looking for ideas for using the service provision budget. However, “it is difficult to get the ideas in place when people are working flat out to get the train built”, Moreover, “Engineers don’t always like taking advice from other people, from outsiders as it were”.

A newspaper has been published from the first seminar for dissemination purposes. There were staff at the seminar from Virgin, West Coast Train Care, Fiat and ALSTOM. The drive of the seminar strategy has been the communication and

dissemination of information and "vision". *"It helps people in the team to know what other people are doing."*

Project control

"More than anything else a Project Director wants direct control. The ultimate is that you control everything...that sort of control can be very expensive. The key factor is having the right people in your team, it doesn't matter what the structure is if you have the right people, any structure will work with the right people in it".

On a large-scale project it is essential to have procedures and good structures dedicated to ensuring control.

"They must be easily understandable by people, this must work from general principals to the specific control of individual work...but you must also be flexible as people like to work in slightly different ways".

In train building there must also be an auditable trail to allow the safety case to be developed. This formality in procedures must also extend to suppliers - certain key suppliers can also be audited by ALSTOM's customer.

In order to manage the project PS draws on a set of indicators that tell him *"where the project is"*. PS has a report of these indicators produced for him every Monday morning. He and his management team will then look at those figures and decide whether the project is meeting its milestones. However: *"Anyone can produce key performance indicators, if the information going into them is not right then they are a useless"*. In response to this, PS tries to use the same base data as is captured on the planning system (the Barns or MRP system) to generate reports. Even then, however, the (weekly) update of that information has to be accurate - *"...it must be believable, there is a continuous problem of validating information, without which appropriate deductions can not be made. The data must be reliable, plausible and must come from the same source. The project milestones must be set out, there are hundreds of them. There are key target dates, which must be met because they are critical, beyond which the project can not proceed"*.

Sheer volume of data can also prove a problem for the smooth running of the project. There are fourteen hundred purchase units to make up the scope of the Pedolino. Consequently, *"There is always something missing from the data, the smallest thing can hold up a car - a connector or a bracket - this is where the management complexity comes from"*.

Whether or not the right staff or the right organisational structures are in place: *"Something is always going to go wrong, usually several things"*. Key to project managers maintaining control is the propensity of section managers alerting them when something is going wrong. However, as PS is aware, *"...it is a huge problem convincing someone that you don't mind if they have made a mistake, that what is critical is that they alert you early enough for you to do something about it"*. Typically, PS learns too late that something has gone awry. *"Managers do not like to give bad news"*. PS is trying to combat this by creating an open, honest and

supportive environment. PS recognises that the success of this can depend on people's backgrounds - many of whom have worked in very 'high and fire' contexts.

Ultimately, the key to running a project, argued PS, is the degree to which people are *"...pedantic, accurate and complete. It is easy to sign a document off and think that it is finished, this is where you need people who are finishers and checkers, people who make sure it is right"*.

PS is continually preaching to his staff the need for quality. *"As soon as you relax for a moment it won't happen anymore. High quality work is difficult to sustain without continual pressure"*. This is partly achieved by PS being very visible - he has an office on the shop floor. Richards Branson himself has been mobilised in order to promote excitement in the design room via three public visits there. PS's key team consists of seven people, they have not always been the same people *"...but the philosophy has always been the same - seek to solve problems together"*. However, PS must not only be able to trust them, they must know when to act when to refer back to PS. *"Asking for help is quite difficult for some people"*.

The contract organisation

The overall contract is held by West Coast Service Provision Ltd. - who signed the contract with Angel Trains.

The Train Service Agreement is the main contract. There were three main contracts. The Managing Director of West Coast Train Care and PS Sizer are Directors of West Coast Service Provision. PS is also a Director of ALSTOM Transport.

Virgin have other agreements with Rail Track - the most important of which is the Vehicle and Route Acceptance Contract. Virgin have a standard deal with Railtrack to provide certain services along with a supplemental agreement from Railtrack to upgrade the whole of the West Coast Main Line. This is essential if Virgin are going to provide the service outlined in their franchise bid.

Determining what is a variation and what should be provided as part of the contract, is a major cause of dispute. Entrenched differences of opinion are unusual but clearing the railway to the gauge (to provide enough space for train to run at the platforms and tunnels) was an area of particular disagreement.

Figures

There are 700 people in West Coast Train Care. ALSTOM have about 500 people working on the contract and there is a similar contribution from Fiat.

Regulation and certification

ALSTOM must go through a rigorous processes to achieve acceptance of its product. It must have ISO9001 accreditation, a Vehicle Acceptance Board certificate, DETR approval and a safety case certificate. ISO9001 involves an independent audit (done by Lloyds for ALSTOM). The Vehicle Acceptance Board is an independent board

which ensures all trains meet the required standard for UK railways. They certify that the design has been carried out in accordance with Rail Group standards. Although manufacturers and Railtrack must have a certificate individual companies do not. The safety case is managed through Railtrack, HRMI and the Rolling Stock Acceptance Board (RSAB).

The direction of influence is not all one-way however. When a new white paper is introduced by the DETR, ALSTOM will be consulted. ALSTOM attend DETR meetings and sits on committees drafting Rail Group standards. ALSTOM have been a key player in drafting standards defining the way in which tilting trains should be designed. Despite this interaction, difficult regulations being introduced once a design has been frozen does occur nonetheless. Interpretation of regulations can also be problematic. For instance, the DETR requirement for a wheel chair turning circle 'adjacent' to the toilet on the West Coast main line train has been a point of contention. As one respondent put it: "...*what does adjacent mean?*"

Phil Barnwell is the Safety Case Manager, Colin Turpin is involved with the vehicle acceptance group. There is a Quality Manager responsibility for the ISO 9001.

ALSTOM also requires a certificate of manufacture from the VAB. This is known as a Construction Certificate.

Getting the train 'signed-off'

As operating conditions often reveal unexpected problems ALSTOM is building two pre-series trains to validate the design before final production. A critical aspect of the design is to ensure a positive passengers experience. Although mock-ups of interiors can be 'signed-off' it is impossible to tell if they work in practice (i.e. that they will be usable, comfortable and look as they should).

Interview with Neil Harwood (Engineering Manager) at ALSTOM Birmingham, 29.06.00.

Present CI and AT

Editors CI (last 30.11.00)

Disk – yes

Centre of Engineering

Engineers at the 'C of E' deal with a number of contracts and with different suppliers. They supply generic systems as well as generic knowledge. The centre centralises expertise, allows the transfer of knowledge across projects and allows "*learning from mistakes*". The centre has been in operation for five years. ALSTOM carried out a bench marking exercise some 8 to 9 years ago by looking at British Aerospace and other large engineering companies.

ALSTOM project structure – the zones

ALSTOM has moved from being a functional based organisation to a project based organisation (having previously been both!). West Coast Main Line has as much project focus as possible; indeed the creation of the zones marked an attempt to breakdown barriers between function.

The equipment zones contain multidisciplinary teams – engineers, sourcing analysts and production engineers. Historically engineers had given sourcing requirement specifications but had not discussed the design with them: "...*they threw it over the wall*". This resulted in errors, misunderstandings and poor buildability. Sourcing analysis now work closely with engineers so as to develop a good understanding of the evolution of the design. Assembly engineers now also work closely with other engineers. The automotive industry work on a similar model.

The Zones are set up largely to do interfacing work, most of the detailed design work is packaged out to external suppliers. A lot of the work is scoped as design and supply packages.

The Birmingham site is purely an assembly operation.

ALSTOM and FIAT

The West Coast Main Line project is the result of a collaboration between ALSTOM and Fiat. Most of the mechanical parts are Fiat's, (i.e. body shells, bogies, tilt equipment, tilt controllers, auxiliaries and the auxiliaries' power pack). Traction, interiors, braking, all of the control equipment and the integration equipment are the responsibility of ALSTOM. The scope has a 50/50 split.

Consortium does bring about organisational difficulties - for one thing the teams are spread across Europe. NH reported, however, that the Fiat interface has not been problematic.

Zone details

The systems zone deals with all of the electrical systems, all of the interactions and all of the schematics and power distribution. The under frame zone deals with piping and wiring. The roof and body ends also contain specialist system areas including the inter-car jumpers and pantograph.

Extra zone groups

Technical council

The Technical Council overviews the overall performance of the train. It looks at issues such as journey time, performance, overall performance of the train, aerodynamics, all other train-level performance issues and the safety case.

The Programme Performance group

The Program Performance Group has responsibility for project plans and time-scales; process and information; factory development, (layout and flow lines) and the IT infrastructure supporting the project. Maintaining progress on all of the thousands of tasks that need doing is key to their work – both at the zone and inter-zone level. Reporting levels to the Director are generally in broad terms but may also include detailed reports for individuals in the management team. This is an extremely difficult project activity, requiring much time, resource and planning.

The design process

The design breaks down into principally three phases; a concept phase, an intermediate and a final phase.

At the intermediate phase, interfaces with suppliers are frozen and the detailed design of systems is undertaken. However, finishing a design is like “...*peeling an onion, every time you pull away a layer you find another set of problems, once you solve those you find another set of problems and so on*”.

The product is based around the Pendolino concept. The train is a tilting EMU (multiple, distributed and electrically powered axles).

Technology transfer

Because the Pendolino is of continental rather than UK in origin, ALSTOM are having to 'Anglicise it'. In the first instance, the train must be made compatible with

Rail Track infrastructure in terms of its' electrical performance. For example, in Europe, feeding the return current down the running rail is usual. However, UK signalling engineers use the running rail as part of their signalling circuit and are presently unclear whether the currents fed by the train back down the rail will interfere with those circuits. The second problem for UK engineers is the gauge of the train. The UK system is a narrow 'Victorian' railway and if the tilt fails in a lean position (a "*hard failure*") then the train could conceivably hit existing infrastructure (bridges, tunnels and platforms).

All UK trains must be compliant with Railtrack group standards. However, current Railtrack standards do not deal with tilt systems. The hazards associated with tilt are complex and not easily translated by UK standards. The narrow gauge issue and the fact the train is running faster around curves (at present UK trains run around curves with a 50% over-speed margin whereas a tilt based train would normally run at half that margin). Tilt also requires speed control systems like TASS (Tilt Authorisation Safety System) not usual in the UK system.

Also, present railway group standards are only applicable for relatively low power (i.e. 125 miles an hour).

ALSTOM have approached the problem by endeavouring to work closely with standards bodies to ensure that the i.e. is no conflict between the train design and emerging standards. There have been few instances in which ALSTOM have designed something which has been made non-compliant later.

Route Mod - Technical Forum interface

Route Mod are a team within Rail Track with responsibility for the upgrade of the West Coast Main Line. They are responsible for the application of the Train Control System (TCS) (- i.e. new signalling systems). They also have responsibility for changes to the power supply, the overhead lines, for any changes to platforms and other areas of other train where it will interface with infrastructure. The Technical Forum at ALSTOM manages this interface. The technical forum is a discussions group concerned with technical interfaces. The group operates via closely defined formal process and protocols. Every piece of information has to be passed through this protocol. Contractually there is no relationship between ALSTOM and Route Mod (Virgin have the contract). Thus, whenever the meetings occur between ALSTOM and Route Mod Virgin is always present.

Tilt technology and PUG1

'Phase Zero' describes the existing 110 miles an hour, non-tilting. Phase one of the upgrade, agreed between Government and Virgin prior to Virgin being awarded the original franchise, describes 140 miles an hour and tilt performance.

For Virgin tilt's primary commercial purpose is journey time, however there is also an "*Alton Towers effect which does sell seats*".

Fiat have been extremely successful in building and testing tilting trains and they have sold more tilting trains than any other company in the world. (They have trains in Germany, Switzerland, Italy, Portugal and Spain).

Adtranz and Bombardier have their own tilting technology. Bombardier's tilting technology is American based (used on the 'American Flyer') and is the same technology that they are applying to the cross country trains for Virgin.

ALSTOM own's 51% of the Fiat F business (as of September 2000).

The design process (again)

An "*immense*" amount of mock-up work has been done in getting agreement with the customer on interiors. There has also been a considerable amount of work done with drivers to ensure that the cab meets their requirements.

Finance and design

Virgin lease their trains from Angel. ALSTOM provide a service to Virgin and Virgin generate an operating revenue as a consequence. Angel, however, is also interested in the residual value of the trains (i.e. the value the trains will have at the end of the twelve-year concession - or when Virgin no longer wants to operate them). Thus, a key part of Virgin's contract with Angel involves them taking responsibility for the trains durability. Key elements, such as the body shell and bogies must be able to last 30 years.

Virgin are "*deeply concerned*" that this should be the case and have employed AEA technology to witness component tests (such as of the body shell). Virgin are also eligible to attend 'first article' tests (an inspection of the first component produced by a supplier) at which point they can veto individual components (they can also veto at the level of the train by not ratifying the take-over certificate).

There is a large market for second hand trains. Indeed at present the system is so short of diesel power that some operators are considering bring Deltics out of retirement from preservation societies.

Extended formation

Virgin is already considering extending the Pendolino formation. At present ALSTOM are contracted for 44 8-car formations and 9 9-car formations. There are now also options to build the 44 8-car formations as 9-car formations along with a possible further set of 10-car formations.

Infrastructural limits

The train's power output is limited by the existing rail power infrastructure. At present, each train can only draw 6.7 megawatts from the system (giving around 5 megawatts for traction once train's the hotel facilities²⁴ and other systems have taken a share). Consequently, further cars will be inserted without more traction.

At the inception of the contract there was a train Infrastructure Interface Specification from Virgin (agreed with Railtrack). The contracted price and the design of the train was then built around that specification.

The PUG2 upgrade is limited to between London and Crew, only a small proportion of the total route. Nevertheless, for this part of the route, Railtrack are proposing 'auto transformers' similar to those used by the SMCF 2 (Eurostar) able to deliver around twelve megawatts to traction.

The Onix 800 drive

The WCML drive is an Onix 800 IGBT. The drive is a high frequency switching AC system. There are twelve motors on the train and six power groups. There is also a converter which transforms the 25 KV supply to a 1000 DC supply. The DC current is fed to an inverter which then feeds AC current to the motors. The high frequency drive cuts down power losses. It is also a low maintenance drive system in so much as it has the low wear brushes normally associated with DC motors. This particular drive is already used on Scot Rail, South West Trains and the Northern Line rolling stock.

Virgin had originally ordered a base formation of seven cars, however the amount of power needed to drive the trains at the required speed (power requirement increases more or less geometrically with speed) required a base formation of eight cars to create enough space for the drives.

Virgin has to pay for any infrastructural changes made on the PUG2 deal.

Usually, Railtrack's income is fixed irrespective of passenger numbers. Consequently, Railtrack has little motivation to undertake upgrade work that will increase its carrying capacity. PUG2 places Railtrack in a profit sharing situation with Virgin - a deal arranged between Virgin and Railtrack. Nevertheless, track access agreements set by the regulators remain generally crude.

Design for reliability and maintainability

“Traditionally product costs have always been key to selling trains. This does not radically change in the advent of a service provision contract”. However, any company taking on service provision elements must see to it that trains are designed for reliability and maintainability. A considerable amount of design effort has gone into design for reliability and maintainability on the Pendolino. To this end, WCTC has staff distributed across the zones interacting with designers.

²⁴ The hotel facilities take approximately one megawatt

At present there are about three staff spread across the zones for this purpose. ALSTOM is looking increasingly at 'out of the box' reliability (although it is felt unlikely that a train will ever run completely first time out of the box!). Generally there is a reliability growth curb across the contract. Moreover on WCML, first cost is not the main driver - most of the systems on the train are leading edge.

Re. Quality initiatives: *"Like any multinational we have big ideas from the centre, I am not sure if they add much value"*.

Interview with Amoi Nagra (Project Manager) at ALSTOM, Birmingham (16.05.00).

Present - NA, AT and CI.

Tape - yes, but very poor

Edit: NA

Fiat Collaboration

Experience of partnership collaboration came from the Eurostar project. However, although there were many partners involved, a lot of them were internal to ALSTOM: *"So it's wooden dollars at the end of the day"*.

ALSTOM have a partnership agreement between themselves and Fiat. Fiat are providing the body shells, bogies and other technology. Although they have a very well defined document detailing the scope of supply: *"That still leaves the obvious holes in the design - so we will have to deal with that as we go along"*.

"Once you have developed the design you think well, hang on, we are supplying that, you're supplying that, but who is supplying the bit in between? You think hang on there is an area that we have left out here".²⁵

ALSTOM were keen to make the documentation process more rigorous:

"If at the end of the day if we make the train late, then Virgin 'do us' for liquidated damages. Then we have to go back into the consortium and say well hang on, they made us all late, we would have been perfectly on time if it wasn't for them and vice versa".

ALSTOM has put interface control documents into place. This is something which ALSTOM has developed internally from other projects. The system tries to ensure that both parties are proceeding on the same information. Any changes first requires the submission a Change Request (CR) form. As the project progresses, the system pulls together all of the change documentation and billing materials, allowing complete tracability. The system was originally a paper-based 'product data management system', although now it has become IT driven, a metaphase engineering management system, which was new to Fiat.

²⁵ An example: external body side doors are operated by a push button. ALSTOM has responsibility for overall electrical integration. Fiat has responsibility for the complete door system, including push buttons. However, this did not include the internal button (presumably because it was not located on the door itself?). Fiat regarded this as a systems integration issue. The two partners had to agree on the technical issue of where to put the button. ALSTOM took responsibility but negotiated a split of costs.

Fiat has experience of more partnerships than ALSTOM and it was felt that it may have exploited this to its own advantage. In future ALSTOM should be better placed to tie down such issues.

"They [Fiat] have their own system which is totally different. Let's put it this way, they have come very much to our way of thinking".

The CR system applies to any sort of change that ALSTOM, their partners, or their suppliers make. For suppliers, the change request is referred to as a Design Variation Request (DVR), but follows a similar process.

Interfaces between ALSTOM and Fiat

ALSTOM and Fiat have different working cultures - these effect the way in which the interfaces between the two organisations work. ALSTOM believes everything should have engineering approval. If, for instance, ALSTOM want to make a change that they know will effect some aspect of Fiat's bodywork then they would discuss the issue with one of the Fiat engineers. They would expect him to then liase with their production and to come back with an assessment of the implications. However, Fiat prefer ALSTOM to talk direct to their production staff.

"I have to say it is still not working that well, we are still pushing it through their engineers"

"...We've got well defined systems and well defined departments who know exactly what they are doing without it being written down, everybody knows who does what".

Virgin Interface

Virgin has a project manager for WCML (their Fleet Director) within the project team based in Euston. He also has another team based in Meridian House, Birmingham to be close to ALSTOM. The team dealing with WCML is West Coast Trains Ltd.

There are two elements to West Coast Service Provision. West Coast Train Care (which does the maintenance) and the New Trains Consortium.

Ron Temple, because of the long-term nature of the business, sits on the maintenance side but also at the top. He has designated authority to two people within Fiat (New Trains) and two people within ALSTOM (New Trains). All correspondence goes through those people. They also address correspondence to Ron Temple if it has to do with maintenance (he also has responsibility for the existing fleet).

There is a monthly report to the customer (which AN pulls together). All of the integration is done at ALSTOM. *All correspondence comes through me, I put out the actions to people, monitor the actions and make sure they are done in a reasonable time and fashion".*

AN and his staff try to front all of the meetings with Virgin. AN has two Assistant Project Managers and, as a team, they try to provide focus to the engineers and designers with regards cost and money.

Project management

Variations and overall contract management is done through AN. The contracts and Planning Manager also works for AN. Monthly planning progress statements and monthly reports are made and given. These are linked to BARN, which is then used to set out the requirements for bills.

The Virgin team

Virgin only has a small group of engineers working for them. *"Not like the old BR or the current LUL, where they have masses of engineers inspecting every aspect of the train. Far from it, in fact in this case they have employed the likes of AEA technology and the Interfleets of this world. They take them on short term contracts to deal with certain [specific technical] issues for them".*

There is a 50 - 60 page document from Virgin describing what the train should be capable of – features requirements. There is also the Red Book. *"The Red Book gives the general layout, aspirations, what the interior could look like and so on".*

There are, nevertheless, lots of words behind the Red Book; there are 40/50 pages of clauses and descriptions of the features and expectations of the general performance of the train. *"It describes how the interior should be - the temperature and lighting - want the customer wants".*

They also have a formalised set of expectations regarding levels of failures.

Changing design drivers

The train has a number of customers, Virgin, Angel and, internally, WCTC.

"West Coast Train Care are the people that maintain the trains and put them out into service, they have got to make them available and accessible [for repair]". AN recognised that the days when ALSTOM received prescriptive specifications from knowledgeable engineering driven clients (i.e. from BR or LU) were over. *"They were the engineer not us, and basically you made the design fit around exactly what they asked for".* Pressures on design were now in the form of *"turn around times"* and *"inspection times"*.

Now - *"You've got to be able to demonstrate that you can do certain maintenance activities within certain times and it is in our interests really to get that down as much as possible; from our own point of view and from the point of view of cost".*

Design culture

AN could also see the potential barriers to this shift in design: *"Obviously a lot of the engineers that have been in the rail industry a long time think in particular ways: You build your train, off it goes to a two-year or a one-year warranty period; not our problem anymore"*.

The traditional approach was very 'over the wall' and 'back to front'. The need to reduce lead times has raised issues of co-location and concurrent operation – getting M&R people to look at the design at the same time.

The Northern Line marked a turn away from this approach.

"We reviewed the design and all of its aspects - not just so that it did the job technically, but so it would be maintainable and reliable... at the end of the day, if the train sits down there are heavy penalties to be paid ".

The creation of multifunctional teams in zones specifically includes maintenance and reliability engineers who have the ability to intervene in the CAD system. They are also involved in formal design reviews. And cross-fertilise with staff at Fiat on these issues.

However:

"You can't turn people around over night, somebody is always asking for the relevance, somebody always needs reminding".

Specialists constantly need to be reminding the team of the issues.

Supply chain management

The rail industry has a very traditional confrontational / adversarial approach to procurement. ALSTOM looked to the car industry and made initial attempts to engage in partnership agreements. This was difficult because of the need to get the supplier to take on some of the risk. In the rail industry very different conditions pertain from contract to contract. Management of risk is all and partnership is difficult.

There is some movement toward new forms of contract:

"I think there are a lot of ideas coming in from the industry about partnership. You could say people were dreaming - but wouldn't it be nice".

With no in-house production (only assembly) all the money is out in the supply chain.

"What we do now is contract out the design - we hardly do any real design here anymore".

On the Pendolino AN has found that a more hard-nosed commercially driven contract still has benefits. In particular, if ALSTOM cannot deliver specifications on time clear

contracts prevent things "getting messy". The WCML had begun as an attempt to follow the partnership ethos, however, this had been moved away from throughout the project in order to make responsibilities clearer and to speed things up. Partnership notions have tended to dilute contracts, but if one party does not keep to the terms the contract is not there to resort to for resolution. There is a need to move towards professional contract management – some other projects have lacked hard objectives in contracts. Some issues (e.g. for the safety case can not be specified in a short supplier scope document.

Arguably, genuine partnership is built over time:

"I have just been to one supplier and he is actually doing very well. They are very willing, they have worked with us for many years"

Leverage may still also be the final arbiter of the quality of a relationship:

"You'd think they would be rushing to you to get the contract wouldn't you, but they don't care".

Stretch 30

Stretch 30 needs to be in parallel to the pre-series build. One argument says that you need to have the piece of kit on the ground up front. Stretch 30 could increase lead time, because making design changes takes time and although it may save cost, could incur liquidated damages if late. Stretch 30 cannot be applied to parts that need to be treated as a black box, such as the brake system.

Long lead items

In decreasing order of lead time the critical supply items are:

Bogies and body shell

Big subsystems - braking
 - traction
 - HVAC
 - Door systems

Electrical

Bracketry

The tender needs to know who the long lead suppliers are. Normally one can expect up to 20 named suppliers in the contract where a change has to be notified to the customer and other parties. Key suppliers have a reputation. Having them on board at the build stage is very important – it reassures the client they (or their consultants) know who is reputable.

Internal suppliers

AN used to work for GEC at Trafford Park in the power station business. GEC required preference always to be given to internal suppliers. Performance on WCML has been okay from the internal suppliers (first time ever?!). No-one from Traction is represented in the design studio however. Some ex-Traction people are employed at Washwood Heath (and vice versa – see Richard Simpson interview). Under the French procedure the traction project manager would be directly responsible to ATL project director. This creates openness and transparency internally.

Testing

The traction kit is the highest risk kit as it is performance related, affecting journey times, the need to fit Railtrack schedules etc. Higher levels of reliability need to be built in and higher running is required to test fully. This requires possession of the infrastructure to permit test running. This is difficult and expensive to achieve. There is no incentive for Railtrack to provide this access. Consequently ALSTOM purchased 22km of test track at Old Dalby near Melton Mowbray (where the original APT was tested). It has been re-built to mimic the WCML with poor quality sections deliberately created. Even so, there is still limited scope for test running – approx. 1000 miles per train for dynamic testing. Ideally many times this amount of test running would be needed before all potential problems can be identified.

Project management

The basic procedures – design reviews etc – are in place with many thousands of detailed activities within these²⁶. Elsewhere in the company an earned value approach is used, which measures how much of a particular work task is done in the programmed time i.e. output rather than input based. On WCML an input based approach is adopted – largely quantitative, breaking tasks into individual activities, check lists of documents and a yes/no counting of target activities, but no earned value measure.

It has enabled some issues to be highlighted such as major resourcing issues, wherein some areas are more detailed than anticipated and some designs have had to be pulled back in house. It also identified reporting issues – an attempt to obtain consistency in reporting.

Learning

AN is hoping to see a few more of this type of project. The objective is to sell more trains with as few changes as possible.

²⁶ Within the design studio complex visual charts showing tasks and progress etc are displayed on boards.

The bill of materials is kept on the metaphase database as a common resource. All CRs are allied to the B.O.M. Other departments such as finance could ally their enquiries to this.

A key issue is the influx of new people into the industry. The really experience rail people no longer carry enough weight in the organization. A lot of projects make the same mistakes – everyone keeps going through their learning curves. A lot depends on key individuals rebuilding the knowledge base. New enthusiastic young designers need to be led by those with the experience. There is a lack of longevity in the HR function.

Meeting with Ken King at ALSTOM (Birmingham), 12.04.00

Present – NA, AT and CI

Mini disc – 3AL

Eds. – CI, NA

KK's Role

KK overlooks the design and technical issues across the zones²⁷.

The zone structure has been a key innovation. The integration of zones is a key issue. Responsibility for integration initially lay with Neil Harwood but it became clear that this scope of this role was too great. Train-born integration is now KK's responsibility; NH deals with the integration of the train with the infrastructure.

KK was seconded from Central Engineering.

KK manages processes rather than hands-on design issues. He has developed new processes to instil and maintain quality in the design processes. The traditional method is for engineering design specs to be produced by engineers, checked by the relevant engineer and then by a head engineer. The process relies on the checker to 'check-in' quality. However, it is too late at this stage – “...*the quality is either there or it is not*” (AL12.04.00).

Design process procedures

KK has put into place procedures to change this. He has introduced a more sophisticated form of documentation. This documentation ensures that specific design issues have been dealt with (e.g. reliability, weight) and that specific check lists for each item have been drawn upon. Engineers thus check their own work prior to a final check. The system provides a consistent basis for final checking with a focus on details related to performance rather than whether a particular item has been included (some issues tend to be buried in pre-existing company procedures).

One of the key issues is the quality of the document itself. Cross-references to other documentation must be included along with correct numbering, dates, margins and so on. The use of the correct format instils rigour and quality. There is a specific check-list for each element of the train which the document should refer to. People often don't know those check lists exist. This document makes it impossible for the engineer to ignore them.

The requirements capture side is also being attacked by KK. It has proven difficult for final checkers to know exactly what to look for. Traditionally this has been done

²⁷ This was described by Chris Holt earlier in the day as the ensembler role and is the first recorded occasion this term was used by anyone in the study. It was then re-iterated by Martyn Vaughan in the final interview of the study.

though experience of previous projects. With this system new requirements, such as client changes in requirement or changes in safety regulation, are included in a validation check document. The engineer will reference those requirements through that document so that it is clear that what has been done actually relates back to the initial requirements.

The key feature of this process is traceability (i.e. from requirement to validation). The work needs to be done at the creating the document level, rather than the checking level.

ALSTOM has introduced new software for this purpose – DOORS. DOORS is a ‘requirements capture package’. Changes can be checked against the engineering spec more easily. What the engineers do is checked against what the requirements actually are. It is a relational database that controls requirements rather than documents. Such requirements might include vehicle speed or passenger loading but will tend not include non-engineering issues like aesthetics. Most issues are performance related - changes will have knock-on effects up through the design process.

Interfaces

Virgin have consultants who interface with ALSTOM (Mott MacDonald, Priestman Goode). Virgin dictates the design of the interior directly. ALSTOM also has to talk to the drivers, whose unwritten requirements have to be captured before closing out.

Although Virgin did not specifically identify that they wanted a tilting vehicle it was hinted at in that it was not possible to fulfil the spec without it and subsequently proven to be required..

Suppliers

KK gets involved with trouble-shooting with suppliers only when technical problems arise. The high voltage (25kV) jumper between carriages on a tilting vehicle is, for example, novel and therefore high risk (it has not been tried before in the UK). KK perceived a risk here through “*eye and experience*” (AL12.04.00) – a gut feel that “*it doesn’t look quite right*”. (No process, KK claimed, can substitute physically looking at the actual design). In this case, there was a clear need to get supplier to talk about some of the technical risk issues, via a meeting between the supplier and the zone team. KK must identify the risk areas and focus on them.

Zones

The zones present their own risk. The divisions chosen have caused some problems. KK felt that they were correct for the design detail but less so for the system engineering detail. The brakes system, for example, cuts across the underframe and the cab zones. Sitting the brakes engineer in the underframe zone cuts him off from the cab zone and from the systems engineers. (Most engineering functions reside mainly in the systems zone).

Historically designers have tended to run the zones. KK felt that as they don't have engineering specific experience it was perhaps best to have the engineers mainly in the systems zone.

Centre of Engineering

ALSTOM has a central engineering function (Centre of Engineering). At least 25 people from the C of E work in the WCML design room full or part-time. These include experts from braking, traction, HV and LV auxiliary supplier, train and auxiliary controls, gauging and dynamics, mass and noise analysis. They are all recognised at an industry level and sit on national and international bodies as well as retaining places in the ALSTOM CoE. When called upon, the CoE can also identify the necessary organisations and individuals that are needed to deal with particular problems in projects (i.e. Inter-fleet, AEA Technology, Engineering Link, Blueprint Engineering Link, IVM, KBD and GKM Westlands). These organisations can provide turnkey solutions or manpower as required.

The central engineering pool is on ALSTOM's site though it is possible to call in other experts from France, Spain or Germany. A La-Rochelle expert, for example, has come in to work specifically on the dynamics of the cabling running from the underframe to the bogie (the difficulties encountered being associated with the tilt). Their input has changed the design. Experts can also come in and carry out project reviews.

Risk

The ALSTOM group network also works at a risk management level. The main WCML risks lie in the complexity of the vehicle and in the lead-time associated with that. There are also safety case risks. Tilting technology and having people in leading vehicles travelling at 140mph are both new in UK. The commercial risks are also "*not insignificant*" (AL12.04.00). The speed of build is "*challenging*" (AL12.04.00): it is expected to be 2-3 times faster than normal. Moreover, because of the profile of the project there is also a considerable reputation risk for ALSTOM.

Project Performance

KK has been inputting guidance and focus to improve the performance of the teams. A project review in February showed that the teams were not on target. It also showed that there was a lack of individual awareness as to what they should be doing and a lack of clarity as to how they should measure their performance. Areas where people were overloaded were also identified (integration functions and the zone leader function). The zone leader role has since been split into a technical and management role. Programme issues were also being neglected prompting the director to bring in a deputy director.

The project

The project is not just about the train itself. There is also a test track to electrify, the building of pre-series proving vehicles and then the series trains. There was also a new layout of the works to accomplish to achieve the faster build rate.

The project has also had to adjust to its own progressing phases. Assembly is presently beginning and this will require a move away from a design focus to more of an assembly focus. Once the train is built, the focus will shift to the commissioning and reliability proving phase.

Within the design phase other changes have had to be adjusted to: the split of zone leader role and the removal of engineers into a systems integration zone. (They ensure interfaces work effectively by delivering comprehensive packages of work to the zones (i.e. “...do this, take care of these requirements” (AL12.04.00)).

As the project progresses staff will move from design to assembly (line-side). They need to get to know the teams responsible for the particular assembly stage relevant to the work they have done. Design has to dovetail into assembly and so design must interact with them and the suppliers to ensure that the parts fit and work as expected.

This is a considerable change of philosophy. Engineers used to sit in offices “... we [engineers] only came down to the shop floor if we really had to” (AL12.04.00), but are now located on the shop floor. The response times to problems are now much quicker – engineers no longer have to walk from the office. Engineers will be forming a supporting role to assembly “...you can’t stop the line” (AL12.04.00).

Once the design is proved the engineers will move on to static testing.

Zone system – cultural history

The zone leaders tend to be designers – this has a historical context. Although there have always been zones, these used to be the sole province of the designer. These were the ‘drafting offices’ in other words. Engineers would be in a different building. Zones are now multifunctional.

Lessons from other projects

From Juniper and Coradia the importance of the safety case has become starkly apparent.

Product configuration is a key issue that has been learned from previous projects. It is now recognised as essential to control the status and modification level of the vehicle and all fitted equipment.. Performance is an issue but it is essential to be able demonstrate that the vehicle is safe. To do this ALSTOM must show that they have managed the configuration of the systems on the train properly. Each change must have a ‘mini’ risk review.

Arguably a more integrated RAMS (Reliability, Availability, Maintainability, and Safety) process is needed. There have been a number of reliability and maintainability issues in the past – particularly from the Northern Line contract, which took a long time to reach the level of reliability required by the contract²⁸. That is down to rigour – the requirement should be captured and closed out with documentary proof, review, testing and inspection. The process must disseminate requirements down through the design and force engineers to check that they are carried out. *“Its painful”* (AL12.04.00). However, this ensures quality and avoids penalties on reliability - the trade-off is that it is very labour intensive.

WCML is unique and if the project does not deliver then other projects will not look at it as an example. Moreover, KK felt that if Coradia and Juniper got new before the end of WCML then they would continue as they have done; with only incremental improvements – there will be no motivation to adopt the WCML model. However, the processes developed by CoE should be transferred across eventually to C and J. They will ‘pick them up’ [*like a virus – one that alters recomb DNA?*²⁹] when they draw on people from there.

Problematically, the organisation is presently product led. If project leaders see their projects as adequate they will be reluctant to change them. Perhaps that choice should be centralised at CoE. ALSTOM does not have such a thing as central projects director able to dictate practice. Perhaps a mirror organisation to central engineering, one that will deal with project processes and working practices, could serve this purpose by determining and diffusing best practice.

²⁸ Although now exceeding these and hailed as a major success story (see Modern Railways –March(?) 2002)

²⁹ If information diffuses like a disease then can this metaphor be used as knowledge management tool? Fits rather well with the evolutionary metaphor – if the disease alters your firms genetic code? Some cultures (i.e. engineering) seem to provide some immunity – i.e. not a passive process of spreading from person to person. Also fits with Neil’s idea that KM and K intertwines with everyday activities – i.e. cannot be viewed sensibly as a separate activity.

Meeting with Jonathan Jones at ALSTOM (Birmingham), 25.05.00

Present – NA and CI

Mini disc – yes

Eds. CI, NA

Finance

JJ is the finance manager for WCML. JJ stressed the need for stakeholders within the studio to own action plans. There is a head count of 120 in the studio and 30 of these own risks. These owners include function heads and specific engineers associated with things like noise levels, weight and so on.

JJ's group's activities are constrained by central finance's programmes. To some extent there is a running battle between project and central finance staff over resource and the way in which things are done.

There are also DTR (group) initiatives which are not necessarily perceived to be of benefit. The "Bridging the gap" project implementation plan is such an example. This is a risk report and action plan summary which attempts to project profitability. The finance group already produce a 50 page report listing 140 risks and 400 live actions. "Bridging the Gap" attempts to summarise this in 2 pages.

The existing ALSTOM report includes an identification of the 'top 20' risks. The top twenty accounts for 75% of all risks by value. The top ten account for 50%. These are generic project risks (late change in build, change in the law).

Of more benefit would be central risk experts reviewing ALSTOM's existing report. This would allow ALSTOM to revise accordingly instead of having to respond to inappropriate new regimes. ALSTOM hold a situation report (100 page) every six months. This is summarised into a three-hour presentation and delivered to France via a video conference. Chris Cox, Jack F? at DTR, France should review the project via this presentation and make an input.

Learning

"ALSTOM re-invent the wheel in every new project" (AL25.05.00). There is informal knowledge transfer from projects but no attempt to structure the transfer of systems and processes. Neil Harwood and Amoi Nagra bring with them a wealth of knowledge. However, there has been no systematic recording of how ALSTOM teams have worked though designs in the past (so that WCML could learn from their mistakes).

There is some learning through risk analysis. Risk reports include DTR / ATL review of projects. WCML have also looked at the Juniper and Coradia risk evolution curves;

the results have been alarming. For Juniper the risk contingency reduces over the design period (the first 12/13 months). However, the risk of LDs goes up again in build phase. From the original contingency of £20m there is a fall and then a steep climb back up £30m. Actually ALSTOM tend to avoid paying LDs by making claims on suppliers.

There have been one off risk reviews but a lack of synergy with the rest of the company. Learning from the TGV experience has not been transferred.

Risk management

At present the WCML team are purely creating 'risk awareness'. They are not actually mitigating or reducing those risks. Neither has there been a fundamental attack on risks on a company wide basis (which would also facilitate learning).

People need to be better trained to mitigate risks. *[JJ promised to send risk report]*. The biggest potential risks are those people are unaware of, or only one individual is aware of and fails to transmit to senior management. *"They hope they'll go away!"*

WCML now has a dedicated risk manager - though this has come late in the day (late, 1999). Other projects still don't have a dedicated risk manager. Risk is still not a driver in projects.

Project management

The primary driver is unclear – there are no fundamental management process through which to drive milestones. The design studio took twelve weeks to create. Consequently, ALSTOM has always finished projects late. Management has also been hampered by poor reporting of figures (e.g. inconsistencies between Stretch 30 and finance).

"We have, to some extent, been busy fools" (AL25.05.00).

Culture

JJ came from the London Taxi project. The project leadership there created a 'burning platform'; a fixed date, set by legislation, by which the new taxis had to be supplied. Here there was a dynamic leadership able to override the *"can't do won't do"* (AL25.05.00) culture of the firm. The leadership (Director level) was maverick but had the respect of team. ALSTOM have not created a 'burning platform' and therefore little sense of urgency. The series build was not ready to start on the 17th of Jan as expected (components not in place). The information to see the milestone was going to be missed was not in place. *"We did not have the information to know where we were"* (AL25.05.00). The project plan was not driving the project.

The 10th of Nov ‘ex-works’ date will not be achieved. Paris have now given March as the ex-works date. JJ has no confidence in having the information to be able to say when the project will finish.

JJ blamed the culture inherited from BR. The business is deeply rooted in BR engineering. BR engineers were dedicated to building “*sexy*” (AL25.05.00) trains – this was the key to design not timeliness. Virgin are inclined to leave details of engineering to ALSTOM – they are more interest in the quality of the interiors.

ALSTOM have not yet moved from their engineering base to recognising that the customer expects to be king. There is a strong need to drive a more commercial approach. “*Engineers need to recognise that they do not need to far exceed the safety case – only need to meet it...ALSTOM still habitually over-engineer their products*”. An intervening factor here is Railtrack. A draconian safety case procedure enables the engineers to maintain a stranglehold on the business.

This clearly needs to be more effectively managed - by checking what is actually installed. For example, a sourcing analyst noticed the specification for an acoustic muffler on the HVAC ducting was perhaps double what is actually required. The zone was prepared to spend £1.2 million but needed to spend only £600K.

“Sourcing and finance have not been able to overturn that strangle hold and establish a more commercial approach. So far as engineering is concerned: “We build fantastic trains – if they are late they are late” (AL25.05.00).

Not all savings are straight forward. In another case there was an opportunity to spend another £1.5 million on better refrigeration. It was determined that this would save £2.5 million over the life of the equipment. ALSTOM corporate will save a million. JJ claimed, however, that more communication with the maintenance and reliability people is needed. ALSTOM and WCTC are separate legal entities and profit centres. There is little motivation at ALSTOM to spend more than they have to on initial costs.

The focus is on building. When the train build was stopped due to change on the wiring loom (that would save re-wiring in future) PS was not pleased. At present the fundamental drive is to build.

“Cost reduction is not a key activity – it is not a part of everyday life” (AL25.05.00). Projects resist cost reduction exercises because of pressure to meet deadlines. Sourcing analysts find themselves unable to respond to initiatives which come from outside of the project because of the pressure on them to make immediate savings.

Finance provides consultancy – though it is a consultancy that projects do not want. Generally, this is because zone leaders are engineers. Commercial people might do it better. JJ could have run a zone.

Chris Derner, cab zone is a commercial manager.

Cost savings

A £6 million cost reduction in materials spend is sought. 6 individuals have a million each to save – this creates a high motivation.

£11.1 m is the forecast likely margin (October) reported to Paris. This is assuming that all the planned cost savings based on action plans are pursued successfully. The project has maintained this and has been achieving improved savings.

However, having contracted for $\frac{3}{4}$ of the value of WCML it will become increasingly difficult to find further cost savings. Contracts have been signed for big value pieces of kit. The top 5 suppliers account for 43% of the materials budget while the top 15 account for 67%.

At present there is 4% contingency to support 27% of what has not been signed up for.

Learning

There is a fundamental danger that at the end of this project the risk information collected will be lost. If JJ left, the information flow described would cease. A set report format would help this transfer.

Thinking of starting a one page labour summary – ‘where we are’.

There needs to be a clear reason for providing information. There needs to be transparency - where the figures have come from. Must ask the right questions, e.g.: Are we heading for an overspend?

Some financial impacts

Labour rates are set centrally – a 20% increase has set put a £3.5 m hole in WCML finances.

Schedules laid down by Central finance are not presented in a way that allows the team to focus on the issues e.g. a statement of purpose, graphic basic message, supporting figures and an action plan. These schedules need to “*hit you in the face*”.

Old Dalby test track electrification. ALSTOM have to spend £25m and need to establish how to fund it (who can contribute – Fiat, Rail Track?).

Awareness, culture

There is a fundamental materials awareness but not yet a fundamental finance awareness. Part of finance’s role is to provide information that will feed into design – “*not run along behind*” (AL25.05.00). Ultimately Paris want ALSTOM to make £26 million. It is unlikely that this will now to be achieved. There is a lack of activity on the shop floor, ALSTOM cannot get components in fast enough and there is now a high degree of apathy (“*its amazing at 5 o clock how quickly this place empties*” (AL25.05.00)). Should have started series build 4 months ago. Out of 150 activities

that should have been completed already – only 30 have been started and 10 completed. There are still big pieces of kit missing (e.g. HVAC). Identifying key milestones and making them visible has not been done.

Management has lacked sophistication in some areas. Each zone has a work content list and quite often they are impossible to achieve. *“We are the victim of a poor plan”* (AL25.05.00). It is hard to see whether zones are overestimating the time they need or whether they are simply under-resourced. Planning (who identify man-weeks of work) should be going into zones and identifying labour short falls and discussing solutions – not just delivering plans. Information is poor – this is a management problem. Zones find it impossible to identify their percentage of completeness when asked. JJ has been supporting this function – creating transparency (x out of y achieved). Can now identify a ‘trend evolution’ at the existing rate of work – the cab and underframe zones are achieving, roof and body ends are under-performing and the rest are in between.

What is needed is a numerical summary of what each Zone needs to do to build the trains on time.

Risk reporting and estimation

Risk management, movement, actions, DTR/ATL input. Each area has a one page summary in the report. The report includes the top 20 risks, increasing and decreasing risks. Each risk has its own owner. The report also includes lessons from other projects (J and C).

Risk evolution £28 m was original resister - WCML risk register is now above that. The report flags up the need for an action on that.

Finance are looking at more structured approach to risks - a good audit trail for each figure is deemed essential. The production of the figures needs to be more scientific. For example, finance had a two day risk seminar last year and agreed figures *“by committee”* (AL25.05.00) to be approximately correct.

For technical issues the penalties of failure to reach targets (such as weight) are easy to quantify in terms of the value of the risk. The cost of a technical risk, i.e. LD penalties, plus the cost for more time in factory. It is then possible to estimate the likely shortfall (if there is good information!) and then look at associated LD and extra costs. Use this to work out magnitude of risk – it is a proper clear formula for doing so. Concrete assumptions.

At present risk assessment is very subjective – risk assessment by committee.

Risk distribution

ALSTOM carries the majority of the risk (for lateness, under-performance). ALSTOM provide 47 diagrams per day at a certain standard of service and reliability. Angel own the trains and fund the operation.

After twelve years the trains will be refurbished inside and out. The risk for Angel surrounds the useable life of the trains. (Tony Collins, Mike Craddock know more about the intricacies of the contract).

Zones and project management

WCML team visited a Canadian bus manufacturer's zone set up. Their design studio had a full mock-up of the bus allowing open access to examine components in situ. ALSTOM cannot do that with a complete train although they did have a cab mock up and an interiors mock up. They now represent progress on the train through an information board.

Zoning led to changes in interfaces – however, ALSTOM did not anticipate the difficulties associated with the new interfaces that were created. The zones destroyed a lot of functional interfaces. Relevant staff are now working together in same spaces but at the same time they created new mechanical and electrical interfaces between systems that staff at ALSTOM did not fully understand how to manage. Ken King has come into try and manage this problem – but this perhaps too late to be effective in preventing the project from being late.

PIT, finance, the technical council and programme performance have not been as useful as they might be – primarily because they did not specify their roles clearly enough at the outset.

JJ was critical of some the management styles he had witnessed. As JJ pointed out its not possible to manage from desk by *“wizzing out e-mails and waiting for replies to come back”* (AL25.05.00) – need to go out onto floor and ask people directly.

Change

JJ felt that the project could have had better HR input to help drive through a new culture (e.g. culture seminars). CSC, by contrast, promoted a stand up daily meeting to ensure everyone knew what they were doing. Planning boards on the floor facilitate daily stand ups. Though it is not viable for all departments (i.e. finance) to have these every day. It is possible to post clear targets on bulletin boards.

Directors (Simon Roberts, Richard Ashford) would do well to come down onto the shop floor and lead.

Control

Problematically zone leaders are not full managers – they are only level three. Consequently they lack sufficient authority to pursue cost savings. For example, the

interiors sourcing analyst had pointed out that a £1.4m table order was bought for 800K by Coradia. However, permission had to come from outside zone to re-source the tables.

- Activity monitoring
- not all activities are equal in resource terms;
 - some may be timing critical;
 - some may be critical for other zones – interface problem.

Meeting with John Reely (Assembly Manager), 08.06.00 at ALSTOM, Birmingham.

Present – NA and CI

Minidisc – 3AL

Eds. – CI, NA

Background

JR joined ALSTOM from school on an apprenticeship. He worked up through shop-floor positions. He was assembly manager for the Eurostar – a “straightforward” project based on the TGV.

Design for assembly

WCTC created the line-side area specifically to get engineers involved in the assembly process. This was the first time this had been done at AL. (In the past these functions have been separate). Engineers and designers are now involved in validating what they have been working on.

Normally assemblers would not see the equipment until it was ready for installation.

JR has been directly involved in looking at design for assembly since the end of 1999. JR has 25 years experience of different rolling stock and this experience enables him to have an influence on design. JR’s aim is to bring the assembly philosophy into the engineer’s mind. JR perceived a need to get involved at an early stage in the process. Only in this way could it be ensured that any changes were a part of the design rather than merely a modification.

Pre-series 1 is aimed at validating the design. JR recognised that it is essential to feed back changes to design (this includes assembly needs).

Work Plan

The design phase is now over and the pre-series build has begun (started in summer 1999). The key task at present is validating the pre-series design. The key measure for 2000 is to clear up all of the design / assembly anomalies (in order to speed up the final build phase). Doing so will also eliminate the design changes that are inevitably passed on to suppliers during the build phase. This not only increases ALSTOM’s costs as variations but also in terms of supplier’s risk contingency and the negative impacts it has upon the suppliers scheduling for the project.

The train market

Increasingly the customer does not want to deal with mechanical issues associated with running the train. The customer now wants to run the train during the day and return it for service in the evening. Moreover, customers are now demanding a train that will run ‘straight out of the box’.

The margins on train manufacture are very low. There are increasing orders but there is also increasing competition.

Work plan (continued)

WCML has staff dedicated to scheduling the material for the production line. Each assembly stage has an area manager (for the vehicle’s foot print) and a stage leader. The stage leader looks after the assembly team, quality, time and documentation. Traditionally, the stage leader would also ensure that materials are delivered on time. However, on WCML, a new role has been created, the process controller. The process controller manages material presentation (i.e. ensuring that all components are present, in order and placed within the foot print³⁰ and that documentation is present). The PC also analyses how the work is put together – the critical paths which exist in the order of assembly. The PC will then devise stages and timing for each assembly aspect accordingly. The PC is also responsible for keeping labour hours, and therefore cost, down. If, for example, the stage leader is overspending the PC would bring this to his or her attention. At present, there is only one area manager (JR) - later it is envisaged there will be up to four in order to achieve the required output.

A logistics dept supports the transport of equipment to the site and ensures that assembly has the materials it requires. Traditionally, equipment would arrive overnight meaning that the stage manager would not know whether it is was available until morning. The process manager’s job is to know whether it is going to be there or not so that work can be planned around it.

A section within the studio is driving the quality focus (Technical Council, Programming and Performance). P&P take care of the customer, set up contracts with suppliers, monitor progress and so on. A third group looks after the BOM. The process group looked after the design of the studio. (see Neil Harwood notes for details).

The design process

Design problems are identified through mock ups and drawings. Mock ups also help sell the concept to the customer (VR is less adept at doing this). Further changes mean variation. There have been £11m in variations so far, mainly in the form of lamp-shades on tables, seats and lighting on luggage racks. Virgin is not interested in

³⁰ Unless it is a large piece of equipment such as a traction unit. This would be “faxbanned” if it is from a local firm or an ordered triggered by use of the previous order, if the firm was abroad.

functional aspects. The ‘feel’ of the vehicle to the end customer is their main concern. Audio is still being used video is not (removed on cost grounds).

Cable and pipe run problems.

ALSTOM projects tend to repeat the same design mistakes. ALSTOM is not particularly good at improving the product through cross-project learning - they “...*design a new product every project*” (AL.08.06.00). JR felt that to avoid this ALSTOM needed to develop a fleet of standard trains. This will allow learning to occur and will also help control costs. Standardisation lowers supplier risk; the design variables will be well known.

At present, the market drives bespoke designs. There would be some learning and design improvement with more follow-on orders but at present “...*the spec keeps changing up to 85% with each order*”(AL.08.06.00)

Slam door market

The Electrostar (Adtranz) is a standard product and is presently the only choice in the ‘slam door’ market - this is their “*back garden*” (AL.08.06.00) market. ALSTOM has nothing to follow WCML and has decided to attack this market – this has driven the Juniper2 philosophy (an investment of £50 million). The market itself is worth 1500 - 2000 cars.

Juniper 2 will be the first ALSTOM product built without any orders being in place – i.e. it is a speculative product. Success in train manufacture is about capturing markets: “...*getting your train in there*” (AL.08.06.00). The customer will come back if the product and the relationship is good. The Autumn ‘Slam Door’ market is the target market for the Juniper 2, a needed rival for the Electrostar.

ALSTOM have around 55% of the UK market share. That must improve - ALSTOM need to produce 400 cars per year at Birmingham.

Reliability and maintainability

On WCML poor reliability and costly maintenance will affect ALSTOM profit directly. It will be possible to make a £40 million loss over the concession period.

In order to improve maintenance and reliability WCTC maintenance engineers are working alongside assembly during the validation period. The battery box, for example, was identified as being of poor design, from an ease of maintenance perspective, as a consequence of this process. There will be modifications in the series build to support ease of removal of the battery. (The original design requires two hours to de-bolt the front of the box to get at the battery. The new design will have catches to drop down and will allow a fork-lift to manoeuvre in and remove it).

Although ALSTOM is behind on pre-series 1 they are spending the whole of the rest of 2000 to validate the design. ALSTOM have never put this much time into

validation before. As there are 4 'flow lines' it is essential to make sure the design is right – this means ensuring that there are no interface problems or other design shortcomings to slow down production. ALSTOM is under great pressure as the project has only a 12 month lead time (as opposed to the usual 2 years).

R&D

ALSTOM makes no investment in 'off-line' R&D. Train builders traditionally "*design as they go*" (AL.08.06.00) within live projects. Development funds must come out of profits; which is difficult as is competition putting pressure on their margins. Some manufacturers are offering a free train for every 10(?) sold – it is a highly aggressive market.

At present the Virgin order is for 53 trains (initially 8 car units but Virgin have since ordered 9 and 10 car units). This could mean 100 extra cars at end of 2002. Virgin are also looking at a possible 25 extra for a weekend service. A two year production run may end up as four years³¹.

The East Coast Main Line is a market ALSTOM can chase with the Pendolino. Bombardier have not made in roads into the inter-city market.

Outsourcing strategy

ALSTOM began moves toward being an assembly only plant during eighties. It is now trying to move toward preferred suppliers and supplier partnerships to improve supplier performance. However, ALSTOM often tend to over-blame suppliers. In reality ALSTOM often make late changes and fail to stabilise the design early enough.

Pre-series – design and assembly

On the pre-series train the build is broken into different tasks in 9 stages – 7 build and 2 electrical testing, colour coded by zone (there are rows of booklets on nearby shelves each representing a work package for the installation of equipment). Currently the best assembly methods are being identified for each task, recorded and ultimately stored in a computer-based form via a line side series of networked PCs.

During pre-series 1, if a team plans any installation they get the supplier to come down and help solve problems directly.

Changes are very lengthy to execute. Re-work through a supplier can take as long as 12 weeks from the identification of a problem to its resolution by a supplier. Preferred suppliers and partnerships help short cut this process by encouraging working

³¹ Virgin has recently issued a further procurement notice in the European Journal for additional trains to cover gaps in the timetable left as a result of not being able to operate at 140mph (see Modern Railways, June 2002).

together. The pre-series vehicle in this way becomes a design tool in its own right. Moreover, because the train will have to be re-built it is possible to work with it informally.

Supplier management

2 years ago ALSTOM used to keep £120 m worth of stock on site. This could prove costly if stock had to be re-worked. ALSTOM now only keep three weeks of inventory (unless the kit is from Fiat or elsewhere abroad) and many suppliers deliver daily to a schedule. (These tend to be preferred suppliers). As a result, suppliers have to be reliable. Generally this works well, though inevitably one or two continue to under-perform.

As ALSTOM's costs are slashed they are looking to their suppliers to do the same (by as much as 10%). WCML has a high level of LD's and these have also been passed on to suppliers. The suppliers... *"got away with murder on Juniper and Coradia"*. There are a potential £1m a month in LDs on WCML - if ALSTOM don't perform this will wipe their projected profit margin in one year. This is the responsibility of the P&P group and the contracts team has to get suppliers to buy in.

Culture

Success for ALSTOM depends upon change and change depends on 'buy-in' across the board. WCML indoctrinate new staff into the new production culture (e.g. 5S principles). All new staff spend 1/2 a day on the principles. They discuss where the project is going, what needs to be done, what their contribution will be. WCML attempts to be open about the problems it is facing.

Each 'foot print' is also owned by its staff and performance is closely measured in terms of 'earned value'. Generally speaking, JR felt that the workforce have bought into the idea that the firm has to be the best to survive (probably 90% of tradesmen).

At present some of the stage leaders are becoming frustrated by the lack of progress. Work cannot proceed on the underframe until the electrics are finished. The components they need are not yet on the shop floor – this is impacting upon moral as staff cannot see any value for their work.

Kaizen will come to WCML later in the year (at present it is moving around Coradia). It spends a week improving each assembly station's performance. It will look at different issues (e.g. bill of materials, health and safety) and will address what it can during that week. Other problems are pursued over the following thirty days. Improvements can be seen directly in terms of performance (e.g. materials presentation) and safety (e.g. better organised work space). Because of this, staff are starting to buy in to it.

Some learning from Jaguar was evident (though the actual root is not clear). For example, regarding material for presentation being bubble wrapped for protection and

placed on purpose built 'toast racks'. So far as JR was concerned: *"This is the next stage"* (AL.08.06.00).

Kaizen has been delivered by the quality focus manager. The original focus was assembly but this has been extended to include design and supply.

Workforce

At present there are 18 staff and 32 tradesmen in assembly, building up to 12 per stage. The 18 will be fixed staff and these will run the project as stage leaders and process controllers. Most of these have been involved in the design process at its early stages. They have also helped design the work area.

Design change process in detail

If a problem is identified when fitting a piece of kit an NCR (non conformance report) is raised. This raises a CR (a corrective report) for the engineering manager. The engineering manager reads that and, if he sanctions it, gives it to an engineer to draw. At the same time, the engineer making the change, must issue an FMI (a field modification instruction) which gives assembly permission to modify the kit. The designer also instructs the supplier to include the change in future deliveries. This can take 12 weeks to 12 months and suppliers will often treat this as a variation. (In which case ALSTOM may well make the modification themselves).

Partnership approaches help lever the supplier to make the changes as part of their on-going contribution to the project (on the pre-series). Suppliers are hired for the pre-series only and are hired for the series build on the basis of *"how well their kit fits"* (AL.08.06.00). There are clear benefits to the supplier of getting the fit right in the pre-series and then going to production. In particular, the supplier can have the confidence to increase batch sizes.

UNDERFRAME ZONE AND SUPPLIERS

Interview with Gary Freeth (Under-frame Zone Leader) at ALSTOM Transport, 29.01.01.

GF has been at ALSTOM for ten years, having started as a contractor. Key responsibilities – team leadership, meeting specified targets, zone programme management and interfacing with suppliers. The underframe zone comprises 10 CAD operators, 1 production engineer, 3 mechanical engineers and 1 sourcing analyst.

New management

JI is the first line of contact with the sourcing manager within the studio (Andy Derbyshire – his manager is now Chris Holt). This is a new role designed to facilitate across-zone communication. His role is to identify synergies across zones with respect to sourcing. This is unique to WCML and was instigated by the project director (PS).

There is now a French management team to whom the zone leaders report. Each ZL reports to one of them. The new French project director is based in Birmingham. GF's boss is there only four days a week – reporting to Paris on Mondays. Along with the project director, there are two engineering directors (French), a system engineer, a train qualification manager, a contracts manager (PS), a French project manager, a design engineering manager (French), and a pre-series delivery manger.

The handbook is referred to as "*the bible*".

Design issues

Design criteria

Staff associated with manufacturing, maintenance, VAB, costing and safety are located in the design studio for use by the zones. Although sourcing management have their own group within the studio they are distinct from other groups in that they also have a representative within the zone. Each zone has a resident production engineer – his role is to work out the build staging strategy. They monitor new design work and design changes - reflecting that back into the build processes. In the under-frame zone, the production engineer works along side zone members. Maintenance issues and assembly issues are all represented in the built design. Each of these is taken as a 'fit for purpose' criteria.

Time management

Lack of time is always a problem. The vast majority of work, at the time of interview, was taken up by design changes (CRs or change requests). During the course of that work, design must liase heavily with production and engineering. Assembly staff raise 'issue sheets'. These are looked at by the zone leader and the principle designer who then looks at the workload in the zone. He asses the nature of the work and the

impacts any changes will have. Based on that, work is allocated to designers suited to that type of work.

Sources of change and change management

Sources of change included assembly clashes, interface problems, and in some cases, material problems. For example, at the time of interview support brackets in the under-frame were being replaced (as it was discovered to be too weak). Best estimates of the required size and thickness of materials are based upon tacit experience (including a fore knowledge of the actual means of fixing the bracket). Assembly will themselves also flag up suspected problems on the basis of their own experience – *“you get a shout from assembly... ‘come and have a look at this, what do you think of this’. The guy on assembly recognises something is not working, some thing is sagging or does not fit properly ”*. A judgement is made visually as to what the best solution is likely to be.

Designers, *“we call them that, really they are CAD drivers”*, do not make judgements on what is required. There were some exceptions to this. CAD drivers with experience could be trusted to *“go down and make a judgement for you”*. Subsequently, however, assembly must raise a formal issue sheet. The zone can then act formally (i.e. in response to the issue sheet). This goes onto the system to be signed off by all of the relevant departments.

Sources of change and complexity

Hopes for a ‘right first time’ approach are hampered by product complexity. As one respondent told us: *“You can come up with a design that you believe to be fit for purpose. You can create all the necessary drawings and paper work. You can get the bits made and have them nailed onto the machine. And an equipment supplier may change something which impacts on what you’ve done. Your control over the design is very much influenced by equipment suppliers”*. Problematically, once the drawings are issued to suppliers, the supplier will often alter them to improve fit with their own capabilities. Although ALSTOM try to resist these changes suppliers can also exert pressure, for example, by being inflexible over the time used to execute the designs – i.e. *“if you want it like this, it will take longer”*. If ALSTOM designers do accept any changes (changes in the thickness of metal for bracketry being typical) they must change all related drawings. Changes in the under-frame are difficult because of the degree to which components interact. This is purely a result of their close proximity to one another. Equipment, cables, pipes and trays are ‘layered’ under the car. *“Change a cable and you will have to move a bracket...what I call the domino effect”*.

CAD, it was argued, does not necessarily improve this situation: *“CAD is only as good as the information that is put in to it”*. Supplier equipment can also change after CAD drawings have been issued. Moreover, *“To get work done, you have to work in advance of ‘official issues’”*. This means that suppliers may provide information on *“bits of paper”* or 2D rather than 3D formats in order to speed up the design process. Consequently, *“...when you have got the final information through things have*

changed...even the head on a bolt can have an impact". (Space envelopes and gauge are a serious constraint in UK train building).

The 'right first time' mantra becomes trite – "*we did – but there are so many other influences*".

Design and configuration freezes

Design and configuration freezes are applied to an area of the design and review meetings are held with all of the relevant parties. At that stage maintenance, assembly issues, FEA work, design for manufacture, assembly issues and so on all have a role to play. The under-frame zone comprises a number of areas of design including hydraulic pipe-work, bogies and bogie movements and cable supports. There are three design reviews (concept, provisional and final) and all areas are subject to each.

As well as design area freezes there are 'gateway' design reviews (to satisfy the VAB) and a **critical gate review**, an internal review to sweep up final issues. **GF will send information on this.** Each review normally lasts around one day. Review dates are negotiated between what is possible, and the dictates of the programme. They are organised "*when you have got most of the information together*", but two weeks in advance. Design reviews may have to go ahead earlier than the ideal date if a major design freeze is imminent.

Managing limited design resources

Fixing the design is undermined primarily by the pressure to meet production targets: "*We have to get cars built by a certain time to satisfy the customer and, at the same time, the VAB*". Supporting assembly, however, drains design resources from the zones. In some cases the trains must, because of a loss of design time in this way, go out for testing incomplete. The dynamic tests of the 01 Pendolino, were run at Old Dalby, for example, without toilets on board. Resource is a problem but there are diminishing returns on design resources, however, having *too many* designers working on a design can result in co-ordination difficulties.

There are also physical processing resource limits on the numbers of CAD stations that can be installed. One cannot always simply throw more resources at the project.

Contractors

"*You get more out of contractors than you do staff*". Even though they are more costly it was felt they were value for money. Individual zone leaders can be selective of contractors because they have control over the hiring of contract staff. The majority of the CAD operators have been in the industry for some years so that "*it is so close knit now that you can pick names...an awful lot of people have worked here before, they know the business and they have built up a reputation of being really good...give them a job and leave them alone and they will sort it out*". Although intense

competition for staff makes it difficult to be very selective most CAD staff are still hired by recommendation.

There are CAD designers migrating in from outside the industry and these designers do make more errors. However, these are normally picked up through the checking system. Ultimately, however, *“There is no way you can know until you hit the shop floor, until assembly...and you start generating CI’s”*.

The levels of inexperienced CAD staff per zone will depend upon the skill and experience of the zone leader in selecting the right staff. As one zone leader told us: *“I have been quite ruthless with regard to people working on my zone. Quite selfishly, I suppose, I wanted reasonable people working around me”*. GF made four staffing changes on taking charge of the zone. Experience in how to judge other people quickly and in accepting recommendations is key to building a strong zone team.

Zone leaders are all different in terms of character and background (mechanical, electrical and so on). Some are more skilled, and more mercenary, with regard to staff selection, than others. Some zones may simply make do with who they are allocated.

Design changes

In making design changes there are numerous influences from outside the zone to consider - there are stress analyses, assembly issues and cost. Within those envelopes the zone controls and takes full responsibility for the design.

Zones and control

Zone leaders can take an active role in procurement. The zone leader will also veto supplier selection. The use of zones takes control away from a central sourcing and gives it back to design managers. Under the old system: *“you knew what you wanted with regards to materials and fixings and then it would go into this black hole called the buying office...they will probably take the cheapest regardless of what you get... We have suffered heavily for that”*. The WCML project zones were regarded as a considerable improvement on this context.

New suppliers on WCML

The WCML project has been characterised by high levels of change. Interiors, since the design has had to be re-thought, are now looking for entirely new suppliers. The level of new suppliers on under-frame has changed by 30% since the start of the project. This is relatively low - overall, the supplier turnover in the project has been around 50%. At its inception the WCML project the level of new suppliers was also high, partly attributed to the creation of a new team with relatively inexperienced people in key positions.

New management (again)

The lack of information coming out of the zones has been addressed by the new management team. The previous approach of management was summarised by one member of staff as: *“rule was by fear - don’t come to me with you problems, come to me with your solutions”*. Initially, the new management team generated a certain amount of resentment - largely associated with cultural differences in management style. The French, it was felt, were far more mercenary. They imposed a minimum 45-hour week on staff and this was interpreted as a punishment (which was resented). Staff were also told they would have to work Christmas week. The UK management would have asked for volunteers. This attitude was felt to extend to suppliers. It was noted, for instance, that they expect suppliers to pay for any prototyping, experimentation and production of samples. ALSTOM (UK) would try to help out financially. However, the new management team was also assessed as being more open and, therefore, more receptive to the highlighting of problems. Their critical advantage was felt to lie in their preparedness to respect the experience of other staff (i.e. to listen).

Project strategy

There has been a tendency in the past to make a slight loss on the build and then a profit on the maintenance. However, ALSTOM Birmingham is under a lot of pressure from Paris to make a profit on the build and to deliver on time. The Pendolino project is also high profile and so problems are always reported in the press. This can be catastrophic to the company’s image.

Knowledge management

Personal / Experiential

Technical experience is carried personally. Knowledge of *“whose knows what”* is equally important and is also carried individually. Interaction across projects and zones is improved by personal networks. These are built up over time.

Managed

Generally, it was felt to be difficult to get people to use formalised ‘managed’ sources of knowledge. The reasons for this were not clearly understood: *“I don’t know whether it’s a pressure of work thing or a pride thing”*. The situation has improved, however, in the past the CoE did not work because of its distance from design staff. Staff from the CoE with particular expertise now work in the design studio where they are visible and available. As such, the design studio encourages informal exchanges.

The design studio is now more open to the rest of the site. The WCML studio was originally locked generating some resentment from other projects. One zone leader felt that this severely hampered cross project learning (i.e. support in solving technical problems). Although staff from other projects do not tend to spend time at WCML (possibly because this is the latest project) staff from WCML now feel freer to visit other projects.

Zone interaction

Zone interaction has also increased in the later part of the project. This is largely due to efforts by the new management. Dialogue has improved vertically within management, with the ultimate consequence that all staff, including those within the zones, are better informed about what is happening in other zones. The previous context had been one of informal competition between zones. This has now ceased.

Banners

The banners were removed by the studio team after the first meeting with the new management.

Tolerances

Assembly tolerances in the rail industry are greater than those found in many areas of manufacturing. Plus or minus three inches may be adequate. The rail industry can neither afford, nor does it require for safety, the close tolerances to which the auto industry is subject. In part, the precision required in cars is higher because the passenger owns the vehicle and so is likely to be more critical. *“At the end of the day what is the passenger interested in? He is buying a ticket to travel he is not buying the vehicle...[Moreover]... finish is money”*. Virgin has driven interior tolerances down: *“the inside has got to be nice”*.

GF will make enquiries as to what he can send us with regards to the staff hand book.

Interview with John Innet (underframes sourcing analyst) at ALSTOM (09.08.00).

Present - NA and CI (last edit NA)

Disk - yes

The underframe Zone

The underframe zone involves general fabrication including bracketry, piping, wiring, side skirts and under panels and drinking water tanks. Although it takes up perhaps 80% of the resources devoted to the train the actual cost of the underframe equipment is not particularly high.

Brakes and traction are no longer part of the underframe zone – having been re-conceived as part of the train's systems. JI still has involvement in their procurement although they are now managed jointly by the system zone manager and technical leader also. JI's continued involvement reflects a desire to maintain continuity of contact for suppliers.

Traction is worth about £72 million. The auxiliary equipment is worth about £6.5 million. Pipes, wiring and bracketry are worth about 10 million.

The underframe zone carries a high volume of equipment, consequently there are numerous interactions to be considered.

Zone supplier interface

The underframe zone operates a one-item-one-purchase-number procurement system. The advantages of breaking down otherwise single deliveries into their constituent parts is realised when there are errors in the delivery. Associated equipment arriving, when arriving under a single order number, is treated as a single order. Consequently, if one item within the delivery is defective or out of spec, the whole delivery must be sent back. When each item has its own order number it becomes possible to retain all of the delivery bar that aspect which is defective. Many items can then still be fitted helping the project keep to time.

Item by item order numbers also allow individual items to be tracked through design, procurement and manufacturing. This is important for managing changes to design. Brackets for larger components tend to be composed of more than one sections - each requiring its own drawing. Consequently, there were complicated knock on effects between the drawings if changes are made even only to one. Moreover, each change must be transferred to the specification for suppliers. From a procurement perspective, this process is much easier to track if each drawing had its own purchase order number.

However, across the zones there appears to be no explicit policy regarding this. The choice between item by item or kit purchase remains a matter for the zones to determine. At present 99% of items on underframe zone are purchased individually. The exception is the transformer mounting bracket, which requires four drawings for the one order number. A subsequent change in order to fit the body shell as delivered meant changing all four drawings.

MGC Cadman

This company is the key supplier for the under-frame zone. They are the first tier supplier. They produce mainly, brackets, side skirts and under-pans. The relationship has not gone well with Cadman's failing to deliver on time or be as flexible as required. (There was some suggestion, from JI, that ALSTOM may have over-loaded them).

Fabricators, though in high competition, do vary in the degree to which they have project management skills and the necessary machinery available. The railway industry has tended to stick with the same suppliers over time

The Cadman's contract is a design and supply contract. (They are using a design house called Transys.) The initial agreement was very open and concerned hourly rates as there were no drawings available at that time.

The design work for the skirts and underpans is complicated by their interaction with other pieces of kit in the design. Many of the cars are different in their requirements and the skirts must accommodate the brake units and the bogies in each. Panels have to meet exacting tolerances e.g. on weight and not every fabricator can do this.

Hydrapower Dynamics

Copper tubing pipework is done largely in-house by ALSTOM - however, other more sophisticated pipework is done by Hydrapower. This involves a certain amount of design work by Hydrapower in collaboration with ALSTOM. This interaction has gone somewhat better and Hydrapower are expected to be part of the series build.

Most of the pipework under the train is simple copper – the production of which is just a case of buying in raw copper tubing and bending it into shape. Hydrapower is more specialised. The complex aspect of the pipework are the surge pipes at the end of each carriage. ALSTOM is attempting to incorporate a complete unit from Hydrapower for this.

Contracting

An engineering requirement specification is written and this is put together with a full set of terms and conditions from ALSTOM which the supplier can reply to in contract negotiations.

For pre-series, if the item is simple, then it is felt that there is no need to go through their contract procedure. In a series build, any such agreements will be more formalised and made more formally binding.

Design process

The surge pipes have been designed with ease of assembly and maintenance in mind. Although it tends not to be the case - JI felt that both of these criteria should apply to all equipment.

Informal interaction

According to JI, the way in which particular 'design issues' like assembly become part of the design is left largely to chance. This is possible, he argued, because excluding the Catia draughtsman and assembly, the numbers of designers in the zones are quite small. As such they are able to interact with one another and those outside the zone, quite easily. (Zone members sit in the same physical area). The underframe zone team have regular meetings with two process controllers from the assembly floor associated with underframe zone equipment. This is aimed at co-ordinating efforts, in particular the delivery of materials as assembly need them.

However, electronic transfer and electronic 'sign-off' tends to promote the opposite - the parcelling and ownership of bits of work, rather than the sharing of tasks.

Formal interaction

There are formal procedures to deal with interactions with assembly. Once a piece of kit has been designed, manufactured and delivered there are set procedures for instructing the shop floor of what they need to do and when. Installation drawings also have to be produced and delivering on this requirement itself often requires a lot of face to face communication.

The contract

West Coast Main Line is ALSTOM's largest ever project.

Zones

"The zone system works well but perhaps needs fine tuning".

JI – History

Prior to ALSTOM, John Innet worked in aerospace. John Innet felt that he had not brought much learning from aerospace. He felt that the supply bases are completely different, both in terms of materials and suppliers.

Supply base

Suppliers tend to specialise in the train industry because of higher specification (in terms of the quality and performance of trains themselves) as compared, for example, to cars.

To some extent, quality programmes which qualify suppliers as approved suppliers help increase the 'narrow-sightedness' of the supply base. A pre-defined supply base may also reduce the opportunities for learning and innovation.

The IVM (a design consultancy) has come into ALSTOM to try to re-design the skirts and under-pans to reduce their weight. Any changes suggested which are accepted will be applied to pre-series 2.

Command structure

John's first loyalty is to the zone rather than to Chris Holt.

The key objectives of the sourcing analyst are to source fit for intended purpose materials at a competitive level, with on-time delivery.

Meeting with Paul Cadman and Rob Barrett at MGC Fabrications, 22.08.00, Birmingham.

Present – NA, and CI

Minidisc – yes

Eds. – CI, NA

Intro and background

MGC (C) produce panel work, bracketalia, under-pans and skirts for the rail industry. C employ up-to-date laser cutters, presses CAD and Catia facilities and employs about 50 staff.

C charge per drawing when using CAD at 1/10 of design house charges. However, C do not have plans to expand their design services – fabrication remains their core business. C's expertise is in “unfolding” 3D models into a flat surfaces which it can then fabricate. C regard design work as work in ‘designing for a particular space’.

Although C do a small amount for the automotive and water industries they specialise in fabrication for the rail industry. C made a strategic decision to specialised in rail work in the mid-nineties at the beginning of its expansion. C find the nature of rail work more conducive to their particular expertise and preferences - large tolerances, large items, low volume and ‘one offs’.

Over the last five years, despite growing markets C has experienced growing pressure on prices. “*The cheapest always wins*” with other selection criteria, such as reliability of delivery, having become relatively less important.

Design coordination

C has experienced difficulties satisfying ALSTOM's requirements. From their perspective this is due largely to the quality and timeliness of specifications emerging from AL. Specification drawings from ALSTOM have contradicted ALSTOM's own previously specified weight restrictions, load cases and budgets. Design changes have also, on occasion, been poorly thought out with respect to their implications for other aspects of the design. For example, the need for ‘beefing up’ the carriage so that the skirts can take more pressure loading going through tunnels has resulted from ALSTOM's late upgrading of the spec for side skirts.

The difficulty of gaining ‘design fixes’ appears to be true, not only of the pre-series WCML (where one might expect a great deal of change), but also of other projects. There was some suggestion that the problem was endemic across the industry.

In one instance, when a predicted 12 week design period stretched to 30, ALSTOM argued that responsibility for the delay lay with the supplier, while the supplier felt that it was unable to act on the specification, because it did not have confirmation of

key design elements (i.e. what ALSTOM intended to put in what space). ALSTOM preferred to frame the problem as one in which the supplier had failed to push the zone hard enough for information. As the supplier pointed out, its only possible to ask for the information so many times! The view from the supplier was that people in the zone were reluctant to go up the hierarchy for a decision.

Lacking and contradictory design information forces suppliers to interpret what design information they have as best they can in order to progress. However, committing to a particular design solution in this way (which they must do at some point!), leaves them exposed to late changes from their client. In such circumstances, it may become unclear who is responsible for the extra design work and suppliers may find difficulty extracting recompense from their client.

Design creep

Engineers at ALSTOM are historically powerful and able to exert high levels of leverage on the design process – often unchecked by other management tiers. Unmanaged design changes can see dramatic price increases. Work on the pre-series skirts and under-pans contract began in May 1999. Handles were added, coating thicknesses increased as did the number of panels (from 10 to 50 per car). Engineers specified stainless steel for longevity and dual locking handles to allow easy maintenance (without compromising security against unauthorised removal or loosening). The under-pans themselves also became a complex double skinned design.

Although the final panels worked well their cost had increased dramatically. The job was recalculated to discover that it has doubled from original calculation. As one supplier argued: *“The engineer is not concerned with price - only with his job looking good. No one noticed that the price of the job had gone from 3 to 6 million”*.

The contradictory demands made by AL, between price and specification, may stem from the operation of its zones and from the ‘best solution’ engineering culture which pervades the industry. Although ALSTOM seeks lowest-cost design solutions as a matter of policy, its zone engineers do not necessarily always act in accordance with this policy.

Moreover, while a supplier may be in a position to inform a zone that design changes are adding costs, this does not mean the zone will pass that information outside the zone. Zones, being relatively independent cost and management centres, are motivated not to pass ‘bad news’ on to the management structure. Indeed, it is relatively easy for the zones not to report over-budget situations while they look for a way to fix the problem themselves. In some cases, this can mean trying to push costs into other zones. (The point at which one zone’s responsibilities end and another’s begins is not always clear).

Thus, while important knowledge about design might be generated in the supply chain and indeed may be passed to the relevant zone, it does not follow that that knowledge will continue its journey any further.

Informal supply

ALSTOM's imperative to 'turn work around' as quickly as possible can often mean suppliers executing work without a formal written order. However, suppliers fear that once equipment is fitted ALSTOM will be in a strong position to argue for lower charges than those agreed. In practice there is little a low leverage supplier can do to resist this.

The dis-benefits of the 'one stop shop'

In order to develop a small number of first tier suppliers ALSTOM has, in some cases, begun to extend the scope of their supply. ALSTOM has contracted some first suppliers to purchase and store materials on their behalf that they would perhaps not normally have chosen to deal with. Moreover, pressures on cost mean that ALSTOM inevitably want to pay as little as possible for this service (*"the management they seem to expect for free"*). ALSTOM's corporate drive toward minimising management costs by pushing management into the first tier of suppliers (see CH interview notes) may thus put suppliers under undue pressure. Moreover, if applied unintelligently (i.e. blindly, as a matter of policy, asking suppliers to manage the supply of materials and components with which they are unfamiliar or in which they are uninterested), such a policy may potentially lead to inefficiencies.

There is a sense that in some cases procurement policies are applied to the letter rather than in the spirit with which they were intended.

Supplier development

Lessons from the auto sector suggest that supplier development is a key part of developing efficient supply capability. At ALSTOM the zones may, however, pose a barrier to this development. Because zones, as pointed out, have their own budgets there is reluctance to invest in the supply chain. Overall, budget constraints and performance measures are such that the zones need to be able to show an immediate return for spending. This may not be conducive to long term development.

Creating trust in the supply chain

Trust is fundamental to efficient and proactive supply. However, ALSTOM may be in danger of undermining that trust. ALSTOM has delayed paying contractors for up to 26 weeks (the "financial marathon"). This is achieved through means such as rejecting invoices on minor or spurious grounds (e.g. incorrect order number, no evidence of receipt). On the WCML pre-series build ALSTOM held-off September payments until October in order to protect their balance sheet.

Paradoxically, ALSTOM could probably have negotiated an agreement for this with its suppliers. Had suppliers been aware of ALSTOM's financial strategy then they would have been able to borrow against the delayed payment (ALSTOM could have agreed to pay any bank charges). Failing to pay on time, or to make clear

arrangements for not doing so, risks damaging the reputation of the supplier with its bank and its own suppliers and so risks reducing the ability and willingness of the contractor to be flexible in the future.

According to one contractor ALSTOM owes £6.5 million to Coradia suppliers.

Poor payment has costs for ALSTOM by encouraging inefficient supply chain management strategies by first tier suppliers. In response, first tier suppliers tend to stay with sub-contractors who may be more expensive but can be relied upon to delay demand for payment. It is not unusual for subcontractors to have to wait 6 months for full payment from first tier suppliers. Ultimately, these costs are passed on to ALSTOM. Moreover, on this trajectory ALSTOM's only remaining strategy is to put contracts back out to competition. This will itself negate any possibility of pursuing cost savings and innovation through long-term partnership learning.

Stretch 30

Stretch 30 teams visit suppliers to reduce cost once a contract is awarded. (Stretch 30 is followed by Kaizen). Working with Stretch 30 is agreed as part of the contract.

Problematically, the late timing of Stretch 30 can mean that changes in materials are made after drawings are complete. Changes at this stage can result in added costs.

Inter-competition collaboration

ALSTOM have borrowed bogie parts from Adtranz in the past. There is a flow of staff between the two (generally not with Bombardier³²).

Zones

MGC supplies brackets to roof and body ends, the under-frame, cab and interiors.

All pre-series supply is complete except for the under-frame. It is unclear whether their contract will extend to the series build. Guarantees that ALSTOM will pay on time will be key to their taking the contract further.

Open book

ALSTOM has an open book agreement with most of its suppliers.

'Kit' for delivery verses individual order purchase numbers

³² These comments pre-date the Bombardier take-over of Adtranz.

Some zones now order each item in what would previously have been a single kit of related parts using an individual order number. Each item is individually packaged. There are some advantages to this (see JI notes on returning defective or incorrect parts) but sending them individually also means that ALSTOM can lose the parts more easily.

BARN

ALSTOM use BARN, a computerised ordering system. However, because it is not updated everyday ALSTOM find themselves chasing parts from suppliers that they actually have in store. Stores operatives cannot keep up with inputting the acceptance paper work onto the system. (It is not unusual for over 100 suppliers to deliver to ALSTOM in one day). There is an e-mail connection between ALSTOM and Cadman to confirm (on a daily basis) what has been delivered and what is to be delivered. This call-off process requires frequent deliveries which is expensive for C.

Staff

Staff quality can prove critical to ALSTOM's relationship with their suppliers. From the suppliers perspective, there are 'good and bad' staff. 'Good' staff will attempt to solve problems and pursue goals in common with suppliers. 'Bad' staff are defined by their not dealing with problems promptly and sometimes not at all.

SMEs (Supplier Management Engineers) visit suppliers (Jimmy Jones for C) and will explore both sides of supply issues. SMEs are thinly spread and are assigned across zones and projects. There are at present 6 SMEs though numbers may now be increased. They will support supply problems at source with engineering expertise.

C felt they could have performed better if they had had more information and more time. Arguably, the underframe would have presented problems for any supplier. At present ALSTOM have 11 sheet metal workers. C has won a disproportionate number of areas of work, 80% success rate, so they feel they must be competitive.

Poor alignment

The alignment and communication between suppliers and ALSTOM can be so bad that suppliers and clients can find themselves working against one another. In one case a supplier had recognised that much of the work being done by them was not going to be correct. However, they reported being unable to get ALSTOM to respond to the problem. Knowing that they would have to do the work again has also proven demoralising for staff at this supplier. Indeed, they have reported losing staff as a result of it.

Cost savings

Making intelligent cost savings is not always easy. Corardia has high levels of expensive stainless steel prompting some sourcing analysts to opt for painted mild steel. However, the analysts in question had not understood that the painting process can end up doubling the final cost (making some items as expensive as stainless steel but not as durable). Moreover, because there has now been substitution between mild steel and stainless steel trains are coming off the production line at different weights. This requires different break settings implying different rates of wear. WCML is an improvement on this – *“it had the right people”* – but this is changing. People are now coming across from Coradia with their own ideas about how to do things and their own suppliers.

More than one supplier has commented on the poor quality of many middle tier management staff at AL.

Shop floor contact

Assembly are forced to solve fitting problems caused by creep in the design process. Typically, pipes *“appear out of no where”*.

Informal design change requests

Making design changes can be done informally – i.e. without paperwork. Problematically, ALSTOM staff who get things done in this way often do not necessarily have the authority to do so. Once that work is done there may be a reluctance or difficulty in paying. One way around this is for the supplier to be promised future work contracts in return. What they are owed can then be added to this contract. The position is not satisfactory - if the contractor is not awarded a new contract, because the price is now too high, then the payment is lost.

Trainees

C reported not being able to fund trainees both because their margins have been squeezed and because work is unreliable. ‘Hands on skills’, those skills that cannot be replaced by mechanisation, will be lost as the present workforce ages. C reported that its own workforce is already an ageing one.

Hidden costs

Hidden costs falling on the supplier include the need for back-up machines, back-up gas for the laser cutters, the coding of welders and the cost of skilled sheet metalworkers sitting idle while the go-ahead for the pre-series 2 is awaited.

Interview with Bob Arnold (Design Manager) at Transys on the 23.08.2000.

Present CI and NA

Editors CI, NA

Disk - yes

Introduction

Transys itself was founded in 1998 but has its origins in 1989. There was an expectation in the late 1980s that a great deal of work would be coming out of BR and that the UK supply base would not be able to fill those orders. At this time there were few foreign firms competing in the UK.

At the same time, Hunslet Engine in Leeds, who provided industrial locomotives and railway equipment to the coal industry, were losing orders as the industry declined. Hunslet Engine had already built some mainline locomotives and so took the opportunity to expand into mainline passenger vehicles. At the same time (1989) there was an amount of discontent in Metro Cammell (now ALSTOM Transport) and a group of 13 design staff left and set up on their own. Subsequently, the two groups got together to form Hunslet Transportation Projects Limited to bid for British Rail work. The company was successful in bidding for the Class 323 EMU's which they designed and built. After some initial reliability problems, they came to be recognised as the most reliable EMU on the UK railway.

In 1992 it was realised that the expected tranche of BR orders was not going to materialise. Privatisation was on the horizon and orders ceased. Hunslet TPL was sold to a company called Genbacher in Austria which sold them on in 1995 to a company called Holec in Holland (to whom they are still loosely connected). Holec are now owned by the Dutch Royal Begemann Group. In 1998 they gave up the capacity to 'whole train' engineer and became design project engineers working for first tier suppliers within the rail industry. Whole train manufacture is now the province of large multi-national groups with which Holec could not compete. They have been very successful at that since 1998 under the name Transys Projects Limited.

The company is now thirty strong and focuses firmly on the rail industry and there are no plans to move into other industries.

Transys's supply chain strategy

Strategically, Transys see themselves as a second tier supplier able to design in any area of the train – from side skirts (WCML) to power pack integration for Cummins on Bombardier's Voyager for Virgin.

Their current main contract lies with Cadman for the design, engineering and manufacture of side skirts and under-pans for the Pendolino.

Transys find themselves in the third tier primarily because large manufacturers like ALSTOM tend to place their order with the company that will actually manufacture the equipment. As manufacturers often have limited design capability they out-source the work to companies like Transys. In Cummins' case, although they were able to integrate the engine parts themselves, they did not have the resource to do it for a contract as large as Voyager.

Buildability and supply chain management

In the past, large manufacturers like ALSTOM have tendered directly to design houses for the drawings they needed. However, when those drawings then went to out to component manufacturers it was found that they would often not reproduce them exactly. Rather, they would alter designs to suit their machines, skills and existing working practices. Sourcing direct to the component manufacturer, rather than the designer, leaves the buildability problem with that manufacturer. The first tier supplier becomes responsible, in effect, for ensuring it gets the right drawings from the design house and for the expense of managing that process.

Transys has learned from this and on those occasions when it does work directly for a manufacturer, they find out who is going to do the fabrication work. This ensures that Transys can design something which can be manufactured first time. This reduces misunderstanding and so cost.

Design

The technical difficulties surrounding the design of skirts and underpans stem primarily from the high speed at which the Pendolino will be travelling and the air pressure loadings that will result from this. In many areas, the issue of pressure loadings have driven a design.

The effect of time constraints on design

The side panels are made of aluminium and the underpans of stainless steel. This was regarded as a sub-optimal solution given that, originally, ALSTOM had wanted to use a mouldable material (with which Fiat was familiar) and that the use of metals had resulted in a weight penalty. The problem stems from the fact that the contract was executed within a twelve-week envelope. The choice of a mouldable material would have forced Cadman away from its core skills in metal and onto a new learning curve. Moreover, having so little time meant that an evaluation to assess the optimum material could not take place. Arguably, ALSTOM's requirements could have been solved better had they had longer to work on the problem.

From Transys' perspective, it was felt that it was no longer possible to spend sufficient time on design. Moreover, it was felt that pressures to shorten design times

had increased³³. Clearly, by pushing design times, ALSTOM and their clients are potentially receiving less value.

The effect of regulation on design

ALSTOM's choice of a moulded material for the side panels and underpanels was based on Fiat's familiarity with them. However Railtrack regulations on loadings are considered probably more onerous than in the countries where Fiat is used to operating.

Limited designer input

The side skirts on the Pendolino are hinged at the bottom making access difficult. Had they been hinged at the top, or had there been an arrangement whereby they could be moved up and out of the way, access would be easier. Being second tier, Transys was not involved in the original concept design and the basic specification requirements were satisfied before Transys had come into contact with the design. *"We work with the specification whether or not we agree with it"*.

Contractual issues

Transys' contract with Cadman is to deliver drawings and ancillary information regarding noise calculations and validation – fire safety, finite element analysis etc³⁴. They must also supply documentation relating to the durability of the design.

Transys do not work on a fee basis, rather they quote a single price for a complete piece of work. Consequently, they take the risk of not being able to finish the design on time. Any variations to the drawing therein that are not attributable to mistakes, are seen as variations over and above the original scope of the contract.

Contract control

Some contract decisions are taken jointly between ALSTOM, Cadman and Transys. This can result in direct communication with ALSTOM. As a result the actual chain of communication has been a grey area for Cadman. However, in some ways this has been necessary. Because Cadman is effectively a metal fabricator, they do not have the expertise to take on work above and beyond 'making the parts'. ALSTOM, therefore, has a tendency to go straight to Transys with technical queries and problems.

It was agreed at an early meeting that Cadman would have a problem working between Transys and ALSTOM. Consequently, although it was agreed that ALSTOM would be able to go directly to Transys they must, nevertheless, keep Cadman informed of any communication. Transys are ill disposed towards this

³³ This may lead firms to balance their scope of supply with specialisation – specialisation increases learning through repeatability. Standardisation may also allow repeatability and so quicker lead times.

³⁴ Presumably for the safety case documentation.

interaction and would prefer to deal only with Cadman. *“There is the continual danger that Cadmans will be left out of the loop”*. On occasion Transys has gone direct to ALSTOM for information rather than go through Cadman. That communication has to be copied to Cadman.

It is the zone with whom Transys deal with directly (Peter Bold).

Once Transys has delivered the drawings to Cadman their obligation to them is at an end unless problems have resulted from errors in Transys’s draughting. They will offer any support that does not involve modifications to the drawings.

A further, part of Transys’s contract included supporting assembly by issuing drawings for assembly and spending time on the assembly line. Assembly drawings were provided through the ALSTOM drawing system, whereas the design drawings were done on Transys’ own system. ALSTOM has no interest in these drawings - only in the final product, safety case documentation and in the assembly drawings.

The design process

Design reviews

Design drawings have three reviews at ALSTOM – the concept design review, the intermediate design review and the gateway design review (which is the final review). An intermediate design review is not always called by ALSTOM.

Attendees from ALSTOM would include the Zone Leader and Engineer and other interested parties (from reliability, maintainability, the shop floor and QA). This is the point at which QA and maintenance issues begin to interact with the drawings and the design process. Changes which come out of the concept design review meeting are then programmed into the design process.

It is a recent phenomena to have concept design reviews in the rail industry - although it is now increasingly common practice.

Keeping the meetings focussed can be difficult. *“These meetings do need a strong chair or they tend to generate an amount of indecision”*.

Generally, the meetings tend to be chaired by an engineer. While each meeting should produce a definite list of decisions they do not always achieve this. - *“Different groups in the design meeting conflict and these conflicts tend to lead to indecision”*.

The effects of design indecision on the supply chain

Indecision in the design process at ALSTOM has negative effects right up the supply chain. One specific problem concerned the handles built into the Pendolino side panels. In the specification these handles were supposed to latch against brackets mounted on T slots on the train body. Part of Transys’s scope of work included designing the bracket which went onto the T slot. However, Transys found that there was insufficient room to do so, resulting in a sizeable chunk of design which Transys

have been unable to do. The lack of space resulted from poor design management essentially, the space had gone because: “...*someone had got there first*”.

The difficulty for Transys in this lies in the fact that if ALSTOM “*suddenly resolves the problem they will expect them to finish the design quickly*”. This causes resource allocation difficulties for Transys and has negative impacts on the efficiencies of their own operation. Ultimately, the costing of design work by designers will come to reflect the costs to them of sub-optimal design management by project integrators.

Arguably, space envelopes should be allocated at the concept stage of the design. No-go areas should be created where particular design solutions are already known.

Resourcing the design process

It was suggested that the zones, and in particular their interactions with suppliers, are under-managed. Moreover, that the WCML project generally is under resourced.

Alternative organisational architectures for design

Arguably zoning work has allowed the design to become fragmented. A serious problem with the operation of the zones concerns their inhibiting of communication across their boundaries.

An alternative strategy, used previously at Metro Cammell (“...*an allegedly efficient train builder*”³⁵) centred around the use of two design managers. One managed design work ‘above frame’ and the other managed the design ‘under frame’. The split between the two areas is based on a traditional engineering approach to train building which finished in the 1960s. Essentially, the under frame of the train was built first and then the shell was placed on top. The split still makes sense in so much as all trains have a floor which acts as a barrier between the under frame and the rest of the train. It is a “*hard barrier*” within the design.

Using this approach means that ultimate responsibility for the design rests with only two design managers - both of whom have very clear responsibilities. Thus: “...*while, disciplines such as piping, wiring, finishes and equipment would be fighting for room on the vehicle, they would fight to keep the various disciplines working together and resolve conflicts between them*”. Increasing train complexity may not to be a barrier to this approach - “*Although trains are more complicated now, it would still be possible to have zones under these two general management areas*”.

It is unclear why the control of the design at ALSTOM has been “*diluted*” and split up into zones. Having lost a tier of management, it has clearly become more difficult to overview the design and to manage it. Moreover, zone leaders at ALSTOM now report directly to someone who is not particularly concerned with the overall design. “*Companies are now also more engineering than design led. Design has perhaps*

³⁵ This statement was made in an ironic tone which implied certainty. Metro Cammell was responsible for the highly successful IC 225 and later, as Hunslet, for the 323 EMU (now regarded as the most reliable in the industry). The above and below frame split was used in both cases to manage the design process.

moved out into the supply chain. Engineers, generally speaking, tend not to be interested in the design as whole...they are interested in their own bit of work”.

Learning

Learning is facilitated at Transys by the fact that there are only thirty people working for it. There is no need to rely upon set procedures for learning from projects. Learning relies on informal communication.

Internal design management at Transys

Transys also have their own internal design reviews. Once a project is running however, there is only a design review if there are problems.

Globalisation of design services?

Foreign companies have problems making inroads into UK markets as they are not used to working in such restricted space. The space is restricted by the narrow UK gauge and is a particular constraint on the underframe e.g. the conventional Pendolino approach could not be applied to the mounting of the transformer..

Other work

Current projects include a tram for Turin with Fiat. Fiat are the manufacturers and have sub-contracted interior design finish to Transys.

Competitiveness

Transys's multi-disciplinarity is the key to their competitiveness. Transys can design on a blank piece of paper and work the design all the way through to completion – through drawing to the peripherals (including safety case documentation). This is an essential competence: *“There is no such thing now as a simple bracket on a British train - even a simple bracket has to have a calculation. If it is in a critical part of the train it needs a safety case”.*

Sanders

Transys are also the leading fitter of ‘sanders’ (for removing leaves from the train's wheels) in the UK market. In this instance they are a first tier supplier, providing a total package of installation, drawings, procedures and supply. Transys, however, sub-contract the design and fitting work.

Interview with Garry Williams at Hydrapower (Technical Director), 07.07.00.

Present - NA and CI (last edit 07.12.00)

Disk - yes

Background

Hydrapower is a 15 year old company that operates in specialist markets (aerospace, transport, defence and offshore) making silicon hoses, stainless steel tubes, gate valves, pipe clips, fittings and small power packs. Emphasis is on quality and service. It employs about 65 people and has (at time of interview) a £5million turnover. Other major customers include Perkins, BAeSys and Adtranz. Hydrapower provide 'traceability' and tailored deliveries (kitting). It is also keen to offer after-sales problem solving as a means of promoting the company and its products.³⁶

Both company directors come from hoses and fittings backgrounds. They began by contracting to smaller OEMs before moving up the ladder to companies like Yamasaki. When they gained BS5750 they were the second in the industry to have it.

The company's approach to customers is pro-active. If an order remains stable (i.e. the same orders each year) then there is perceived to be a problem. Innovation, building a rapport with the client and pro-actively solving customer problems is seen as a route to increased business. To this end, the company has staff dedicated to particular customers.

"You have got to give them something they have not already got...you have got to solve that problem".

"If you stand still you will go backwards"

Hydrapower is always on the look out for new opportunities to expand its supply.
"So far we have worked under floor. We are now starting to creep into the carriage".

"The rapport between engineering and other areas and ourselves is very good - you have got to have that...All-in-all we give a service - it might not be as quick"

³⁶ One example of their after-sales service concerned Jaguar. Cleaning and moisture is a key issue for Hydrapower's equipment. As pipes must be free of both moisture and dirt before delivery they are vacuumed, charged with nitrogen and capped before delivery. Assembly staff at Jaguar had been complaining of moisture in the pipe work and so Hydrapower visited the site. Their visit revealed that Jaguar assembly staff were removing the sealing caps en-masse prior to assembly, in order to speed up the assembly process. Consequently, the pipes developed condensation before they came to be installed.

HydraPower get paid a blanket fee of thirty pounds an hour for design work for all members of staff and bill ALSTOM, by agreement, at the £18,000 mark.

Promoting client acceptance of innovation

To develop their business with ALSTOM, a year ago Hydrapower invited ALSTOM to their plant. They invited a spread of people ("*...from sourcing to the shop floor*") in order to get buy-in at all levels for new innovations. The shop-floor can be a serious barrier to technology adoption - "*Fred on the line does not want it to work - if that man does not want it to work - it is never going to work*".

Hydrapower also strives to create a recognisable image (using product labelling, jackets and caps). All of this is aimed at encouraging familiarity and 'buy-in' at all levels.

Stretch 30

Hydrapower was well disposed toward Stretch 30³⁷. In particular, it was felt that it had provided opportunities for Hydrapower to diffuse products across project lines (i.e. Juniper, Coradia and Pendolino). Hydrapower had been invited by Stretch 30 to list "*what we they could do*" for different aspects of the train in terms of technology and price, against existing suppliers. ALSTOM had been relying on a number of different suppliers for fresh water pipe work, insulation and fitting and Hyrapower offered to design and build a compete unit - an offer which ALSTOM took up.

Scope of supply

Hydrapower's scope of supply now extends from effluent pipes to grab rails. "*We do a lot of running for them... We are willing to do the running, they are lazy*".

Hyrapower has found itself increasingly stepping outside its normal scope of supply. For one part of the WCML contract it was asked to make luggage-rack rubber gaiters. Not having any experience in this sort of product, they set about exploring what was available. After visiting a car warehouse they selected a rubber gear stick sleeve, which they cut-up to fit the luggage rack. They took this to ALSTOM who offered them the contract (on the understanding that they would be made of silicon and would be low-toxicity).

Hydrapower now has this made by a supplier, marks it up and sells it on to ALSTOM. A 10% mark-up for this sort of contract is normal. ALSTOM has benefited from saving its management resource.

Hydrapower has turned work down (the supply of electrical switches) that it deems to be out of its scope.

Core competence

³⁷ It was felt that ALSTOM had an unwillingness to share savings with suppliers (cf. AVE). Hydrapower uses this shared gain approach with its own suppliers.

Hydrapower identifies its key technological competencies as lying in the handling of particular materials (esp. rubber and silicon) - *"...it doesn't matter if there is a hole running through the middle or not"*. Thus, as they recognise, knowledge of reliable well-priced suppliers is critical to their competitiveness. This knowledge ensures that they are well placed to be responsive to ALSTOM's needs.

Innovation

Technological innovation is seen to stem from the identification of a design problem being experienced by the client, for which the supplier is able to deliver a technological fix. Hydrapower identified design problems with ALSTOM's Coradia when it shifted from the 175 to the 180 model³⁸. The 175 engine frame had come with an integrated engine and gear box, however, when a new engine was developed for the 180 model these components were separated. This change meant that rubber transmission pipes carrying oil coolant now ran past (35mm away) a hot (500°C) turbo instead of an inter-cooler as had previously been the case.

The design had other drawbacks. The frame supported long metal pipes which, because of their length and rigidity, were difficult to line during assembly - this became an issue every time the engine had to be dropped and re-installed for maintenance.

Hydrapower began promoting an innovative 'flexible metallic' pipes as a solution to both of these problems. The new pipes would also allow faster easier fitting and reduces vibration noise.

"Everybody wanted it (the engineers, stretch 30, the 'progress chaser') except the sourcing analyst. Cost was the issue despite the benefits... You get to that point, when you should have been working as a team, and he squashes it - he wants it for nothing."

When the pipe was eliminated from the contract Hydrapower responded by looking at areas to save on cost. They re-negotiated with their suppliers on the volume of supply, put pressure on suppliers and did further design work (managing to eliminate one of the expensive stainless steel welds, for example).

"We did everything ourselves - the spot light was on us and we had an opportunity to shine."

Eventually a concession was given to Hydrapower to supply two flexible metallic pipes. This allowed Hydrapower to show assembly the benefits of the pipes at first hand *"...the sourcing analyst was increasingly under pressure and we got a concession for another five; because they know they cannot do anything else but this."* Eventually a price was agreed and although the margins were low, it was an opportunity to place the product. Within WCML the technology was picked up and

³⁸ Product development can bring new problems requiring further solutions.

quickly migrated to other areas of the train³⁹. It proved particularly useful for connecting the Pendolino bogie to the surge pipe running down the length of the train. (The air surge pipe takes the 'surge' out of breaking system - effectively a buffer back up).

A further area of innovation concerned the re-design of pipe joins (based on flanges, a 'V' clamp and self-locating gaskets) in place of the existing nut and internal cone arrangement. The flanges and 'V' clamp are easier and quicker to locate and do up than the previous arrangement and requires far less torque to tighten them. Hydrapower initially got 'buy in' from maintenance staff (ease of use) and then began looking at where else they could use it. Hydrapower was able to offer those at no extra cost.

Hydrapower has since gone back to Coradia and promoted the clamp there - it has been used on a number of pipes: *"The cross pollination process is working very well. People see them and ask: What can I use these on?"*.

"Primarily it's a people game and this means you must not make promises you cannot keep".

Work with ALSTOM has *"stabilised"* - Hydrapower staff have their own passes and car stickers and are allowed into increasing numbers of different areas. This enables Hyrapower to talk to assembly staff about the ease of fitting and make improvements. Their relationship with ALSTOM is founded upon continuing to develop products in this way.

Supply innovation

Surge pipes are large and difficult to handle and in response Hydrapower has innovated an improved means of delivering them. There are two surge pipes, one each side of the train, both of which come in three sections. Hydrapower have developed a pyramidal rack to store them more easily. It also uses less line-side space and is easily transportable. These are also covered in company logos to promote the company on the shop floor.

The surge pipes have been designed by a supplier in conjunction with Hydrapower.

Design for maintenance

Design for maintenance seems to emerge as part of ALSTOM's 'what can you do approach' - NA.

³⁹ If technology change is evolutionary then it is evolution with intervention - transposing technologies to areas where they will out-compete existing populations.

"How can I do it - how can I get it out if it goes wrong - what are the consequences if it goes wrong".

Specification documents cover design for assembly, design for maintenance ("*...with minimum number of men in least possible time*"), safety case and safety culture as a corporate standard. Many of these specifications standards have emerged since 1998 - so they are most likely aimed at WCML.

Pipe maintenance

The probability of something clogging the pipe from the toilet module is quite high. Rather than WCTC being forced to remove it each time Hydrapower designed and developed an in-situ cleaning mechanism. Capped outflow pipes have been installed at junctions in the pipe. The caps are accessible without the removal of other equipment and the waste material can be pushed through under pressure to clear the pipes once the caps have been removed.

Pipe insulation

The Pendolino has a number of external pipes and at 140 mph can experience temperatures of -20° C. This requires them having an internal heat trace. Hydrapower introduced silicon pipes, which have integral heat traces and which themselves offer insulating properties.

Kitchen pipe materials - cost / durability trade-offs

Design for maintenance must reflect overall cost savings and ALSTOM will draw on the expertise of its supply chain to make calculations. The use of a particularly aggressive cleaner in the Pendolino kitchen, for example, had implications for the service life of drainage pipes. Hydrapower was able to advise on the optimum trade off between the cost of a grade of stainless steel which would resist the cleaner and the material / labour costs of replacement. In this case, it was calculated that a lower-grade stainless steel with more frequent replacement would give better value over the life of the train.

Informal supply chain arrangements

"I have worked on this since 9th of the 3rd 2000 and I mean hard work, constantly, and I haven't even got permission to go ahead with anything because the engineering specification has not been signed off; there is no DVR and no written intent to purchase. If they pulled the rug from under me now, I would not have a leg to stand on"

"They can't get an engineering specification out complete and yet they expect you to bend over backwards and get it sorted before they have even given you the authority to go ahead".

GW has relied on obtaining an advance, unauthorised copy of the specification from the zone engineer.

"They have got too much to do in too short period of time...we are a low priority...them knowing we will do it anyway makes us a low priority"

To begin building a train a week, on ALSTOM's deadlines, Hydrapower needs the contract three months minimum from the deadline to allow it to 'productionize' the product. The three-month deadline has now gone. *"They have dug themselves a bit of a hole and we must still attack those problems knowing that they may not have a contract. They are putting us in an impossible position...the customer is not being fair"*

ALSTOM's supplier strategy relies on the carrot of: *"The potential of £100,000 per carriage of work"*.

Competition

There is plenty of competition.

"We have taken out three of their [ALSTOM's] suppliers - these suppliers will be clawing their way back".

Along with other companies Hydrapower is moving into the Sri Lankan market.

Other strategies

GW was contemplating the idea of moving toward the supply of labour to fit their components. The standard of the fitting work can be crucial to the performance of the equipment, making Hydrapower's own expertise (developed on the shop floor) invaluable. There are also advantages for Hydrapower's own production to have shop floor workers see the machines into which the hoses they are making will fit. Not only does this have practical implications for the shop floor's understanding of how something 'ought' to fit but it encourages a sense of pride in the work and an appreciation of the material's aesthetics in the context of the overall design.

Hydrapower actively develop workers to relate to particular customers. Those workers then move up to foreman positions and can head-up teams going into that client later.

Hydrapower will operate three shifts to cope with the demands of WCML.

Reliability conference

No

Outsourcing

Design outsourcing is avoided. Work is specialised and competitive - consequently *"...if you take design work to your suppliers they will be after your business"*.

Hydrapower has bought a full Catia package to be compliant with ALSTOM. It is necessary to have this in order to be able to feed back information. There is a monthly cost of software updates and training to be borne.

Learning

"That has been the biggest learning curve for me - understanding trains...why, how; the history behind things". A new perspective can still be valuable however. GW had uncovered a particular size fitting used extensively by ALSTOM but which did not integrate easily with other standard fittings used in other markets. This effectively prevented ALSTOM from standardising. GW looked into the matter to find that *"ALSTOM don't know why they use them any more"*. As was pointed out: *"Sometimes it takes an outsider to see the logic in something"*.

INTERIOR ZONE AND SUPPLIERS

INTERVIEW WITH LYNNE GODDARD (LG), ALSTOM TRANSPORT, SOURCING ANALYST, 30TH JANUARY 2001.

Supplier Selection

Criteria vary, but always key is cost, quality and reliability of delivery. ALSTOM sends out a full tender pack which includes engineering specification, documentation required, quality requirements and so on. The sourcing analyst is responsible for getting all of the documentation together and preparing the pack and sending it out in a tender format. The project sourcing manager is in theory responsible for ensuring the zones have the technical requirements information (or at least will be when the key commodity structure is brought into operation).

Interior Design

The Pendolino interior is currently undergoing a period of redesign (having been deemed not fit for purpose). This was an internal decision made in August by Paris after a 'walk through' inspection of the interior of the pre-series car⁴⁰. The suppliers for interior linings are AVE, Express Plastics, Jukova and TRB.

ALSTOM's supply chain tiers are mixed depending on the area of supply. On one area of the West Coast Mainline contract, AVE supplies TRB Plastics. On another area, TRB Plastics supplies AVE. Although ALSTOM would prefer to source through a single supplier to reduce handling costs, there is a reticence to interfere with arrangements i.e. with TRB Plastics, which are at present working well.

ALSTOM has a good relationship with TRB Plastics, however it is interesting to note that building that relationship with TRB Plastics has been relatively torturous in contractual terms. TRB Plastics has examined the level of risk and responsibility, which they are contractually prepared to take on, in minute detail⁴¹. However, this professionalism is also reflected in their own administration and processes, to ALSTOM's advantage. TRB Plastics' own efficiency in this regard effectively manages the contract for ALSTOM, reducing its overheads. The key to maintaining this relationship, it was felt, was paying them on time. The Stretch 30 team introduced TRB to ALSTOM through the Juniper project and a long term relationship with LG has been developed across these projects. This does not stop ALSTOM

⁴⁰ Jones Garrard has been dropped from the contract. They were an external design house employed by ALSTOM to design and to liaise with their suppliers. ALSTOM identified 4 suppliers for this purpose. ALSTOM contracted with them, and then with Jones Garrard, creating a tripartite contractual arrangement. Jones Garrard were in effect the design authority.

⁴¹ For example, in terms of taking on responsibility for the fire resistance of partitions. TRB would not sign until they had the fire testing approval.

looking at TRB's competition, but a change in supplier will also incur cancellation costs.

Supplier capability

Suppliers are usually expected to demonstrate capability in project management using project management planning. Capacity project plans are required from prospective suppliers and ALSTOM will also audit them. As well as looking at suppliers' output capability, ALSTOM is also keen to examine their quality control systems. ALSTOM will work with suppliers in order to help them achieve ISO 9000, an example being Jukova⁴² whose output was very good, but not ISO9000 accredited. Jukova achieved ISO9000 in six months, having previously had almost no QA procedures. The company supplies the luggage stacks, litter bins, fabrications, casting and paintwork, which it is updating.

Proceduralisation

ALSTOM is becoming increasingly procedure driven (although the procedures are not always followed). At present each project does things in different ways. There is variation across projects in reporting procedures, for example. One such variation includes the use of performance bonds with suppliers. A new supplier being looked at by West Coast Mainline for window pans has been told by West Coast Mainline that performance bonds must be in place. However, a sourcing analyst engaged in contract negotiation for the Juniper project told them this was not required, undermining WCML's argument that this was standard. The key commodity structure should overcome these problems. There will always be quirks in terms and conditions but the basic requirements should stay the same across all projects. There is at present very little interaction with other projects, seen by some as a major failing. As a result, problems with suppliers tend not to be shared.

Interior design change on West Coast Main Line.

The key thing with design change is that there should be no adverse aesthetic impact. ALSTOM has suggested a film instead of a laminate coating for the interior ceilings. These are less labour-intensive to produce. This proposal was mooted a year ago, but rejected because the laminate is cheaper. However the laminate was found to be more costly to assemble and to fit less well with the designs that were ultimately used. The film has now been approved. A reluctance to approach the client with suggested changes has been perceived on this project.

The main sources of change have resulted from the design not being 'right first time' and from interface changes. The interiors zone is having to deal with a lot of design issues. The design will not change in appearance but it will change in quality. Suppliers that have been used successfully on other contracts may not have the

⁴² Jukova is a new supplier for ALSTOM, but has prior experience working for Russian Railways.

required capability. On WCML a greater attention to aesthetics is called for. A specific problem manifested itself in that the centre ceiling raft is not strong enough for the fixings in so much as it rattles and can be moved around. The problem is perceived to be with the design house. The design they produced was not fit for purpose. The designers were under considerable time constraints, however. The fault may also lie in the design process itself. Jones Garrard has what it calls a period of design finalisation, and what ALSTOM would call production support. In this period Jones Garrard tweaks the design to make sure that, come the end of pre-series 2, it will be able to go out to its suppliers and say *“this is what we really want”* and freeze the design. This did not happen however because of delays to programme and ALSTOM being so late in closing out the design and interfaces. The continual modifications often imposed a design freeze, in the full knowledge that the design was not yet finished. *“We are not very good at closing out issues, we are good at raising issues. Actually, closing that problem out seems to take an eternity”*. ALSTOM has been forced to largely rework Jones Garrard’s designs. Some ex-Jones Garrard employees have been brought in-house to do that work.

Contractual arrangements

There was nothing which limited Jones Garrard to a particular spend, as would be the case in a design and supply contract. Payment was for hours design time rather than a fixed price. ALSTOM also found itself unable to keep track of design changes, as Jones Garrard interacted directly with the suppliers. Having the drawings come via ALSTOM did not help as there were not enough staff to view the drawings before they went back to the suppliers. Drawings had to go back to suppliers without being viewed or checked and there were knock-on effects to interfaces with other zones. ALSTOM had initially tried to execute a design and supply contract, however this proved to be too expensive. Suppliers factored in their own risk. It was also suggested that the higher price might simply have been a more accurate estimate. The tri-partite arrangement established for the interiors design proved very difficult to manage in practice. The designer and manufacturer need to be more closely linked.

Supplier knowledge

Important supplier knowledge is often brought to bear on the design. Suppliers sometimes identify engineering solutions that are lower cost and are frustrated if ALSTOM does not accept them, given that ALSTOM stresses cost so heavily. Often acting on information from suppliers, sourcing analysts, although they are unlikely to have engineering knowledge, must then interact with engineers and try to suggest changes. Engineers can be resistant if they feel their designs are being questioned. The zone structure has helped to facilitate this interaction however. Sourcing and engineering used to be in different buildings. Co-location first occurred on the Juniper project: finance, accounts, sourcing analysts and engineers could all interact closely. However the zones do not necessarily interact with one another quite so well.

Project management

The zonal structure can also be a slight hindrance to the sourcing function in terms of its co-ordination and common policy formulation. The zones have encouraged different reporting practices. Not having the same information to hand for planning (e.g. status information) has caused problems at project management level and a lot of time is taken up by reporting activity. The reorganisation in August 2000 has improved the situation. This created the role of project sourcing manager and sourcing analysts now report to both Andy Derbyshire (project sourcing manager), who reports to the rest of project management, and to Chris Holt who deals with key commodities.

At the time of the interview the build was supposed to begin on 26th February – the process was already behind schedule. The position was reflected in the statement: *“I have nothing – I have no drawings.”* This is a problem when a supplier is quoting three months delivery from receipt of drawings. Design resource has been a major problem. Bringing in fresh designers is not an immediate solution as they must progress up a steep learning curve before becoming effective. The time pressure this creates means that sourcing analysts do not have time to draw up proper contracts or to spend time controlling costs. Tenders must also go out as incomplete packages of work. The true cost can't be assessed until the specification package is complete. Sourcing analysts are thus prevented from fulfilling their role properly (*“engineers aren't responsible for cost. They have an awareness of it and they should be designing to that but ultimately it's not their job, it's not part of their responsibility”*). Sourcing is forced to put out limited amounts of work with a letter of intent and a target price. In the meantime, that design is also taken to other sub-contractors to assess a benchmark. Suppliers with letters of intent are asked to agree to a competitiveness clause by which they agree to either match or lose the order to any supplier who tenders a 10% or more better price. However, ALSTOM may have laid down the tooling which an alternative supplier would not have access to, so the cost implications are not straightforward.

Train building, whether using a series build approach or not, is highly prone to endemic and expensive changes as the design process progresses. There seems to be a lack of resource at the front end, resulting in a desperate scramble for resources later on. Resources could be better time-managed as well. There tend to be a lot discussion within the teams: *“we just talk, we do lots of talking trying to resolve things, but actually getting down to the work is another matter”*.

The perception is that other railway manufacturers have similar experiences; e.g. Adtranz seem to have the same problems and *“if anything, ALSTOM is seen to be tighter controlled than Adtranz”*.

The Red Book

LG has had very little contact with the Red Book and no direct involvement with Virgin or Priestman Goode. Engineering design has responded to the red book not sourcing.

Centre Of Engineering

In the past LG has learned a lot from centre of engineering staff e.g. fire, safety, materials expertise, brakes, HVAC and so on. Contact is informal – either by telephone or “walking over” and this was regarded as having worked well.. C of E staff also monitor and interact with suppliers to ensure the efficacy of designs.

Pre-Series and Series Build

Ideally ALSTOM wants to keep the same suppliers from pre-series to series build. New suppliers have to climb a learning curve. However, because of late drawings, it has been impossible for some suppliers to demonstrate their value and some relationships have broken down. In some cases tenders have been high enough to warrant going to new suppliers, for example AVE’s tender added £7 million to the series build. Variations in the design may have accounted for as much as 80% of the work done. Tendering for pre-series should have enabled the best supplier to be identified, but in practice, the implications of design changes are that the original costing was inappropriate and if the cost has changed it is necessary to prove a new market price.

Approvals Process

There is no time allocated for the approvals process, negotiating with suppliers or creating tender documents. There is an assumption from design that once a design is complete, manufacture should start immediately. That is to say there is very little appreciation of the sourcing role by engineers *“that’s something we need to highlight to the project. It’s not fully in the plans at all”*. In theory, the approvals process should not in theory take long, but the opposite is usually the case. Since it is an unavoidable process the effect is to put project timings back. West Coast Main Line has an IT based signing off system called metaphase. Once a design has been signed off and sourcing has got a quote the signing off process then goes through another iteration, and sourcing must then get approval for payment. *“It can take months. It’s not everyone’s priority”*.

Improvement to Procurement

At present, back up work is almost impossible to catch up on e.g. documenting negotiations. Sourcing needs to find more effective and efficient ways to do administrative work. Relationships with suppliers would be improved if suppliers were located on site, however not all suppliers do want to do this. Jones Garrard, for example, had staff who did not want to relocate on site. Co-location was not specified in the contract. As a consequence, it was felt *“Jones Garrard project managed us [ALSTOM]”*.

Insisting on passing liquidated damages to suppliers can have the effect of forcing them to add in a price safety margin, which can also result in slower delivery than required. There is more use now of performance bonds. Ultimately, varied contract conditions must be applied to different suppliers. There is no single solution.

The sourcing function needs to have everyone's buy-in. Sourcing tends not to see the start or end of a project. There was, however, a pre-project meeting between the Juniper and WCML project teams.

Interview with Mike Thompson (MD) at AVE (07.09.2000)

Present – NA and CI

Editors – CI (last ed. 30.11.00)

Minidisk – no

MT argued that the philosophy of out sourcing was a flawed in that by pursuing it large manufacturers loose the opportunity to learn.

AVE

When AVE was taken over by Arrowvale Electronics the company was in a poor state. Staff numbers were down to 28 (from 270) and out of that 28, 18 people were in the office and only 10 were on the shop floor.

At the time, no suppliers would give AVE credit so MT had to agree orders with ALSTOM before he took it over.

AVE then won Scotrail contracts and have “...*delivered ever since*”.

AVE was formed in 1985 with 3 staff; it now employs 250 and is still the seventh fastest growing business in the Midlands. It supplies around a million parts to industry per year, of which 99.9965% are compliant to specification. The company won the Business Enterprise ‘Business of the Year Award’ in 1995 and is a top 50 UK manufacturer (by turnover?). AVE recently acquired Transintec.

AVE deliver a full design and build service and draw upon their own web of suppliers. The company is ISO9001 accredited.

Industry staffing problems

The rail industry lost many experienced subsequent to the dearth of orders that followed the privatisation of BR. MT argued that while modern railway designers are good at concept design they are less good at furnishing engineers with finished detailed drawings. This is partly because newly trained designers, and designers trained in other sectors, have come into the industry lacking the tacit experience of those they are replacing. The experience they lack is of the intuitive but critical sort, the sort which alerts them to the fact that: “...*that ain’t going to work*”. New designers, lacking in this experience, may be more heavily reliant on computer based design tools and, as was pointed out by more than one supplier, good computer driven design work can nevertheless fails in application.

Supply chain relations

First tier suppliers expect to maintain close relationships with ALSTOM – and to do so across a number of projects. However, this has proven problematic as ALSTOM has a high turnover of key staff.

Although ALSTOM has been keen to develop supply chain relations, and to implement programmes as such Kaizen and KanBan with them, their least-cost philosophy may act as a barrier to doing so. As one supplier, referring to the adoption of good management, practices put it: *“Whatever it is always too expensive”*. It was also felt that ALSTOM is unreasonably distrustful of its suppliers. Given that long term relations (and indeed reputation) are key to supplier survival it makes little commercial sense for first tier suppliers to try to *“fleece”* ALSTOM. Yet this assumption seems to drive ALSTOM supply chain management policies. (This view is confirmed by interviews within ALSTOM.)

Informal working

Unclear payment structures and high degrees of ‘informal’ work were seen as problematic by suppliers. Greater clarity and simplicity in the structuring of payments, such as an agreed hourly rate and a fixed mark up, would benefit suppliers. Then, *“...it may then be possible to work together to get cost down”*.

Least cost supplier strategy

Arguably, there are many hidden risks and false economies in dealing with lowest cost suppliers. It is not inconceivable that suppliers, will ‘buy’ business through attractively low, but unsustainable bids. These suppliers will work at cost (or less) in order to fend off collapse. As such they are a self selecting sample more likely to collapse or fail to deliver as promised during the contract. *“Cheaper suppliers go under”*. In one instance, during the London underground contract, ALSTOM went with a supplier that had undercut the existing supplier by 40%. As predicted by the incumbent, the new supplier failed to deliver (having used non-compliant cables and connectors) and ALSTOM was forced to send an 11 person team into to a twenty person company to sort out the problem.

ALSTOM cannot always drive hard on costs and expect always to deliver on time. *“ALSTOM need to get trains out of the door-but are obsessed by cuts”*.

ALSTOM’s procurement plan, is to develop a core of reliable suppliers able to manage their broader supply structure. The detail of their supply chain philosophies are, in many respects, however, counter to achieving this. On WCML 60% of the supply base is new.

Supplier control of the design process

ALSTOM’s conceptual design work is highly regarded while its detailed design work has been much criticised by suppliers. One response from suppliers, aimed at dealing with these inadequacies, has been to assert control of physical areas of the design. (For example – the whole interior *“...from floor to ceiling”*, entire cab areas and

entire electrical systems “...to the back of the wall panels”. Control of physical areas may not prevent intrusion into that space by other aspects of the design but it does provide some grounds for resistance

Reliability conference

One reliability conference (to discuss design for maintainability) focussed on issues surrounding cleaning. Cleaners pointed out the shapes that were difficult for them to clean. Difficult to clean shapes in design resulted directly from a lack of experience feeding back from maintenance.

ALSTOM don't talk to their own shop floor

ALSTOM have logistics problems – evidenced by unused floor space. Talking more to the shop floor more would help them to deliver to schedule.

Further problems with ALSTOM's supply chain management

Design changes

The greatest problem faced by ALSTOM are continual design changes. 2/3 of AVE staff are engaged in dealing with design changes. ALSTOM also need to create confidence in their suppliers to invest for the long term.

Ideally, suppliers would put a full time rep on site.

ALSTOM don't learn from their suppliers

ALSTOM do not appear to learn from design errors. On Juniper, for example, designed-in 360 degree folds in certain types of Aluminium resulted in cracking. Although their supplier had offered alternative solutions, the same mistake was still made on WCML.

There is some evidence to suggest that ALSTOM does not respond even to critical information from suppliers. In one instance a supplier had informed ALSTOM that the parts they had ordered from another supplier were out of spec. Logistics at ALSTOM had shipped-in manufactured parts regardless of supplier's advice, only to discover later that the parts would not work. Ultimately, a \$4 million pound order needed to be retro-fitted at a cost of £675,000.

ALSTOM need more open dialogue with their suppliers

Suppliers critical to ALSTOM require more regular and open dialogue. Not least so that manufacturing needs can have a voice in the design process. ALSTOM risk loosing the respect of their suppliers if they do not improve their performance.

The WCML contract contains 100% liquidated damages which, if applied, would kill the supplier. Consequently they are unenforceable.

ALSTOM need to build trust

ALSTOM does less than it might to build trust. The stretch 30 programme, for example, had been based on sharing any savings 50/50 between their suppliers and themselves. However, when AVE made a £320,000 saving on Juniper ALSTOM, under pressure to claw back losses, chose not to share the saving.

ALSTOM also resists giving long orders. As one supplier put it: *“They don’t want us to think we are on a gravy train”*. Local suppliers in particular find the attitude frustrating in light of clear motivations to help Washwood Heath be more efficient. If they cannot, the work will go to the continent. As one supplier argued: *“I don’t want to supply Europe when I can supply just down the road”*. Arguably, 50/50 savings are a poorer incentive than the promise of continuing orders.

Control of suppliers

Suppliers, cannot always use the suppliers it wants to and must abide by ALSTOM’s procurement policies.

On occasion ALSTOM has sourced direct to a supplier which their first tier suppliers are using. In so doing ALSTOM had absorbed the available supply capacity of certain components, and prevented their own first tier suppliers from meeting agreed schedules.

Interiors supply

The original interiors order was for around £20 million and sourced through a single supplier. ALSTOM later split the order into 6 packages.

Supplier interaction in the design process

Access to the ‘red book’ is restricted by Virgin. Even key suppliers only have access to that part of the red book which is relevant to them. This contrasts sharply with experiences on other contracts. AVE, for example, reported that when working with Bombardier (interior and train front end) they interacted closely with Virgin, Railtrack and Bombardier. The project went well, according to MT, because design and buildability issues were discussed early.

The Bombardier project made extensive use of mock-ups to facilitate this interaction. ALSTOM have tended not to use mock-ups resulting in design errors not being picked up until first assembly. In the Pendolino interiors ALSTOM has been forced to use slip joints to hide mistakes in the length of luggage racks.

If suppliers were involved earlier in the design process they would be able to input buildability into the design. Some suppliers would also benefit from a space within ALSTOM in assembly to be able to test their equipment close to the production line.

Staff

The quality and experience of procurement staff at ALSTOM may fall below the demands placed on them.

Commercial strategy

Washwood Heath does not itself make a profit though Onix and Traction do. On WCML, WH expects to break even and then start making a profit through the service agreement.

Meeting with Shawn Doyle (Contracts Manager) at Jones Garrard, 17.07.00.

Present – NA and CI

Minidisc – yes

Eds. CI, NA

JG history and competence

The company is 25 years old and was started by Jones and Garrard, an engineer and a designer. Their main markets are transport (rail mainly), medical devices, structural packaging (fast moving consumer goods – e.g. flip top shampoo bottles). Their core competencies are industrial design, engineering design and project management.

They are responsible for the Eurostar exterior, the exterior and interiors of all Hong Kong trains, the Spanish AVE (version of Eurostar), the toll plazas on the Oresund Denmark- Sweden bridge, Juniper and Coradia interior and exterior and airline seats (though BE(?) Aerospace of the US).

Exteriors and interiors require more or less the same skills and experience. In JG the same people do all of the work.

Despite appearances, train front ends do not have to be particularly aerodynamic – rather they are aesthetic. There is some thinking but no actual wind-tunnel testing. Pressure testing does have to be done.

Interiors must consider – human impacts (vandalism, wear and tear). Knowledge about the performance of coatings and material over time is critical. There are also Rail-Track group standards for interior integrity (load conditions, crash loading) – these are not as constraining as in the airline industry.

JG lead contractor on Coradia and Juniper.

JG – used to be a pure industrial design company. Found that vision was being lost in engineering – engineering not working with client directly. Industrial design must also start with good engineering knowledge – must know what is not practicable.

JG offers the client a concept through to production service. The client is fully involved in this process to ensure that he or she gets what they want. Good industrial design needs a basic engineering knowledge - maintaining the client's vision through to the engineering of the product.

JG also brings suppliers into that process. JG has worked with AVE Rail products, TRB, ExPress Plastics. The design should have the client's brand not JG's. Design judged on aesthetics – they buy JG quality (the process). It is a customer-led process.

SD is a project manager.

Contractual arrangements

JG has no contractual link with any of the interiors suppliers. Their contracts are direct with AL. The original ‘design and supply’ contract with Percy Lane Products (PL) of Tamworth was dropped by ALSTOM in April 1999. ALSTOM came to JG and asked them to contract directly to them – the scope of supply did not change but ALSTOM now “*signed the cheques*”.

All suppliers were initially chosen by AL. JG was hired for design work, ExPress Plastics for interior panels and TransLec for the light units. PL were also to do the brackets and final assembly. They were also planning to set up a stores site at or near ALSTOM to manage supply.

It is not entirely clear why PL was dropped.

Arguably the direct contracting set-up is more costly to manage. Although it is likely that the new set up was a cost driven decision from Paris. Letters of intent had been issued on a fixed rate (cost, scope and deliverables) but ALSTOM were instructed by Paris to improve their cost targets. PL was willing to negotiate, but under different circumstances, so negotiations failed and ALSTOM took over.

JG has a fixed scope and fixed deliverables contract but they do entertain alternatives (e.g. lower cost with royalties)

Interactions

JG is “*prohibited*” (AL.17.07.00) from talking to Virgin. ALSTOM interiors zone is the interface along with the Red book. This was agreed early on with Virgin. JG also interacts with Priestman Goode. JG only came on board after the red book had been worked up.

Priestman Goode (PG) and Jarvis La Soso (sp.?) (JLS) work with Virgin. PG had done airline work but did not have previous experience of trains. Consequently, they did understand the particular problems of train design in terms of vibration, noise, human abuse and so on. JLS had done work on Virgin Mega Stores.

Between them they produced the Red Book – theme sketches. JLS dealt with atmosphere while PG identified the shapes, surface finishes and colours needed to carry it through. Virgin did not want a train, they wanted a “trendy London bistro” – ground breaking. JG took the specs stemming from these and turned them into physical artefacts.

The design was initially unsuitable for use in train vehicles. The noise level, for example, was very tight (65DBA). However all of the surfaces were hard. JG had developed expertise in noise suppression – they had built the Corardia floor, the quietest diesel, for example. JG though not strictly sound experts set about adapting the design. Once noise gets in it has to be absorbed. For example, the stainless steel

vestibule floor tread plate, while it looked the part, echoed terribly. Virgin, PG and ALSTOM re-thought the design.

JG's key role was thus to bring in the train expertise and to bridge the gap between drawings and artefacts. PG, though not experts in trains, were chosen because Virgin in effect did not actually want a train.

PG, JLS - JG interaction was mediated through the interiors design zone. Would have been better to get involved with them earlier.

PG – Ian Scoley
Jarvis LS - Murray Jarvis

Contracts with suppliers

Most projects, like WCML, have a contract for a fixed design brief, on a fixed price, for fixed deliverables. JG have developed long term, though non-contractual, working relationships with suppliers. Their engineers work closely with suppliers to economise design and to enable them to work to their processes.

Full design and supply contracts (WCML being an exception) are becoming more common.

On WCML JG “*work along side*” (AL.17.07.00) AVE Rail (main interiors supplier), Technical Resin Bonders (Honey combed composite panels – supply AVE (AVE then supply ALSTOM), EXCIL (interior lighting – just have to interface with them e.g. locations for power supply - they do their own design via the red book), ExpressPlastics (body side panel) and JUKOVA OY (miscellaneous – luggage stacks, magazine racks, litter bins and some trim).

Zone interactions

Interactions with ALSTOM are primarily done through interior zone.

Earlier in project there was much freedom to talk to whoever was necessary. However, ALSTOM felt it was losing control and introduced its own Technical Clarification Note (TCN) – essentially a correspondence tracking device. Originally a Design Request was used by JG and the other suppliers – this comprised effectively a question with space for a response and a ‘close out’. This would be faxed back and forth until a problem was resolved. This took pressure off ALSTOM – only introduced them when problem solved or needed their help. If JG solved problem raised it with JG at progress meetings. Referred to as ‘off line’ design work.

ALSTOM recognised, however, that there were implications of changes on costs. For example, a small design change agreed between AVE and JG may mean that AVE has to buy new tools. ALSTOM wanted to track all those issues to control costs. TCNs were introduced and must now go through the relevant sourcing analyst at ALSTOM -

Lynne Goddard for interiors. She passes it on to the supplier if no cost implication. This has relaxed a bit. JG use a 'shot gun' approach⁴³ on all TCNs to keep all relevant parties up to speed on changes. There are hundreds of these a day. Most are minor modifications for manufacture, suppliers offering alternatives (higher grade at same cost) and interpretation of client specifications. Requests come through JG but JG is not involved in dealing with cost implication. ALSTOM then deals direct with the supplier.

Alan Marsden – tech contact from Zone who tracks issues. He provides info to fill out TCN form. This is informal – as it must be on any big complex contract.

Risk liability

Design and supply contracts carry great risk. Particularly so if JG had stayed with Percy Lane. *"But there is risk and reward"* (AL.17.07.00). The supplier prices accordingly to adjust for risk or reduces that scope of the job.

Cost

JG perceives cost to have been the main driver of the WCML project. ALSTOM gets pressure from all sides, particularly from Paris. There is a history to this - the ALSTOM group has carried losses from Birmingham for around 10 years. WCML has to make money.

Supplier relationships

There are no formal joint meetings with suppliers. These are held on an 'as needed' basis. Weekly project review meetings (adopted from Juniper and Coradier) were held. These were held at JG in Leicester during design phase but now, since moving into series build, these are held at the ALSTOM site. These meetings provide a valuable ring-fenced amount of time – Wed morning up to all day. Even if nothing needs to be talked about they are still held. Issues discussed include technical issues, open design issues, commercial issues and the impacts of design elsewhere. This has helped to track project progress. There has been tendency for them to degenerate into technical a review *[do not pass this criticism on to AL]*.

Colin Richardson is the interiors Zone leader.⁴⁴

There is only so much management resource to throw about. JG tends to be forgotten about by some key players in ALSTOM unless there are pressing issues to be resolved.

Interaction in design

⁴³ i.e. in parallel rather than sequentially.

⁴⁴ Only until the August 2000 shake up.

Stating space envelopes is the first step in the design process. As the design progresses it becomes clear at what points other objects can be pushed into it – interface management is key here (ALSTOM's expertise). There is a lot of give and take – though technical issues form the final constraint. The main problem in this is that the zones operate as autonomous entities – there no link across the top. This makes design interfacing very difficult. *“Internal external customer issue gets muddy”* (AL.17.07.00). People sit next to each other but they don't necessarily talk to one another. CSC *“...could not change the attitude of the people – even if its restructuring was ground breaking”* (AL.17.07.00).

Regulation issues

DETR accessibility regulations for handicapped. These include the colour of the grab hold relative to panel behind it, seat distances, the location of buttons and call-for-aid boxes. This is communicated by a document created with the help of the industry – the final document is legally binding. Unlike the red book, it is a quantitative list of engineering requirements – the number of priority seats, with certain space (from table, clear space to stand), vestibule door turning radius and so on. These are enforced through tours by Government agency personnel (there are a number of agencies).

Safety case from HMRI – this body enforces Railtrack Group standards and works in collaboration with Railtrack. Railtrack Group standards include the vehicle structure, its ability to run on the infrastructure and interiors (in terms of crash survivability). (Denver Brown is the fire test expert at ALSTOM). Materials must meet British standards in flame spread, toxicity etc. Testing on the material done once but each time it is used the documentation has to be re-submitted with the safety documentation for that train.

Reliability Conference

The first ALSTOM sponsored reliability conference for WCML was held at the end of June. Steve McCanan presented issues on reliability. This was the first time these issues had been raised with the suppliers. J Riley has not been involved intimately with suppliers over these issues given that he has to represent assembly across the whole project.

Ultimately, existing experience and common sense have been the main drivers in designing for maintainability. WCTC has not been much involved in design issues. The next tier of knowledge, how designs have held up or performed in past, has not been fed back as it should from the maintenance depots.

This can be thought of in terms of as a maintainability 'knowledge gap' and the adoption of life cycle costs (LCCs) in design.

Knowledge gap – Not enough specific maintenance experience has gone in to the design process. An interiors visit to Steve M's Manchester maintenance depot has been organised on the back of the conference. The plan is to get them to identify top

ten maintainability issues “...*from guys who turn the wrenches*”. All five suppliers and sourcing analyst and an engineer from ALSTOM (if possible) will visit the depot.

LCCs – There is still a great deal of scope for change though proper LCC analysis needs to drive this. At the reliability conference, for example, ExPress plastics was promoting Schneller film (vacuum formed onto the panel) which although more expensive than paint is more hard wearing. A year ago first cost the main issue and ExPress Plastics would not have had a hearing. Schneller demonstrated that over the life of the train costs can be lower.

ALSTOM now has money to fund feasibility studies for innovations to attack LCCs. Suppliers are not motivated to seek innovative solutions if cannot see a profit emerging from that effort. Clearly, if they are paid to do research into innovations that is a different matter.

Richard Ashford – quality manager, LCCs, reliability and maintainability.

Problem for industry – how do you manage LCCs?

Designers / contractors lack of control over long term costs. They cannot know what the replacement costs of particular items will be in the future, so they are naturally reluctant to sign up to LCC penalties. If they were asked to sign up to a number of cycles – or other non-cost measure – that would perhaps be more reasonable.

Clearly, a ‘design and supply’ contract allows greater scope for this sort of long term control. PG, had they accepted LCC contract clauses, would have rolled some of them onto JG. However, JG would have been able to exert more control over suppliers to deal with that. Virgin has laid down stiff penalties on ALSTOM and ALSTOM has passed them on. This is too simplistic in approach – it does not account for some of the relationships involved. JG, for instance, needs to control the costs of suppliers if they are going to take on LCC clauses. At present, JG has no contractual control - most suppliers won’t even entertain open book agreements.

Supplier involvement

The design process (at its crudest) starts with a concept, then goes onto detail then to manufacture and supply. Supplier in at concept – he sees what he is bidding for. Get involved in detail. He can bid with confidence. If he has not been involved, he will not want to sign up to LCCs.

ALSTOM has taken very one-sided approach (Steve McAdam WCTC) – their performance criteria has a bonus scheme as well as penalties. However LCC contracts for suppliers have no bonus scheme built into it. Consequently, there is no incentive to suppliers to sign these contracts – not much supplier enthusiasm [*personal observation – not for quote*].

Suppliers feel that ALSTOM is adversarial “*all stick and no carrot*” in their approach. Suppliers applauded the suggestion that ALSTOM is adversarial at the reliability conference.

[First tier suppliers may have to become larger in order to capture supply chain control to cope with LCCs.]

Outsourcing design

Franchising was happening at same time as design devolution. There were no trains ordered for three years prior to the franchises being agreed. That backlog means that order books are relatively full. Design outsourcing has created lots of opportunities.

In the rail industry, designers work for manufacturers. Manufacturers and designers come as a package to the train operator. In airlines, the larger airlines come associated with their own designers. Large airlines are very brand conscious – they dictate bespoke design. For the smaller operators there is a Boeing standard interior. In the rail industry, WCML is an exception. Virgin brought in PG to work with them. Train operators may be becoming more brand conscious: although train operator competition is different from that of airlines because there is less direct competition over passengers.

Learning process

At ALSTOM people work in familiar groups: Juniper and Coradier staff move forward as a distinct team and tend not to mix with other teams. Each group therefore only take lessons forward from their own projects - Juniper is now several years old.

There is clearly a tension between developing experience within particular projects and the benefits cross fertilisation. Perhaps managers could be circulated.

At JG there is learning from project to project simply because “*all of the people do all of the work*” (AL.17.07.00). The number of people required for a project changes over its lifecycle – with the trend being toward needing less people – therefore some members are inevitably re-deployed to other teams where they take their experience. Later these teams are themselves downsized as the design process moves on and new teams formed [*knowledge shuffling?*].

Continuity of link with ALSTOM

Lynne Goddard is the third sourcing analyst on this project – lack of contact continuity has been a problem. [*Not for quote*]

Summary

There are high management costs and stresses associated with this sort of contract for ALSTOM. The ideal for ALSTOM is ‘design and supply’. In this type of contract ALSTOM has less risk and creates vested interests in the design and supply side to deliver the best product at best cost.

Bringing suppliers and designers in at the same time has advantages. AVE, for example, cannot predict how much it will cost to execute a conceptual design. AVE ALSTOM is more likely to get less risk adjusted price. JG has involved suppliers informally in all work they do – AVE has sat in on all meetings involving design change. JG has allowed ‘horse trading’ to go on between them. ALSTOM has benefited from this management input. In WCML the design was set before the suppliers were brought on board.

A better strategy may have been to go to suppliers to bid against a pre-series train. Having tooled up and worked out all of the bugs and numbers of brackets, suppliers can then go on to bid against a known design for a fixed price. This is lower risk for them and allows them to bid at a lower price. Instead, ALSTOM simply got them to bid on conceptual designs and then told them to cut costs - arbitrarily at 15%. Very crude approach.

Limited competition - if a supplier knows they are likely to get repeat business they will be better disposed to provide good service and get involved in the process – even if they are no longer the cheapest. Trust provides give and take. For example – suppliers will put someone on-site to sort problems out. Ultimately ALSTOM must “...get the train out of the door as per delivery schedule or its all for nothing” (AL.17.07.00). They need their suppliers to help them do that. This is not what drives the rail industry at the moment – it is cost.

JG – competitors.

Other designers in the industry stop short of managing suppliers. INBIS, KBD AS&T have engineers but not designers. PG, Design Acumen and Seymour Powell have designers but not engineers.

Interview with Phil O’Leary, Project Manager, at EXCIL for WCML contract (31.08.00)

Present – ALSTOM and CI (last edited 5. 12.00)

Disk - yes

EXCIL

Excil provides interior train lighting to the rail industry. They have worked with ALSTOM on the London Underground contract (Piccadilly, Jubilee line and Northern line) on the Arlanda airport link and on Juniper and Coradia.

EXCIL has also worked for Bombardier.

EXCIL has ISO9000 accreditation and employs 35.

Advanced Lighting Driver Technology

EXCIL has provided next generation drivers for the Pendolino.

The drivers create a 'soft start' (by pre-warming the contacts) and smoother running (using high frequency). The lamps flicker at above the mains frequency so there is no visible flicker. Technology is now patented. Although the lamps are expensive, they are sold on the basis of the ‘cost of ownership’. Generally, florescent reliability tends to be low. EXCIL has always run equipment under its capacity to gain reliability, but London Underground were the first to buy into the new generation inverters.

Transport markets are generally more demanding than construction market in terms of reliability and durability. Train manufacturers also take a longer-term view of their product than do construction contractors. Specifications are also far more exacting. European standards require a lamp in a train to strike at temperatures down to –35C whereas a construction fitting would only be expected to strike down to -5C. The train environment also creates a very wide voltage supply range to cope with. A 110 volt unit will have to cope with anything from 67 volts to 140 volts. High voltage spikes and surges (8 kv on a 110 volt circuit) must also be anticipated in design. Unlike cruder equipment, EXIL designs units to keep constant light output even with a variable power supply. Moreover, the units are intelligent, if the unit won’t strike the driver will stop trying. High shock and vibration combined with a 20 – 30 year service life creates obvious difficulties. Domestic markets expect only 3 years for a unit.

Lighting is also becoming an increasingly integral part of the aesthetics of the train. Adaptive lighting is becoming more important (dimmable high frequency florescent lamps).

Some of the driver’s circuits have now been written onto a chip giving fewer parts and so greater reliability.

Generally it takes 6 weeks to get through the rail tests for a light. Electro-Magnetic-Compatibility – European regulation – i.e. how much interference put back into mains and how much radiation into atmosphere is a key issue. This legislation is driven by sheer growth of electrical equipment.

EXCIL is trying to move into bus and coach markets.

EXCIL Contract

General

On WCML EXCIL provides internal florescent lighting for the Pendolino - the concept designs come directly from the virgin Red Book. The contract itself is for detailed design and manufacture of vestibule lights, full-height pillar lights, capsule lights in the low pantograph area (no raft possible), luggage rack 'up lights' and down lighters. The contract is managed by AVE rail.

EXCIL has a contract for the entire build.

EXCIL has particular expertise in high reliability florescent light driver-units. The design has its roots in the demands of the London Underground specification and is tailored to suit the characteristics of florescent lamps to give long life. A lamp with a normal driver will last for 10,000 hours, whereas with EXCIL's new generation drivers it may last 30,000 hours.

Maintainability

Suppliers to the WCML contract must state the life-cycle costs of all equipment on a standard pro-forma. For maintainability, ALSTOM also state fixed times within which the lights must be accessible for maintenance. To change an inverter must take no more than 6 minutes. EXCIL have had to prove this is possible in 'type-tests' observed by ALSTOM.

Suppliers

EXCIL have to be able to guarantee parts for 30 years and want their subcontractors to do the same. EXCIL cascade down ALSTOM's specifications to their suppliers.

In some cases ALSTOM will specify such details as the thickness of a coating on metal plate. EXCIL then pass that on to suppliers.

These specs have been built up by years and years of experience by ALSTOM of the rail industry and from past failures.

The design process

The Red Book drove the design process for EXCIL. The Red Book has no dimensions – only an indication of use and appearance - leaving EXCIL to fill in the gaps. EXCIL, moreover, has only seen the interior section of the book. *“We had great trouble getting the red book – even the sections relevant to us”*. There were initially only two copies of the Red Book but ALSTOM were unwilling copy them – probably for IP reasons.

Typically, in designing a new piece of equipment EXCIL will try to match their existing designs with what is in the Red Book. The ‘down-lights’, however, had to be designed from scratch.

Pricing a design is achieved by sending out enquiries to subcontractors. EXCIL try to send their drawings out to at least three contractors and seek the best price.

Suppliers have some part in the design processes. Suppliers will give advice, for example, on manufacturability. Generally, advice covers manufacturing rather than design issues.

The critical suppliers were for the polycarbonate strips that prevent passengers getting their fingers into the light fitting. This had to come from the US because of fire regulations in the UK.

Design interfaces

AVE is the first tier supplier in this part of the contract (although JG also deal direct with ALSTOM). EXCIL interfaces with Jones Garrard to discuss issues like space. Although EXCIL can discuss matters with Jones Garrard directly, they must send copies of all the minutes of all meetings to ALSTOM. This was a late addition to the process – see JG notes. It is during these meetings that the details of the designs begin to take shape.

EXCIL has met Virgin at design reviews held at ALSTOM but has not met with them alone to discuss design issues. Problems and alternatives are discussed at those meetings so that they can be sure that suppliers are all using, for example, exactly the same paint. Priestman Goode represents Virgin at these meetings.

Design changes - learning can be costly

The original WCML team were new and had not worked with EXCIL before – this led to many changes later in the design as more experienced staff arrived from other projects and transferred their experiences.

Six months before the interview, as a cost reduction exercise, ALSTOM reviewed all of their schematic diagrams and substantially reduced the number of lighting rafts running through the ceiling. For EXCIL, this meant unwelcome re-designing and re-costing (although it was put to EXCIL as a ‘cost reduction’ as less wiring overall was required). Although the contract is a design and supply contract EXCIL are protected from some of the worst effects of the changes. Design was paid for on a fee basis while supply was paid for on delivery. Nevertheless, on the basis of the changes *“...the whole job had to be re-costed”* – a cost in time and opportunity to EXCIL.

Getting designs 'signed-off'

EXCIL has spent time in the design studio for regular meetings. Issues discussed focus around specific design choices to be signed off. EXCIL has found difficulties in getting designs 'signed off'.

For example:

"If you wanted to use a polycarbonate they [ALSTOM] will say you have to talk to the materials manager. They [the Materials Manager] would say it's the wrong colour - so you will have to speak to somebody else about that".

"You do have someone you can speak to but then he will then distribute it to other people...Nobody wants to be held responsible for saying yes...the zones create a distribution of decision making".

The key problem for suppliers was the time taken by the decision making process. At the time of interview, EXCIL had had no drawings approved by ALSTOM. Problematically for ALSTOM, from the point at which EXCIL has completed drawings for a simple casting, it takes a further two months to complete the artefact itself. Lead-time for suppliers did not seem to feature in ALSTOM's project plan. Moreover, at this point the completion date of the series build was already an issue for ALSTOM.

Although staff at ALSTOM are aware of this problem their primary concern remains keeping the project moving. Consequently, suppliers are routinely encouraged to carry on – but at their own risk. *"There is nothing in writing"*.

Changes add further to these costs: *"It costs us a lot of money through re-work...you do things and then they change their mind...they cannot see that small changes are costly for us and our suppliers... to them its just a small lighting box"*.

Ultimately, in order to prevent suppliers from increasing their prices as changes are made, EXCIL must use the same tactics as ALSTOM in dealing with its supply chain. In order to get suppliers not to charge for changes, EXCIL also uses the lever of a potential further 53 trains worth of further business. While useful, this lever is also dangerous in promoting informal request practices.

((Good will and flexibility amongst suppliers should be treated as a valuable resource by ALSTOM.))

EXCIL's supply chain management

Supply is scheduled at around a train set per week. Delivery will be once a week. EXCIL plan to work a month ahead of ALSTOM's schedule with their suppliers.

EXCIL has six suppliers for the WCML contract.

Supply is a problem for EXCIL - in particular, there is a high degree of lateness. Their contract is two weeks behind already because the work of one contractor was defective (causing a door's studs fall off). ALSTOM's schedule does not allow for unforeseen occurrences of this sort.

EXCIL is also having problems getting electronic components in the UK and is having to source to India. There are agencies available that search for specific components.

EXCIL has standard contracts with suppliers although it is now also looking at partnering style contracts.

Risk

Risk is passed to EXCIL via a RAMS specification (Reliability, Availability and Maintainability). EXCIL must report to ALSTOM predicted reliability and agree targets for the train's life. EXCIL uses a military hand-book for reliability measures.

It's not just a question of supplying fluorescent tubes!

EXCIL must do shock and vibration tests on all equipment. Equipment is also tested for electromagnetic interference as part of the safety case. An inventory of combustible material must also be provided to ALSTOM. This in itself is a complex issue. While so much combustible material is allowed – how much is also dependent upon where it is located. Higher amounts of combustible material are allowed in an IP 55 environment (sealed against dust) as the material cannot escape and set fire to other materials.

The series build

The pre-series train was started in Jan 2000. This should have finished July 2000. Pre-series 1 and 2 was expected at the end of October 2000.

Pre-series 2 should finish in September. Surprisingly, suppliers like EXCIL were unsure of the build stage ALSTOM were at.

There are 53 trains - 44 8 and 9 9-car trains. The pre-series are 2 9-car trains.

ALSTOM supplier management

ALSTOM 'Suppliers Management Engineers' (SMEs) visit EXCIL once a week to check their performance. SMEs look at documentation and products - in the future they will also be getting involved with EXCIL's suppliers. Supplier managers raise problems but do not get involved in technical issues.

Long term supply

From EXCIL's perspective, it is not possible to guarantee the supply of parts for thirty years. Moreover, there are IP issues over the driver (which is patented) so EXCIL do not intend to hand over complete technical drawings.

The parent ((LPA (inter car jumpers))) takes over responsibility if EXCIL go bust.

Stretch 30

EXCIL have not yet done a Stretch 30 exercise for WCML, however, they have done so with ALSTOM for Juniper. *"In the end the good ideas did not get implemented... Who is going to pay for the good ideas?"*

WCML is EXCIL's most troublesome contract with ALSTOM because of the level of variations. The cost for tooling to make small changes to a fitting can be enormous (£30,000 + design time). Much design work is constrained by what has already been designed and by the incentives created by lock in to existing tooling.

Improvements ALSTOM could make

ALSTOM has used various wattages and styles of lamps – each one requires its own inverter. The WCML team was new and generally inexperienced – they were driven very much by the Red Book – perhaps should have questioned PG more.

Energy efficiency

Energy consumption on trains is a concern for emergency conditions. Dead sections between sub-stations also mean that the train must be able to run lights and other systems on battery back up. EXCIL products are 90% efficient allowing more time for a rescue (1.5 hours is estimated to be the maximum time to get a rescue vehicle out to a stricken vehicle). The vehicle also has stages of shut down and EXCIL also supplies the equipment which controls this.

Learning

Design notes, calculations and write-ups of the procedures behind all decisions are kept on file.

There is also a learning history embedded in the products themselves. “*When you have designed so many products a new request does not mean starting from scratch. You think, what have I got that’s similar*”.⁴⁵

There are also ISO9000 procedures for design, manufacture and test. All designs all follow the set sequence laid down in the quality manual. Changes of design are also proceduralised. All contracts are thus conducted in the same way - making the lessons they have to offer more accessible.

Meetings also have standard forms and standard agendas.

The benefits of being Customer driven?

“WCML has the highest number of variations I have know on any contract”.

Reliability conference

Cancelled

⁴⁵ An excellent quote illustrating the engineering design process in practice.

INTERNAL SUPPLIERS

INTERVIEW WITH RICHARD SIMPSON, ALSTOM TRACTION 070201

Present: Neil Alderman and Chris Ivory.

Richard Simpson

Background as a mechanical engineer and graduate trainee. Worked as a project engineer on bogies with Adtranz, then 7 years at Alstom, Birmingham. Moved into project management on the ScotRail project and then dealt with the pantograph on WCML. Moved to Preston as project manager for WCML at Traction. This background has provided a wide experience of different aspects of the train.

“need enough fingers in enough pies to answer the right questions”

Alstom mobility scheme

Project managers tend to move around the company. There is no structured policy of movement, but staff can apply for 2 year placements in jobs advertised within Alstom. Relocation assistance is given for employee and family.

Alstom Traction

Traction was bought by GEC in the 1980s and subsequently became part of Alstom. Traction also supplies to Bombardier for the Virgin CrossCountry franchise. Bombardier attempted to acquire a traction capability through acquisition of Adtranz. Whereas Alstom, Birmingham, has tended to specialise in the UK, Preston has tended to Internationalise its efforts, in particular in transferring build processes into local facilities elsewhere in the world. Recent restructuring by Paris has decreed that Preston Traction will now focus on Metro vehicles. High speed traction will be the responsibility for the ex-Fiat facility. Preston's skills in transferring technology have led it to be handed the Metro engine focus. Different engineering skills would have been a poorer way to differentiate the sites. WCML has a project team of 25 at Traction. In total, 500 people work on service and renovation on site.

West Coast Mainline Power Unit

25 kV AC power supply. Alstom Traction supplies everything required to get the 25kV input to tractive effort on the rail. Alstom Traction provides the transformer, roof equipment, including vacuum circuit breakers, and the main transformer which converts 25,000 volts to 415 volts. The real expertise lies in the electronics in these systems. Traction also provides inverters and traction motors (i.e. all of the black

boxes which bolt to the train). Major components are sub-contracted to mainly internal companies. Control software is outsourced to Villeurbanne in France, which is an Alstom company. Isolated bi-polar gate transistors are sourced from Tarbes in the South of France, and traction motors also come from France.

Transformers come from the US, part of the transmission and distribution arm of the company. There are some problems here – this arm of the company is more used to the power station market and high volumes. For West Coast mainline they are only producing 50, a non-standard design with non-repeatability, making it uneconomical for them to sink engineering effort into the project. Consequently they have little interest in cost-reduction programmes worked out with Alstom traction. One way of defeating this situation has been to tender outside the company at the same spec., and having gained a lower price, negotiate with Alstom companies to lower their prices. In this case the transport arm of the company negotiated direct with the transmission and distribution arm of the company to instruct the US plant to lower its price.

Another example is ScotRail. The Spanish body shell plant was quoting £10.5 million for 120 body shells. An external Hungarian company was able to quote £6.5 million for the same job. The internal company could not compete. The policy on outsourcing is unclear on the ground. There is a presumed figure of 15% for cost reduction but this is unconfirmed within the company on the ground. Outsourcing tends only to be pursued if there have been particular problems on cost or delivery with an internal company or there is a capacity problem.

External Suppliers

External suppliers tend to be critical in terms of delivery rather than in terms of availability of alternatives. *“There are over a dozen companies locally whom we could go to for fabrication.”* Fabrication was outsourced due to a scaling down of staff. In the late 1990s Alstom Traction lost engine building, although they designed the West Coast Main Line engines, and focussed on propulsion casings and auxiliary converters as a core product base. Most engine production was moved to France. Alstom Traction can be seen as a systems integrator for the drive system. It integrates components, tests and validates and supplies the complete system to Washwood Heath, where the traction system is integrated with the brakes systems and the rest of the underframe.

Customer Specification

BR were highly descriptive in their specifications. These were easy to deal with and to roll out to suppliers and to manage thereafter. New customers like Virgin, HSBC, Porterbrook are quite different. They tend to hand out performance specifications including such things as noise levels, journey times, passenger comfort requirements and so on. These traction requirements tend to drop straight through Alstom Washwood Heath to Preston, although the two sites tend to work carefully together at the tender stage to help define what can be specified. The Washwood Heath plant can not do this with an external supplier, which is one reason why the brakes and air conditioning systems end up so expensive.

This process leaves the risk with Preston. At the same time, because there is no prescriptive specification, external design and supply suppliers will raise their prices accordingly to accommodate the risk. Preston's risk is mitigated by involvement at the tender stage. At the tender level Alstom Traction is regarded by Alstom Birmingham as very much a sister company as opposed to an internal supplier. Contractually, there are no performance penalties passed on to Traction. Neither is there any financial fall out for it as a separate business unit. Business unit finances are transparent to other units and it is recognised that a failure to deliver will damage internal relations. Employees at all levels of Alstom Traction are aware of their business unit's performance. A penalty hitting Washwood Heath as a result of poor performance at Preston would affect Traction's standing within the organisation.

At the tender stage Alstom Traction simulated the traction system based on data on the route profile, weights etc. in order to identify the specification needed to achieve a particular journey time. One issue to be resolved was how to distribute power down the train within a given space envelope. This led to the proposal for an 8 rather than 7 car formation.

Interface Management

There are mechanical interfaces with the body shell including fixings, cabling, power requirements and other systems. Alstom Traction also takes responsibility for rolling out detailed specifications to lower tier suppliers.

Design Fixes

Defining the space envelopes with Alstom Transport is an iterative process. Spaces are negotiated with the underframes zone. Interfaces also have to be checked and re-checked for correct meeting of connectors, correct control signals and so on. Alstom Transport tends to take the lead in driving changes and will often then begin to treat Alstom Traction as a supplier rather than a sister company. Nevertheless, Alstom Traction expects to be paid for variations. Payment is against a schedule, like any external supplier. There is a fixed price contract, with an initial payment followed by a final payment on delivery.

Contract

Contracts tend to be weak in capturing the promises made at the tender stage. There tends to be an unclear specification against a clear price. At a later stage the client will look in detail at what it is they've actually bought. Quite often there is a discrepancy of interpretation. This problem stems partly from the fact that the customer does not necessarily understand the details of the design. The client themselves may also be divided as to those parties who put the train into service and those parties who define the spec. The unified delivery of specifications by companies like BR and SNCF no longer exists. Lack of experience perhaps makes it difficult for the new breed of customers to define clearly exactly what they need in technical terms.

Maintainability

Maintainability and design issues go back to the London Underground contract seven to eight years ago. These hinge on a 35 year service provision. Consequently more focus was placed on design for maintainability and reliability. Design for maintenance is regarded largely as good practice and common sense. Under BR practice these issues tended to creep in at the review of drawings stage. There are also maintainability reviews structured into the design process. For West Coast mainline, West Coast Train Care staff specified at an early stage what they required in terms of maintainability.

“These are the things we’re going to be taking on and off the train. Are they accessible in a reasonable time?”

Pressures to finish designs within certain time limits do tend to mitigate against the quality of this input. On West Coast Mainline, only the major issues have been dealt with. Any further changes have had to be balanced against the time they will add to the build in terms of variations to suppliers with existing specifications. West Coast Train Care does not have the authority to force that change. It is not the organisation with responsibility for delivering the build on time. Maintenance issues are raised at the regular project level meetings. These meetings will include the TMS suppliers, Fiat, Alstom Traction, the Project Team at Alstom, and West Coast Train Care.

“More often than not, it’s just a phone call – can you do this or that? Yes we can – we’ll get on with it, and so on.”

West Coast Train Care staff will inspect the train while it is on the line and ring Traction is anything requires attention. One example included a breather gel cartridge. The strap holding the cartridge to the underside of the train was deemed not robust enough for maintenance purposes (i.e. continual un-doing and doing up). The cartridge fits to a pipe or a transformer. The strap still had to be quick release however, and a more robust quick release mechanism was sought. It is however difficult to assess long term costs and benefits. Alstom Traction nevertheless has to deliver a reliability plan through calculations and simulations to assess how its equipment stacks up against the overall reliability targets (permitted levels of failure) for the train. Problematically, these reliability targets tend to come too late for the design process, once first build and testing is already underway. This implies the need to revisit existing designs. If maintainability and reliability targets are not defined at the outset, cost to Alstom Transport will inevitably be added through variations when designs are revisited. There is a problem of converting these aspects of the client contract into adequate specifications for suppliers. Noise and waste are also issues which need to be broken down and apportioned at the beginning of the design process at Alstom Transport.

In principle it is possible to model these issues, however such modelling takes time and resource. Alstom Transport and other train manufacturers are spread extremely thin across a large number of potential bids. There are many train operating companies who are pricing tenders for new and renewal franchises. Moreover, having

asked for a tender, a customer will typically “*go away for 2 months, come back and want the train tomorrow*”. Clearly this impacts negatively on the lead time for design. The solution to this may be to systematically model the apportionment of particular requirements at a stage before the tender is accepted. Because train systems: air conditioning, brakes, pantograph and so on are relatively standard, apportionment can be modelled from experience. At the moment that source of knowledge simply isn’t collated into a single system. Having said this, an apportionment model for reliability based on previous experience at La Rochelle, has been transferred into West Coast Main Line. Based on this experience, the model determines that x- percent of reliability problems are associated with doors, y percent with traction, and, say, two percent with the driver’s seat (because there is only one). This provides a scenario for new build project teams to work from. Building these models requires off-line R&D effort. It was argued that the dimensions of this sort of knowledge are not easy to capture.

“I am sure that the reliability model ... is something that has been lived and breathed for a number of years”

Nevertheless, as Alstom Transport increasingly gets into service provision, reliability data will become increasingly available (for example, all failures on the Northern Line have been collated on a single database). To do this, West Coast Main Line will be using a system called ‘Fracas’. TMS (the Train Management System) is distinct from this system. TMS has 3 levels: driver information (e.g. direct action requirements), maintenance information and the lowest level engineering information. Fracas has been in use for 3-4 years. Fracas stands for Failure Reporting Corrective Action System. The engineering level on the TMS allows the parameters of the train to be adjusted. Fracas on the other hand is an internal Alstom universal System.

Stretch 30 and long term costs

Alstom Traction has its own sourcing manager who is involved with Stretch 30. It was felt that Stretch 30 exercises can sometimes interfere with the required specification of a given item. Stretch 30, like all activities which interface with the design process, must be balanced against the cost of making changes in order to achieve savings. The tendency is often for engineers to feel “*that they are having their legs chopped from under them*”. Engineering culture has proved resistant to attempts to reduce specifications. It is a learning process for them that “*they don’t need things to be gold plated*”. Nevertheless there have been instances in which Stretch 30 has given engineers ground for resistance. One Stretch 30 initiative reduced the specification of the fabrication holding the 100s of relays to the train. Stretch 30 introduced a wire clip, the clip having to be stretched over the relay to hold it in place. Ultimately the wires were overstretched during installation and the clip would come loose, causing an intermittent fault on the train which was particularly difficult to locate.

Performance based specifications may be responsible for ultimate over specification as engineers try to ensure that they’ve covered all eventualities. Alstom Birmingham may be guilty of not making enough upfront effort to analyse long term costs, reliability of suppliers, and so on. This it was argued may be due to lack of

experience. Many traction engineers have been in the business for 12 years or more whereas many of Birmingham's designers are relatively new. Lack of experience tends to lead to over-specification in design. A focus on first cost also arises from a lack of incentives to better the targets in the contract. It was suggested that reliability improvements over, say, a five year period could be financially incentivised.

Delivery schedules

Alstom Traction works to delivery schedules provided by Washwood Heath. These are found to be unreliable. In practice a lot of reliance is placed on personal communications with Washwood Heath. The project manager is in Birmingham once or twice a week so this contact is very close. This causes resource allocation and supplier payment problems for Alstom Traction as delivery schedules are built into its business plan and supply chain management *"Alstom will speed up or slow down. We have little scope for reaction"*. There is however some flexibility in dealing with suppliers. Each supplier has a 30-day fixed delivery agreement plus a further 30 days for payment for materials (this does not apply to labour costs). Whereas purchasing staff tend to understand that the supply chain cannot be switched off, those trying to expedite the materials into the company do not. Alstom Traction has no storage capacity. Alstom Traction cannot afford to pay a third party to store materials which it has paid for and have not been paid by Alstom Transport. Alstom Traction has a core of long-term suppliers underpinning trust and co-operation between all parties. Alstom Traction's suppliers *"don't expect to get turned over on this arrangement"*.

The Alstom Birmingham supply base has yet to get to this level of trust. Despite changing philosophies, the Birmingham supply base tends to reserve judgement on collaborative approaches. Internal suppliers have been more problematic for Alstom Traction. When Alstom Birmingham has blocked supply for whatever reason, Alstom Traction's internal suppliers have been inflexible and have taken a *"tough, I'm sending it anyway"* approach. There is no *"competitive edge or customer friendliness"*, primarily because internal suppliers know that Alstom Traction will have to go to them again anyway. Internal suppliers also tend to lack visibility in terms of their capacity issues or any local difficulties they may have. Internal suppliers tend to keep any major problems *"under a table"* until the delivery date arrives.

THE PERSPECTIVE OF THE ROSCO

Interview with Ian Knights - Project Manager West Coast, Angel Trains

02 April 2001

Roger Vaughan and Neil Alderman.

Background

Ian Knights is Angel's project manager for WCML and has been with the organisation for two years. Prior to that he had experience of major projects in offshore and power, with an emphasis on detailed inspection and quality plans, which were new to Angel.

Angel regards itself as a supplier of services: financial, legal, project management and engineering. In addition to the WCML it has three other contracts with bank finance, although these are less than £100m.

The railway industry has changed considerably since the BR days. Then it might have taken five years to get projects right.

Development of the WCML contract

- Even before Virgin won the franchise in 1997 they had a technical and commercial team in place together with financiers to write the Red Book. Angel got involved at that stage through its consultancy arm to prepare the Red Book with Virgin and a Train Supply Agreement (TSA see Annex). The TSA looked at the specification for the delivery of the train and maintenance over the life of the franchise. At that stage Angel was not the preferred bidder for funding for the deal. Just had three people working with Virgin on a consultancy basis.
- Those preparing the Red Book had previous experience with the London Underground, where ALSTOM had a lead in through its Northern Line contract. Staff were recruited from ALSTOM or the London Underground along with some of those involved in the East Coast Main Line upgrade. Although the Northern Line project delivered late, it is now one of the better elements of the underground system for reliability. This new process has been somewhat personality led in that groupings that knew each other actively looked for a better way of doing things.
- The outcome was a contract for supply of the train of about £600m and for maintenance over franchise period over 15 years in excess of £600m.
- The TSA went through and specified what Virgin wanted for the maintenance of services and agreed that ALSTOM would take over existing maintenance services

which Virgin had inherited - Mk I, II, II and other trains on the West Coast as well as for the 53 Pendolinos.

- Contract documents were pulled together in February 1999, the TSA and Red Book had been continually developed. Three other documents, Sale and Purchase Agreement (Angel and ALSTOM group including Fiat). Angel is the owner of the trains, TSA is between Virgin and ALSTOM; Lease Agreement between Angel and Virgin Rail; Train Recourse Agreement which pulls all three parties together.
- The parties to the agreement include OPRAF now SRA, in case Virgin Rail becomes insolvent – who do we Angel go to get payment for our lease – SRA as last resort until another franchise can be set up. This is not statutory funding.
- When the agreement was set up in 1998 the agreement with ALSTOM was that Angel was the preferred funder and through RBS put capital in to get the contract set off. After the contract was signed Angel went to the market to get various types of funding – bond holders to pay back the substantial part of that funding. (see Annex)
- A down payment was made by Angel of 50% of the contract value - from RBS - £280m.
- They were therefore involved at a very early stage in the project conception.
- From February 1999 Angel moved to fund the contract and securitise that asset – bond holders, senior subordinated debt from RBS (guaranteed by European Investment Finance) and junior subordinated debt from Angel Leasing (with RBS sitting behind Angel) agreed September 1999. Bondholder funding came from the market and all monies returned to RBS to offset payments made and the rest put on deposit until needed. Angel is not a quoted company.
- Financing agreements are complicated - with very sound legal advice. Commercial contracts to get the trains and provide the services supported by financing contracts.
- The trains have a 35-year life. SRA agreement with Virgin for 15 years. Next year when they are in service there will only be 10 years remaining – so Angel have to look at the remaining 25 years and so want to ensure the highest residual value at that point to minimise the capital payment made by Virgin. It has to be a tax efficient deal and maximum residual values. That's why it was decided to go down the route of getting the manufacturer to maintain the trains. He would be exercised that if he had to maintain them he would want this to be easy with a reasonable maintenance interval. If Virgin get the next franchise it would be 15 years+.
- What experience was around to estimate the value after 10 years? The high-speed trains built in the sixties are still running so there was data on mtbf. But what about a competition between a depreciated train and a new train for a new franchisee. Angel looked at the depreciation of those trains and estimated that a

new franchisee would not see a new 10 year old train say depreciated to 80% as anything but cheaper than a new train costing perhaps 50% more than today. Its unlikely that after 10 years that anyone would be able to do better and the physical dimension are restricted so can't put a longer train or a wider train so won't be better off replacing them. However, this exercised a lot of peoples' minds. It was a major piece of risk analysis by RBS, Angel, by Virgin and the lenders.

- This deal broke the mould. Other people are considering it as it goes forward with the idea of a service provider rather than a manufacturer and a maintainer at your risk. Other franchise holders are in that position at the moment. Angel undertake the C6 maintenance at the 500000 mile mark under the lease but all the general running requirements and general maintenance – either the manufacturer does it or someone does it on his behalf.
- Angel has a contract to build them a train and provide a service to Virgin. If the manufacturer doesn't supply the trains on time there are liquidated damages and other provisions. In the service agreement there are liquidated damages if he doesn't get the right number of trains on the track when Virgin want them or repair them on time. Virgin's interest is in having a train that will work out of the box and is highly reliable for the first twelve years.
- Aircraft leasing is generally 8-10 years - we are moving to much longer periods that gives more financial stability say for pension fund involvement. A lot more bankable. We have other contracts where funds have been let by other banks but this is the only one fully securitised other than assets brought in from our previous ownership by Nomura.
- Angel is by far the biggest provider of rail leasing finance and expects to repeat the WCML model.

Project management

- Angel trains interest at the moment is looking at the build of this train and its long-term life of 35 years. Systems on the train are clearly going to fail – traction motors will be replaced – but all we need to know is that the next generation can be fitted. We are looking at the body shell integrity, is it going to flex over a period of time and fatigue? As project managers that is our long-term interest – not Virgin's.
- There were a number of bidders on the table in 1997. The MK IV bogies were provided by Sig of Switzerland the latter is now owned by ALSTOM/Fiat. There was confidence that the high-speed bogies would be reliable. Angel looked at the technology and was happy with Fiat who had been producing tilting bodies for twenty years; the bogies were good, the tilting bogies have European operating experience in Switzerland so we had confidence in the major bits of the technology.

- Washwood Heath is ALSTOM's fit out plant that means that if something is wrong it could be ripped out and replaced. They have now implemented an assembly line approach following the example in the aircraft and auto industries.
- Q. Other projects haven't had the happy coincidence of individuals so in trying to routinise the process how can the project integrator role work? After the contract stage people pull back and look after their own risks which they can manage with responsibilities being mediated by the contract. Angel pushed ALSTOM very hard to establish a 'hospital bay' for delinquent vehicles. It took ALSTOM nearly a year to agree with them. Assembling PS1 going down the assembly line they had one of the large control modules alongside the line. The overhead crane came down the shop to lift it, it had something dangling down, and smashed into it and buckled it so that it couldn't be installed. It took the manufacturer six weeks to provide the next one off the line. So the production line was held for six weeks and then ALSTOM agreed that it would be useful to establish the hospital bays.
- Angel accessed the French president of ALSTOM if it became necessary which on occasions it has.

Engineering overview

- We recognised that Angel and Virgin's interest were about 90% aligned. Their interests are the initial term, ours the very long term. We agreed that Virgin would be the project managers as Angel's managing agents. They do the day to day overseeing of the build of the train; I oversee what Virgin do from a long-term perspective.
- If they take too short term a view I get them to check things out or arrange changes through ASLSTOM. E.g. there are some attachments to the under frame that Virgin had accepted but we refused. This is not acceptable – only six bolts are fitted that will corrode and fatigue. The equipment could come off a train travelling at 140mph – this is not acceptable – it will need to be re-engineered before we will accept the train and our next stage payment to ALSTOM will depend on its resolution.
- Finance for the Bombardier Voyager trains was through NatWest which is now part of RBS. They had used a TestCo to oversee the project. Angel has moved from that position to having an engineering staff of 50. Angel will get some of the TMS output on the reliability of systems – looking for 50000mile between failure. Angel has been involved in the maintenance and design review.

Acceptance

- This is a three-part process:
 - i) first inspection is by the maintenance people
 - ii) second inspection is by Virgin Rail Group (dealing with customer perceptions)
 - iii) third inspection is by Angel concerned with long term life e.g. the fatigue life on welds.

- Q. Do you share a mutual interest with the Railtrack vehicle acceptance process or do you have some special interests – do they conflict? Angel's interests are greater rather than in conflict. Ours are the long-term life of the train. Virgin and Railtrack have to make sure under PUG2 that tilting trains can pass for example. Angel would be interested if something goes wrong with the train, corrosion damage to components for example leading to an impact on another train from a different fleet.
- Angel has a copy of PUG2 but no contractual involvement.
- Q Who takes the insurance risk for write-off of vehicles e.g. if there is an accident? There is an insurance agreement which gives Angel a proportion of the value (close to 100%) back, Virgin have an interest because they still have to run the service. Original contract is 53 trains and 46 diagrams so there are trains in reserve – for training, for maintenance and an element for damage just a contingency reserve.
- We see ourselves as a service provider. When Nomura owned us we were very much a supplier of services into the marketplace. The RBS ownership has extended our services to finance and engineering, legal and project management services.

Maintainability

- Angel look at maintenance histories, particularly the reliability of systems of which there are around 35. A failure is defined as anything that sets a train down for five or more minutes. There is probably about one failure per month. Angel is involved in major design reviews along with Virgin, the Train Service Provider (WestCoast Traincare), ALSTOM and external consultants. These reviews assess potential failure modes through a series of 'what if' scenarios. Angel is effectively concerned with everything from the sole bar to the rail. Whilst the risk lies primarily with ALSTOM, Angel takes on long term life and safety risks.

Human resources

- ALSTOM had the experience of Northern Line prior to their Virgin contract – a lot of the people who were involved in the preparation of the Red Book had a background in London Underground so there are a number of aspects here of people who tried to break the mould. They made some progress in London Underground. The trains were delivered late but four years down the road the reliability of NL is one of the highpoints of the whole system. Physically that seems to be working. People working on both the technical side, maintenance and the commercial side got together and started drafting what eventually became the TSA. They worked either for ALSTOM or Virgin hired them from LUL. Virgin also brought in many people from the ECML upgrade. Angel was involved in that through their previous MD Dr John Prideaux who had been responsible for ECML. His leadership led to moving down this route – a departure from the way

BR had worked – financier, manufacturer, maintainer got together and said there must be a better way. Whether this is the way for the future is yet to be demonstrated.

Innovation

- The main innovation in leasing terms concerns the longer time periods involved and a greater stability for the finance provision. In technical terms Angel had a good look at the core technologies – the bogies (the Mark IV bogies came from the Swiss company SIG – part of Fiat – and there was confidence in these) and the tilt mechanism (the Pendolino had European operation under its belt).

Lessons learned

- Walls between design, manufacture and maintenance still exist within organisations;
- Involvement in design reviews is essential – need to assess why changes may be needed;
- The managing agent role seems to work (Virgin is in a very good position with PUG2).

RV/NA/07 Sep 2001

Annex : Extracts from “The procurement, financing and leasing of advanced tilting trains for Virgin Rail group’s use on Britain’s West Coast main Line”, Studies in Leasing, Law and Tax, John Vale, Angel Train Contracts Ltd

- The infrastructure owner Railtrack is responsible to Virgin for the up grading of the track and thus enabling trains to travel at speeds of up to 140mph.
- Angel is funded in this (..project..) by the issue of £482m senior secured bonds, £29m of senior subordinated debt from its parent the Royal bank of Scotland (RBS) and £76m of junior subordinated debt from Angel itself. The European Investment Fund (EIF) is guaranteeing the senior subordinated debt, RBS has provided undertakings in respect of a fixed pattern of group relief payments and RBS has made a £40m liquidity facility available.
- Prior to the award of the West Coast franchise the SRA (formerly OPRAF) agreed with Railtrack an upgrading of the Track which would accommodate trains running at speeds of up to 125mph and tilting.
- The successful Virgin bid however took things further and was based upon trains running at 140mph and tilting. A further agreement was entered into with Railtrack to accommodate the higher speeds and a unique revenue-sharing

payment scheme was agreed between the parties instead of the conventional access charge.

- A sale and purchase agreement exists between Angel Leasing and the manufacturers setting out the terms of the train purchases. An operating lease exists between Angel Leasing (Angel Trains 100% subsidiary) and West Coast Trains Ltd (Virgin Rail Group 100% subsidiary). The manufacturers have entered into a revolutionary Train Service Agreement. ‘Revolutionary’ because this is the first time this type of agreement has been used in the ex-BR industry.
- The Train Service Agreement (TSA) is fashioned on the London Underground Line Contract under which Alstom is providing fully maintained and cleaned trains to LUL on a daily basis over a 20-year period. Another Angel subsidiary ATC Consulting assisted West Coast Trains in the procurement of the trains. West Coast Trains selected the manufacturer/maintainer ahead of selecting Angel as lessor. This resulted in the TSA being the principal document, containing as it does, the performance specification of the trains, delivery arrangements and details of the maintenance and performance regime.
- At the time the commercial arrangements were being finalised the long-term funding arrangements were not in place. RBS provided Angel with a short-term bridging facility that if necessary could have been extended to the full franchise and primary lease term. It was always the intention, however, to access the fixed sterling capital markets and consequently it was necessary to incorporate the likely requirements of the capital markets into the commercial structure.
- The sterling markets have been accessed before to fund rolling stock in the UK. Angel securitised its original portfolio of assets in two issues shortly after it was acquired by Nomura in 1996, and more recently Porterbrook successfully accessed the market to finance stock. However, in each of these previous issues either the stock had already been in operational service or, where the trains were still under construction, bank funding was used to finance the build period. In the case of the West Coast Trains transaction, however, the capital markets also provided the build period finance.
- Another unique and groundbreaking feature of the West Coast Trains transaction is that the stock financed is a single fleet on lease to a single operator. In all previous securitisations the rental stream came from a portfolio of trains with a number of customers.
- To achieve this cost effectively it was necessary to implement a structure that ensures the bondholders are paid out under any likely scenario. The manufacturers’ support for the obligation of their subsidiaries, coupled with surety and bank guarantees achieved this. Together, the surety and bank guarantees were sufficient to ensure that in the event of the manufacturers’ failing to perform and the contracts being terminated, the bondholders would be fully repaid.
- In the event of lateness, the party responsible for the delay is responsible for the payment of liquidated damages to Angel in an amount equivalent to the lease rentals which otherwise would have been payable but for the lateness. This,

coupled with the surety bond and bank guarantee, removes the major element of noteholders' exposure to train delivery and build risks.

- Besides providing bondholder security, these arrangements provide strong incentives to ensure that the manufacturer delivers on time. This is achieved through the liquidated damages regime and the balance of the purchase price being paid only on acceptance of the trains.
- As mentioned above the manufacturers have entered a fixed price index-linked maintenance and availability contract up to 2012, known as the TSA. It covers a set of stringent criteria to be met day to day. If the trains do not meet the standards, the manufacturers are liable to West Coast Trains Ltd for liquidated damages.
- At the end of the lease term whether or not it runs its full course the trains must be returned to Angel in a state consistent with the agreed return conditions. Essentially maintenance must be fully up to date and the train must be consistent with the original specification, except where altered by agreed variations.
- The investors can take comfort from the regulatory environment. Under section 30 of the 1993 Transport Act SRA has a statutory duty to continue to run train services in the event of default by a franchised operator. The Act does not specify that exactly the same services have to be run, but without continuing to operate the existing trains it is difficult to see how else the SRA could satisfactorily discharge its obligations.
- So important is this obligation that the Franchising Director has entered into a Direct Agreement with Angel Leasing. In the event of a default by West Coast Trains which results in Angel Leasing terminating the Operating Lease, the Franchising Director has the option to step into the existing arrangements and take the trains on lease at the existing rentals.
- The capital structure is typical of other UK securitisations with the special purpose vehicle, West Coast Finance plc (issuer), lending the proceeds from the issue of the notes via a fully secured inter-company loan to Angel Leasing co Ltd (borrower). The borrower is further funded through senior subordinated debt of £29m from RBS, re-payment of which is guaranteed by the European Investment Fund (EIF), plus junior subordinated debt of £76m from Angel Train Contracts.
- Since Angel was not rated, RBS entered into a group Relief Agreement by which a fixed cashflow of group relief payments will be made into the structure.
- Further facilities were established in the form of a £40m liquidity facility and a Guaranteed Investment Contract (GIC). The GIC was designed to ensure that the borrower entered a fixed rate of interest on surplus cash. As discussed the surety bonds issued by New Hampshire and the RBS issued performance bonds were designed to ensure that even in the event of non-performance by the manufacturers the bondholders would get paid out.

- Three ratings agencies were used to rate the bonds: Standard and Poor's, Duff and Phelps and Fitch IBCA. They prescribed ratings of A, A+ and AA respectively, the spread partly reflecting the reliance on RBS and the different ratings ascribed by the agencies to the bank.
- The issue raised £482m and represented the largest single tranche of fixed sterling notes ever issued.
- Using the proceeds from the issue the borrower has been able to repay the original bridging loan from RBS. The remaining surplus balance of monies staying on deposit until such time as the trains are accepted and the subsequent acceptance payments fall due. On acceptance of the trains, title passes to the borrower.
- The bondholders enjoy first and fixed security over the new trains, the cash accounts and the commercial and securitisation documents and a floating charge over all the assets and undertakings of the issuer and borrower.
- To further protect the bondholders there is a prohibition on distribution to parties ranking behind the noteholders:
 - until acceptance of the last train
 - upon occurrence of an event of default under the secured inter-company loan
 - if the six month debt service cover ratio is less than one and a half
- Furthermore, cash balances held by the borrower and the liquidity facility held by the issuer together represent nine months of debt service cover.
- The issuer has also given certain covenants, including a negative pledge, restriction on activities, no disposal of assets and no variation or waiver of rights under the documents.
- The bonds have a weighted average life of 10.4 years. During the construction period of the trains semi-annual interest only payments are due. Thereafter semi-annual capital and interest payments are due resulting in the bonds maturing in March 2015, three years after the franchise and primary lease term. The investors were persuaded to accept the residual exposure at the end of the primary lease term in 2012 on the strength of the outstanding debt to residual value ratio, the residual value itself being governed by the probability of alternate equivalent stock being readily available.
- The lease term expires at the same time as the current franchise agreement in March 2012. Before that time SRA will invite bids and award a new franchise. Angel has covenanted that it will not enter into a lease that is less financially attractive than the current lease with WCT. As there is unlikely to be any comparable fleet of trains in the UK at the time and as the Pendolinos are required to maximise the economic value of the franchise, the winning bidder for the franchise will be economically motivated to lease the Angel Pendolinos.