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Engineers versus Industrial Designers: The Struggle for Professional Control over the British Railways Mark 2 Coach, circa 1955–66

The railways offer rich opportunities for understanding how professional rivalries shape the design of passenger vehicles. As Greg Votolato has observed, a vehicle provides an artificial carapace protecting the fragile human body-in-motion from the external environment, while the interior offers a space satisfying users' practical and emotional needs.¹ With a railway coach (or carriage – the terms are interchangeable) these two elements are closely connected: the engineered body, underframe and running gear (wheels, suspension, brakes and so on) not only affect passengers' comfort and safety but also in some degree constrain internal layouts and facilities. Historians such as John H. White and David Jenkinson have acknowledged this relationship in their accounts of, respectively, US and British railway vehicles, but these and other scholars have tended to skate over the design *process* linking the two dimensions.² This is particularly true for the period from the late 1920s when (at least in Britain) the emerging profession of 'industrial design' started to challenge engineers' long dominance of coach design. This article analyses a later stage of the struggle between these two groups through a study of one of the most important vehicles on Britain's post-war, nationalised railways, the British Railways (BR) Mark 2 (Mk2) coach.

Designed from the late 1950s, introduced in 1964 and built until 1975, the Mk2s were a key in the mid-1960s transformation of BR's longer-distance passenger services into Inter-City, a profitable and internationally recognised brand. Later variants of the Mk2 continued in everyday service well into this century and a few are still used on the national network; the UK's National Collection of historically significant vehicles holds a Mark 2d from around 1970. Historians have paid the design some attention. The standard history of BR engineering sketches the technical context and hints at the important but troubled part played by industrial designers, while David Lawrence's recent study of the latter's role within BR makes some

passing references to the Mk2 and its precursors.³ Michael Harris's detailed history of the coach is more forthcoming about the relationship between industrial designers and BR's engineers but does not offer a systematic analysis of the complicated dynamics.⁴ This article therefore builds on Harris's account by arguing that designing the Mk2 was a struggle over professional *jurisdiction*.

For the historical sociologist Andrew Abbott jurisdiction is the key to understanding how and why some occupations achieve professional status: jurisdiction gives specialist practitioners control over their work, from which flow all the other social and economic attributes of professional standing.⁵ Jurisdiction means an occupational group has gained the power to define: what problems fall within its remit; the formal, conceptual terms within which such problems are codified as knowledge; and therefore what in practice constitutes an acceptable outcome. But achieving and then maintaining jurisdiction is not easy. In particular Abbott dismisses the claims of earlier scholars that professionalisation follows, or even approximates to, a regular sequence of establishing, for instance, ethical codes of practice, academic training programmes, entry exams, vocational licensing, and so on. While common, such developments must always be understood in their historical contexts as elements of evolving systems of *competing* occupational specialisms; jurisdiction usually involves one occupational group winning the power to define technical tasks in the face of opposition from other groups undertaking broadly similar work. A specialism creates and maintains the exclusive, jurisdictional link with 'its' work by exploiting historically contingent formal and informal social structures, practices and discourses. This often requires endorsement from other powerful, non-professional social groups including, for example, employers or government. And as Abbott emphasises, even established professions can face threats to their jurisdiction, either from insurgent occupations trying to wrest control of all or some of the

incumbent profession's realm of practice, or from corporations or bureaucracies seeking to reduce the autonomy of the professionals they directly employ or hire as consultants.

The BR Mk2's design history offers ample evidence of such jurisdictional disputes. It is most obviously a story of how after the second world war British industrial designers mobilised the state's resources in the shape of the nationalised British Railways in order to consolidate their uncertain professional status.⁶ Like their counterparts in, for example, the United States, industrial designers had started to claim a distinctive identity from the late 1920s as manufacturers sought to expand markets by encouraging emulative acquisition among increasingly differentiated groups of consumers – 'Keeping up with the Joneses'. Designers turned functionally similar products into desirable commodities by imaginatively reworking objects' forms and surfaces; the classic example being the streamlined aesthetic of the 1930s. On this reading, industrial designers' would-be professional status was inherently tied up with not only the economic vicissitudes of manufacturing but also the problematic ethics of 'excessive' consumerism.⁷ Working from the mid-1950s in a public-service organisation like BR arguably improved British industrial designers' position on both counts. But it also inevitably involved them in a drawn-out jurisdictional dispute with the specialism that had previously dominated railway-coach design – mechanical engineers.

We should not assume that this rivalry played out in a similar way in other countries, for in Britain the railways usually built their own coaches and employed the engineers who designed them whereas elsewhere, including in the US, the latter more often worked for private-sector rolling-stock manufacturers.⁸ The particularity of the British case was reinforced by the railways' uniquely restrictive structure gauge (the infrastructural dimensions dictating rolling stock's maximum height, width and length), which placed (and still places) severe restrictions on what in design terms could be imported wholesale. While there might be broad similarities between coach designs in different countries, any moves

towards an international standard – for example, in pursuit of interoperability across Europe – has always had to contend with this constraint.⁹

Finally, in post-war Britain the national political context shaped BR's managerial structures and strategies in ways that presented industrial and engineering designers alike with opportunities and challenges that were not necessarily mirrored in other countries. In particular from the mid 1950s and even more so in the early 1960s, BR's growing emphasis on commercial rather than public-service norms opened up a space for industrial designers to challenge engineers' traditional jurisdiction. Engineers' defence of their position was complicated by the fact that they did not form a homogenous group within BR – some were attached to headquarters while others worked in regional drawing offices. The relationship between these various factions morphed along with the wider changes in BR's managerial structures: from centralised, functional management under the Railway Executive (RE) (itself nominally responsible to the British Transport Commission (BTC)) (1948–53); to a more decentralised arrangement under the BTC (1953–62); after which the new British Railways Board (BRB) reasserted national control. In contrast the railways' industrial designers largely worked at headquarters level: a handful were employed by BR while others were brought in as consultants for particular projects.

In sum, while the BR Mk2's design history was at one level 'merely' a jurisdictional dispute between an insurgent and an established profession, this dispute was itself symptomatic of the struggle faced by Britain's railways and more generally the country's manufacturers to find a new role in the rapidly changing political, social and economic landscape of the 1950s and 1960s.¹⁰

Engineering jurisdiction to 1947

The Mk2's development can only be understood in the context of engineers' long dominance of coach design. From the start of the mainline era in the 1830s British railway companies

knew that ‘amenities’ such as comfort and privacy were essential for capturing the highly profitable business of the elites that travelled first-class. While the earliest of these well-appointed vehicles belonged to the pre-railway tradition of coach building, from the 1870s sharp inter-company competition and rising consumer expectations drove up standards in all classes of accommodation, at least for long-distance trains. By the late-19th century railway coaches were being built on a large scale, often in the companies’ own workshops. The typical railway was managed hierarchically on functional lines. But while even the Chief Mechanical Engineer (CME) was nominally responsible to the general manager, in practice he enjoyed considerable jurisdiction over design: the much less powerful commercial departments had only a limited input. Thus typically the CME, usually working with a subordinate Chief Carriage and Wagon Engineer (these titles varied between companies and over time), drew up a specification which was then worked into a detailed design by draughtsmen in the drawing offices, normally located in or near the company workshops where skilled workers translated the drawings into a coach. A carriage’s structure – a body mounted on a separate underframe to which the running gear was fixed – along with the interior layout, fittings and decor: all were the responsibility of mechanical engineers.¹¹

Increasing competition from road transport between the world wars spurred what in 1923 had become the Big Four railway companies into paying more attention to carriage design. The railways’ commercial departments became more influential, marketing the passenger coach as a space of ‘civilised velocity’ in contrast to the alleged dangers and discomforts of road transport.¹² But mechanical engineers continued to dominate design: while they took increasing notice of overseas techniques and practice, most British engineers continued to believe that designing a good passenger environment meant concentrating on mechanical fundamentals such as a carriage’s strength and riding quality, followed by supplementary details such as interior layouts, facilities and fittings.¹³ While this approach

could produce good results the more imaginative engineers recognised that railway carriages had to compete with the fashionable – in the 1930s increasingly streamlined and art-deco – styling of motor cars and coaches.¹⁴ The most professionally confident engineers also acknowledged that the slowly emerging professions of interior and industrial design were better qualified in this regard. For example, in 1928 Nigel Gresley, the talented CME of the London and North Eastern Railway (LNER), sought advice from the leading decorating consultants White Allom Ltd about the interiors of new carriages for the company's prime Anglo-Scottish express, the Flying Scotsman; Gresley returned to the company throughout the 1930s.¹⁵ Similarly the GWR's self-propelled diesel railcar of 1933 combined a distinctive streamlined banana-shaped bodywork with an equally innovative interior designed by Heal & Son of Tottenham Court Road, best known as a fashionable furniture firm.¹⁶ The company's chairman Ambrose Heal was a leading advocate of industrial design, notably as a founding member of the Design and Industries Association (DIA), established in 1915 and the chief organ for the would-be profession up to 1939; another founder, Frank Pick, was responsible in the 1930s for the London Passenger Transport Board's highly regarded design work.¹⁷ However in all these cases interior designers, working as consultants, did not seriously threaten engineers' jurisdiction: engineers controlled the project specification and management.

The engineers' coach: The Mark 1, 1948–64

The outbreak of the second world war halted these promising if exceptional forays into what we should now call industrial design. After 1945 engineers continued to control carriage design: acute shortages of capital, labour and materials put the emphasis on repairing and replacing war-torn carriages at minimum cost, helped by the development of a national set of dimensional and structural standards.¹⁸ With nationalisation in 1948 matters continued much as before, at least until the big management shake up in 1953. Up to that point the RE

managed the former Big Four, now divided into six geographical regions, on strictly functional and highly centralised lines. The RE's member for mechanical (and electrical) engineering, Robert A. Riddles, guarded traditional jurisdictions. In February 1948 he established a Carriage Standards Committee (CSC) of draughtsmen from the regional drawing offices. This developed a specification for what became the Mark 1 (Mk1) range of coaches, built between 1951 and 1964.

Figure 1(a). The engineers' coach. A restored example, externally in 1950s' condition, of a British Railways Mark 1. Photo: Peter Russell/Somerset & Dorset Railway Heritage Trust.

Figure 1(b). Publicity photograph of a first-class compartment in 1951. Photo: National Railway Museum

This design was at best workman-like: although BR's engineers knew about technical progress overseas, continuing shortages of capital and materials precluded much innovation. The Mk1 thus followed the best of conventional practice with a steel body mounted on a steel, load-bearing underframe; although stronger and safer than most of the Big Four's coaches, there was otherwise little advance on familiar standards.¹⁹ In the words of the official historians, the Mk1 only 'paid some regard to passenger comfort, as influenced by riding qualities and seating arrangements'.²⁰ Despite guidance from an ad hoc Committee on Interior Decoration, which included representatives of the commercial and operating departments, the hotels division, and the RE's architect, the interiors were plain (perhaps influenced by the prevailing aesthetics of utility), with simple details, spartan fittings and predominantly wooden wall finishes along with limited use of plastic panelling. Innovations found abroad and in some cases previously tried in Britain such as fluorescent lights, pressure ventilation and double-glazed windows were absent. Even the Mk1's improved riding

qualities proved short-lived as the suspension wore badly, and interior noise levels were higher than in most older stock.²¹

In the context of post-war austerity and the need to demonstrate progress in rebuilding the nationalised railways the Mk1 was sufficiently modern for mock ups of the internal compartments to be displayed at the state-sponsored Festival of Britain, opened in May 1951, and the stock was extensively used on the prestigious express trains bringing people to the event.²² However the Mk1's conservative, engineering-led design sat uneasily with the Festival's wider emphasis on putting the more commercially orientated and aesthetically nuanced perspectives of industrial design at the core of Britain's economic renewal. Several organisations and individuals associated with this rationale were later in the decade to facilitate BR's hesitant embrace of industrial design. Particularly important was the state-sponsored Council of Industrial Design (CoID), established in 1944 on the back of the DIA's pioneering work to promote industrial design within British manufacturing and to the public.²³ The CoID worked closely with a number of designers, among them the first design consultancy, the Design Research Unit (DRU), established in London in 1942. The DRU's co-founders included Herbert Read, Marcus Brumwell, Misha Black and Milner Gray – the last two leading lights in the post-war rise of industrial design who were to work with BR. Alongside its work for industrial clients, the DRU equally enthusiastically propagated industrial design to a wider public, working closely with the CoID in high profile events such as the Victoria and Albert Museum's 1946 exhibition, *Britain Can Make It*.²⁴ Although focusing on domestic and small-scale industrial products the exhibition referenced passenger coaches.²⁵ However for the time being the solid but uninspiring aesthetics, layout and internal fittings of the Mk1 underlined the fact that industrial designers lacked even the limited influence they had enjoyed on the railways before the war.

A jurisdictional challenge: The Design Panel, 1955–56

In 1955 the railways were finally promised significant state investment and the BTC's multi-million-pound Modernisation Plan put improved coaches high up the list of priorities. This gave industrial designers an opportunity to challenge railway engineers' jurisdiction, particularly when in 1956 the BTC established the Design Panel (DP), a high-level advisory committee.

External and internal factors shaped the BTC's policy. Externally, the national politics of design and economic renewal were a major driver. In the mid 1950s the CoID was looking for ways to appeal to domestic engineering firms: earlier attempts to make good design a key to boosting exports in consumer goods were achieving little and advocates of industrial design turned to the engineering and service sectors instead.²⁶ In this context the CoID saw BR as a great opportunity – industrial design could help remake the image of an industry desperately in need to shake off the legacy of war and austerity. In 1955 the CoID claimed that 'in the bold plan for the re-equipment of British Railways, design is implicit in almost every section'.²⁷ The council's director Sir Gordon Russell investigated the use made of industrial design by railways worldwide, publishing the results in a special issue of the CoID's influential magazine, *Design*.²⁸ His ideas were favourably received by several key members of the BTC, including General Sir Brian Robertson, chairman since 1953, the businessman T. H. Summerson, a part-time member and chairman of its North Eastern Area Board, Major-General Ll. Wansborough-Jones, the secretary-general, and Christian Barman, the chief publicity manager. A personal interview between Russell and the BTC laid the foundation for the DP, which first met in August 1956.

Russell's timing was good for the sudden availability of state capital came at a difficult time for the BTC, not least because it was still in the process of reorganising BR in the wake of the RE's abolition.²⁹ The scale of the modernisation programme threatened to

overwhelm BR's engineers and workshops: the involvement of many outside manufacturers risked a mishmash of styles. Moreover in sharp contrast to the high regard in which London Transport's (LT) rolling-stock design and wider visual style were widely held, BR's standards had been publicly criticised for some years. Thus just before Russell's initiative the BTC had started to engage outside firms to advise on, amongst other things, the styling, internal layouts and fittings of new coaches – the DP promised a more systematic approach.³⁰ But given the strength of engineers' jurisdiction it was never going to be easy gaining their acceptance of new ideas: as Russell stressed, external advice had to be channelled through a body that was fully part of the railway, as 'any attempt to impose it from outside would be likely to meet with opposition as so many railway families had given devoted service for several generations.'³¹ As formally part of the BTC's corporate 'railway family', the DP was thus perhaps seen as a way of winning over sceptical engineers. On the other hand, BR's complex, multi-layered and functional structure meant engineers were more than likely to regard the panel and its small executive staff in the same way as an external consultancy – that is as an imposition – particularly since the DP reported directly to the BTC and until 1963 only met six-monthly. Such difficulties quickly became apparent.

Nevertheless in many ways the DP's membership was judicious. Just two external members joined the majority drawn from leading BTC personnel, its area (that is, regional) railway boards, and senior managers from BR and LT (another BTC responsibility). With Summerson in the chair until October 1963, engineering matters were represented by John Ratter, a very senior BTC headquarters manager responsible for technical and research development. Alongside him from the BTC were Wansborough-Jones, Barman, and Dr F. C. Curtis, the chief architect since 1949, plus E. C. Arkle, the most senior commercial manager on the London Midland Region (LMR), and E. C. Ottaway, LT's senior supplies manager. The two outsiders were Russell and W. J. Worboys, a director of the giant chemical firm ICI

and the CoID's chairman.³² As Brian Haresnape points out, through Barman and Ottaway the panel had direct experience of LT's strong design tradition, while through Russell and Worboys it was closely connected with the wider industrial-design profession.³³

However by excluding mechanical engineers the DP almost certainly made it harder to encourage new thinking, despite the BTC's recognition that industrial design 'cannot... be treated in isolation. It must be co-ordinated with engineering and other technical design'.³⁴ Traditional jurisdictions proved hard to shift: in retirement nearly twenty years later Roland Bond, Riddles' successor as CME (1953–58), still thought that working with the DP had been 'an irksome and time wasting business' and that engineers had been 'quite capable of ensuring for ourselves' that external styling met 'the best contemporary standards'.³⁵ The appointment of, for example, E. S. Cox, the BTC headquarters manager responsible for engineering design and, from March 1954, chairman of the CSC, might have created opportunities for dialogue. But even if engineers had been willing – and there is no evidence of this at the time – in the BTC's strict hierarchy even such a senior individual as Cox was probably regarded as too junior to have joined the DP. This was doubly unfortunate given that Cox and other headquarters engineers like A. E. Robson, chief carriage (and wagon) engineer from 1954 to 1958, were formally responsible for directing national standards for coach design.³⁶ In another twist, in 1956 the regional drawing offices gained considerable autonomy from these headquarters engineers, further diluting control over the men who prepared the detailed designs. Thus 1956 marked the start of what the official historians tactfully characterise as 'the uneasy, but stimulating, relationship between engineer and industrial designer'.³⁷ As we detail shortly, J. F. Harrison, the CME from 1958, proved adept at defending his profession's jurisdiction.

The task of bringing industrial design into BR's engineering thus fell largely to the DP's sole executive member, Barman, and, from July 1957, the BTC's newly appointed

Design Officer, George Williams. Williams, who had long experience of design in the motor industry, the Royal Navy, DRU and the CoID (where he was responsible for the Festival of Britain's transport sections), headed a small department of three or four qualified designers. They largely acted as intermediaries between those parts of BR that wanted, or were instructed to acquire, guidance on styling, ergonomics and so on, and the consultants who carried out most of the detailed work on important projects. In particular Williams strengthened BR's relationship with the DRU, as in 1946–48 he had worked closely with Milner Gray on the *Britain Can Make It* exhibition; the DRU's Misha Black now became a figurehead of industrial design not only in Britain but also abroad, becoming BR's design consultant for diesel and electric locomotives in 1957.³⁸

Engineering jurisdiction continues: The 1957 prototypes

A BTC initiative in 1955–57 to inspire the next generation of standard coaches, particularly in terms of better passenger accommodation, gave the DP an early chance to engage critically with BR's engineers as well as to comment on private manufacturers' aspirations. Ultimately however the episode showed that for the moment mechanical engineers continued to dominate most aspects of carriage design.

The national political forces that had led to the RE's abolition in 1953 also put pressure on the BTC to give outside industry a wider role in designing coaches. In late 1955 Robson invited four outside firms to build prototypes based on the Mk1 to demonstrate new thinking on interior layouts, fittings, materials, heating, ventilation and insulation; BR's Eastern Region workshops at Doncaster also took part. Despite some imaginative ideas from the Sheffield manufacturer Cravens and, to a lesser degree, Doncaster, industrial designers generally found little merit in the prototypes.³⁹ While the DP's report to the BTC in July 1957 commended Cravens, it also asked permission to work with BR's engineers in designing new carriages. However for the time being the BTC's headquarters engineers blocked the DP's

more radical ideas. In May 1958 Robson argued that features like wider windows and doors would require prohibitively expensive investment in BR's workshops, although as we detail shortly this argument was already being undermined by a Western Region (WR) initiative requiring just that.⁴⁰ However the BTC allowed the DP to develop their ideas independently in a long-term project, the Carriage of Tomorrow (CoT). Although only a paper exercise until the early 1960s, by mid-1959 the CoT was envisaged as much more than a re-fitted Mk1, with wider external doors and windows, improved inter-coach gangways, and a host of internal improvements including air-conditioning. This eventually became the experimental XP64 train – ironically based on a modified Mk1 bodyshell – introduced into public service in 1964.⁴¹

Before exploring the CoT/XP64's influence on the Mk2 it is first necessary to appreciate how the WR was able to develop a radically new approach that would both define the Mk2's engineering structure and, as it turned out, further hinder industrial designers' influence.

Engineers divided, 1956–59

BR's regional drawing offices had gained some autonomy in the wake of the RE's abolition in 1953 but the process accelerated sharply in 1956. Despite this neither the regional general managers nor their senior engineers had the authority or resources to develop new carriage designs without permission from headquarters.⁴² But the arrangement did allow for new thinking that might otherwise have been crushed at birth by the kind of conservatism exemplified by Robson.

Figure 2. Engineering innovation. Swindon's self-propelled diesel trains of the 1950s had an integrated bodyshell but kept the Mark 1's utilitarian aesthetic. This example is seen in 1974.

Photo: Colin Divall

In the mid 1950s the WR's Swindon drawing office had gained considerable expertise in designing 'integrated' structures for self-propelled diesel trains, and in 1957–58 its carriage (and wagon) engineer, J. W. Innes, developed this approach for locomotive-hauled coaches. Innes was a founder member of the CSC and a key figure throughout the Mk2's gestation. His thinking revived an idea considered in 1948, combining a coach's separate body and underframe into a single (that is, integrated) steel structure strong enough for everyday service.⁴³ This gave a much lighter vehicle for a given strength – important since most improvements to the Mk1 made a heavy design even heavier. However because the body was load-bearing it was much harder to change the position or size of the holes for doors, windows or inter-coach (gangway) connections. In late 1958 the BTC authorised the WR to develop and test a 'prototype integral structure' – probably always interpreted by Swindon to mean a complete coach.⁴⁴

Thus at precisely the time that the structural relationship between a coach's external surfaces and internal spaces was becoming more tightly coupled, the BTC held apart the two sets of specialists, engineers and industrial designers, who needed to co-operate to exploit the synergies between the two elements. Michael Harris characterises this as a deliberate policy.⁴⁵ This was certainly true of the 1957 experiments with the Mk1, partly justifiable in terms of short lead times – but it is harder to be so categorical about the parallel project at Swindon. Here the sin was arguably one of omission rather than commission: that after 1958 the BTC and BR headquarters staff collectively failed to manage the WR's project. This is consistent with Johnson and Long's observation that in the late 1950s regional engineers generally asserted their new-found autonomy from headquarters.⁴⁶

In any case such criticism of the BTC, made with the benefit of hindsight, must acknowledge the practical difficulties of designing integrated structures in the late 1950s and

early 1960s; a lengthy exercise involving manual stress calculations followed by stringent static tests. Computer programs to obviate much of this only started to appear towards the end of 1959 and were not fully operational until 1965. Thus even if Williams or the DP had been consulted in 1957–58, Innes would probably have rejected the body changes just being mooted for the CoT; there were far fewer risks in proposing to cut wider doorways, windows and gangway connections into a Mk1 body (which eventually happened with the CoT/XP64) than into an untested design for an integrated bodyshell.⁴⁷

This is not entirely to excuse Swindon's parochialism. It is a moot point whether collaboration between Williams and Innes later in the 1950s would have sped up the introduction of the CoT's more radical structural features, eventually used on the Mk2's later variants. Moreover by 1960 a bare bodyshell to the original integrated design had been built, and at this point it would surely have been appropriate to have discussed interiors with industrial designers. However they were excluded until 1963 – Williams later complained that the work at Swindon had been done 'under cloak of secrecy'.⁴⁸ Instead from autumn of 1961 the bodyshell was first tested and then fitted out by Swindon to a specification broadly similar to the latest Mk1s before finally starting public trials in January 1963.⁴⁹

Figure 3(a). The prototype Mark 2. Seen here in 2009 still largely in original external condition. Photo: DiverScout at English Wikipedia

Figure 3(b). Publicity photograph of the prototype's first-class compartment in 1963. Little advance on 1951 although the Design Panel had improved some details. Photo: National Railway Museum

Towards shared jurisdiction, 1960–63

In the early 1960s both professional groups exploited the increasing threat to the railways' profitable long-distance market from mass motoring, express road-coach services and even domestic aviation to pursue their jurisdictional claims. Since the late 1950s national politicians had been giving increasing emphasis to motoring as central to Britain's putative economic and social renewal, while marketeers sold, and the public bought cars in ever greater numbers as a fashionable essential for modern mobile lifestyles.⁵⁰ BR's senior business managers recognised that a replacement for the dowdy Mk1 was urgently needed. Industrial designers argued that only they could deliver key elements of a stylish, attractive, *modern* travelling environment that would satisfy passengers' affective as well as their practical needs; engineers responded that theirs was the more fundamental contribution and that nothing should be allowed to slow the introduction of a better-engineered and hence commercially viable coach. Such rhetoric became more effective as BR became increasingly business focused, particularly once Dr Richard Beeching moved from the industrial conglomerate ICI to become BTC chairman in June 1961 and then, in January 1963, head of the BTC's successor, the BRB.

Beeching was an important ally for industrial designers: according to Haresnape, he was deeply aware of 'the true value of good design in industry' and fully supported the DP's work on the CoT as well as giving the panel, from 1964, important new responsibilities to develop a radically new corporate identity, 'British Rail'.⁵¹ The return to centralised management under Beeching also probably helped Williams by reducing the number of engineering barons with whom he had to deal; in October 1962 the regional drawing offices came back under Harrison's control. Further shifts towards functional management were also important; by November 1963 both Williams and Harrison were answerable to Ratter as the sole BRB member responsible for technical departments – although by 1965 Ratter's

workload had proved unsustainable and further reorganisation was necessary partly to control the mechanical engineers more closely.⁵² In any case industrial designers' enhanced prestige was reflected in the new title for Williams' post, Director of Industrial Design, and at a more practical level by modest enhancement to staffing. Although the DP remained chiefly an advisory body, it now met quarterly and reported to the board through its chair – from October 1963, no other than Ratter.⁵³

These arrangements created an environment in which industrial designers and mechanical engineers began to work more closely together, although the relationship took some years to mature. Indeed the final design for the initial batch of 70 'pre-production' Mk2s, authorised from August 1962 and entering into service from 1964, was agreed well before a full rapprochement and so represented a compromise between the competing jurisdictions.

As we have seen prior to Beeching's arrival there was considerable distrust between the two professions, despite the fact that by around 1960 the DP enjoyed growing influence over, amongst other matters, the styling of new trains and locomotives.⁵⁴ Between 1960 and 1962 Williams therefore tried harder to develop a working relationship, partly by inviting key engineers to four BR-wide conferences with BR's industrial-design consultants. The first meeting merely underlined the distance between the two groups. Misha Black, for example, condemned anyone who believe that 'if a thing worked well it would automatically look right'. This and similar comments solicited angry responses from engineers, who cast doubt on industrial designers' claim to be the sole arbiter of good aesthetics. Engineers also criticised the DP's effectiveness: Cox, by now Assistant CME, conceded that industrial designers had a role to play in providing initial visualisations for projects identified as needed by '[t]he railways' (that is, anyone but industrial designers!) but argued that the panel had failed to develop a consistent approach across the wide range of rolling stock delivered under

the Modernisation Plan.⁵⁵ Cox therefore proposed limiting the DP to a series of initial concept sketches with all subsequent work left to engineers. Not surprisingly Williams disagreed, arguing for the ‘closest collaboration’ on a continuing basis between engineer and industrial designers once a project’s basic parameters had been established: ‘He could not, as Mr Cox had advocated, work in a factual vacuum.’⁵⁶

The fundamental issues were thus twofold: first, which of the professions should have jurisdiction over a project’s initial specification; and secondly, which should decide upon the inevitable revisions. By 1960 the DP’s second report on the CoT accepted that only engineers could specify bodyshell structure, doors, gangways, bogies and other running equipment (thereby ruling out any say about the external surfaces of Swindon’s project), urged collaboration on heating, lighting and ventilation, and claimed initial responsibility for seating and other interior fittings.⁵⁷ However by September 1961 – when the CoT was still a paper exercise – the DP was claiming jurisdiction over matters previously left to engineers, such as window widths and carriage lengths.

Harrison exploited the urgent business need for new coaches to block this challenge. In July 1961 the BTC (including Ratter) had decided that all new coaches would be of integral construction – meaning that the Mk2 would be based on the as-yet unfinished Swindon prototype. For the DP Summerson, supported by Ratter, had pressed hard for the CoT’s (still untested) ideas to be considered, and Harrison seems to have been sympathetic towards some suggestions for the interiors. However in August Harrison, anticipating the DP’s more radical structural proposals, decisively argued that these would delay the new coaches by possibly 18 months because of the need to rework the stress analysis. By confirming in December that the Mk2 would be based on Swindon’s prototype, the BTC ensured that for the time being mechanical engineers retained jurisdiction over structural design. Even so, Harrison recognised that industrial designers could no longer be ignored

since around this time he instructed Innes to rework Swindon's drawings to accommodate wider windows.⁵⁸

In short the ground was moving in favour of industrial designers, particularly as from 1962 BR's commercial function gained greater authority over the planning of passenger traffic. At the same time marketing was consolidated in the commercial section, creating a centralised, more business-orientated body with growing influence.⁵⁹ Improving BR's public image became more urgent and encouraged the greater use of market research, long-favoured by Williams and the DP, in understanding what features might appeal to potential passengers.⁶⁰ But at the start of 1962 and still frozen out of the Swindon project, Williams and the DP urgently needed to make progress with the CoT, still a paper exercise despite the recent appointment of Wilkes & Ashmore to develop sectional mock-ups.⁶¹ In January Summerson, perhaps sensing that the initiative might slip away from the DP, tried to persuade the new Beeching-led BTC to use the Swindon bodyshell for an experimental CoT train: this was rejected because of the long lead times. Instead the BTC agreed to an eight-coach train based on the Mk1 body and underframe: this could be developed more quickly because the structural ramifications were far less complex. By October 1962 the LMR's Derby workshops – which eventually built all the Mk2s – had been provisionally ordered to construct the vehicles, a decision confirmed in January 1963 after further detailed changes to the interiors based upon critiques of the third and final mock-ups. The train, now designated the XP64, was finished in May 1964 and in June started a year's service to test public reaction.⁶²

Figure 4(a). Compromise. The XP64 showcased the Design Panel's thinking on passenger facilities and marketing but used a modified Mark 1 bodyshell. Photo: National Railway Museum

Figure 4(b). Publicity photograph of the XP64's first-class compartment in 1964 – almost pure Design Panel. Photo: National Railway Museum

The CoT/XP64 project seems to have eased relations between the two professions a little: each group now had its own initiative. There was also some co-operation; by spring 1962 Cox was working with Williams and Barman on the CoT's detailed specification in addition to welcoming, via the CSC, occasional suggestions about internal fittings for the Mk1 and other vehicles.⁶³ Certainly by the fourth BR-wide design conference in July 1962 the atmosphere was far less antagonistic than two years earlier. Cox confirmed that relations had mellowed: 'Railwaymen find that the consultants are more modest as individuals than might be expected from the perhaps exaggerated claims made on their behalf by the specialist press'.⁶⁴ However, professional boundaries were still policed: Cox remained doubtful about designers' contribution beyond improving appearances and the clever use of materials, and he was still not convinced of their jurisdictional claims over functional elements such as the DP's proposals for wider doors and the widespread adoption of open (that is, non-compartmental) interiors — practically denying major features of the CoT.

Nevertheless within eight months the DP's rising fortunes were demonstrated by the largely favourable reaction to a record-breaking public exhibition *New Design for British Railways*, organised by Williams and opened by Beeching at London's Design Centre in February 1963.⁶⁵ In a campaign that included the industry's leading periodical, *Railway Gazette*, and a special issue of *Design*, Williams stressed his profession's centrality to the railways' new commercial culture: 'The degree of comfort provided for the traveller is entirely dependent on design... The attitude of the rail passenger is conditioned most by his experience in the environment of the passenger train, which is his most important point of contact with the railways.'⁶⁶ By implication Williams criticised the 'strongly established

formula, evolved over the years within the railways' that had until recently excluded industrial designers: by contrast he claimed that now there was almost no railway design work without 'embodying Design Panel influence.'⁶⁷ While still something of an exaggeration, the public and industry's enthusiastic reaction to the initial exhibition and follow-ups held in Brighton, Derby and BR headquarters boosted industrial designers' position within BR. The 6200 visitors at the exhibition's opening day were a record for the Design Centre,⁶⁸ while on the whole the mock-ups of what had temporarily become the 'Carriage of the Future', including a striking new blue-and-grey livery, were well liked.⁶⁹ However, as we have seen, the hard reality was that the engineers' prototype Mk2 had already entered experimental public service, eighteen months before the XP64.

Reconciliation: The production Mk2s 1964–68

This lead was decisive in shaping the overall styling and facilities of the first batch of forty-six 'pre-production' Mk2s, ordered in August 1962 and introduced in 1964. The intense commercial pressure to get these into service meant they differed little from the prototype. The exterior styling was much cleaner than the Mk1 and looked strikingly modern – although the traditional, almost monochrome liveries were something of a let down – but apart from the widespread use of glass-reinforced mouldings the interiors of these first-class, compartment vehicles were little different from the most recent, DP-influenced Mk1s.⁷⁰ From the DP's perspective the next – or 'production' – batch of Mk2s needed to reflect the XP64 philosophy. But it was not until the Mk2b in 1968 that many of the XP64's more radical features were incorporated (others proved impracticable), by which point wider events had brought BR's engineers and industrial designers to tacit agreement over jurisdiction.

Delays to large-scale production were critical in giving both groups time to learn to work together. In the mid 1960s the BRB's finances were under intense government scrutiny and final ministerial approval for an initial batch of some 200 Mk2s, first discussed in mid

1963, was not finally given until July 1964, with the first orders for a new design (an open second) not placed until October. At first this uncertainty played well with Harrison: throughout 1963 and well into 1964 he blocked pressure from Williams to incorporate the more radical (and as still untested) ideas from the CoT such as wider folding doors, improved lavatories and vestibules because these would slow production. However by September 1963 Harrison agreed to some of the DP's simpler suggestions once the initial, first-class vehicles had been built, and during 1964 Swindon worked with the DP on the open second's interiors. At roughly the same time Derby was co-operating on the final drawings for the CoT/XP64.⁷¹

This growing rapprochement bears some comparison with the 1930s when CMEs like Gresley were happy to accept outside advice as long as they remained in control. But the parallel is not perfect – a CME in the 1960s was subject to more stringent managerial direction from outside his profession than in the 1930s. In 1964 Beeching reiterated in the *Financial Times* that higher management had to ensure standards of industrial design, a theme consistently advocated by the CoID since the 1950s.⁷² Even after Beeching returned to ICI in June 1965 (and Williams died suddenly that November), the BRB continued with Beeching's line that 'the public's thoughts will be largely formed by the things they see and use'.⁷³ Thus ultimately the board's authority guaranteed industrial designers a measure of jurisdiction, as long as in turn the DP could demonstrate that it understood what might appeal to potential customers and, by bringing in new ideas from leading design consultants, kept the new brand of British Rail, introduced in January 1965, from becoming 'introspective'.

Nevertheless partly because they were in charge of manufacturing, engineers maintained considerable control over the pace at which elements from the XP64 were introduced into wider use. While the interiors of the first production Mk2s to enter service (the open seconds), in 1965, were influenced by the XP64, even the DP agreed in the light of the train's public trials to abandon or modify several key fittings. More significantly while

the next batch of vehicles, the Mk2a introduced in 1967, drew more heavily on the XP64's interior, it was another year before the Mk2b incorporated the DP's wider doorways. Engineers were still in overall charge: even at this late stage the DP complained about not being adequately consulted about the final drawings and criticised several of the interior details.⁷⁴

Figure 5(a). Rapprochement. Innovative engineering and modernist interiors turned the Mark 2's later variants into a design classic. An air-conditioned Mark 2d open first of 1971. Photo: National Railway Museum.

Figure 5(b). The interior of the same type. Photo: National Railway Museum.

While it is impossible to pinpoint a moment at which BR's engineers and industrial designers tacitly agreed jurisdictional boundaries, 1965–66 marked an important transition despite the continuing squabbles over the Mk2. Outside Britain, railway modernisation of long-distance passenger services in Japan and parts of Europe had since the late 1950s demonstrated that while higher speeds were critical in competing with other modes, the train generally did best when it packaged reduced journey times and frequent services with the comfort, relaxation and less tangible benefits afforded by well-designed rolling-stock. For example, the cross-border Trans-Europe Express (TEE), first-class-only diesel trains introduced in 1957, had shown that elite passengers would both shun airlines and pay premium fares, while the high-speed Japanese bullet train, introduced in 1964 and open to all, took competition to an unparalleled level.⁷⁵ While BR's modernisation was not in the same league, the rapid success of the newly electrified services between north-west England and London, planned from the late 1950s and launched in 1966, probably helped convince engineers that industrial designers really did have something to offer: the DP's claim that 'the latest Mark II second

class carriages operating on the London Midland service have many XP64 features and have been well received by the public' was not far off the mark.⁷⁶ Even before the new trains started running the two professions had together begun to develop a specification for the Mk2's locomotive-hauled successor, and from 1968 that for an even more important project, a high-speed diesel train which became the internationally acknowledged design icon the InterCity 125.⁷⁷ In the highly competitive inter-urban passenger market of the late 1960s, disputes over professional boundaries could no longer be allowed to delay the pursuit of 'speed and comfort' at more than 100 mph.

Figure 6. The Mark 2 was an important part of BR's Inter-City marketing in the late 1960s.

Photo: National Railway Museum.

Conclusion

The design history of the BR Mark 2 coach exemplifies the jurisdictional battles faced by industrial designers in post-war Britain as they tried to secure professional status by identifying and gaining key roles in the modernisation of the UK's economy. Despite financial problems the railways were an important target: even in the 1960s the industry remained a sizeable part of the UK economy. Working through the Design Panel and its executive staff, Britain's industrial designers played an increasingly important role in turning the rather staid, bureaucratic railway of the mid 1950s into the increasingly competitive passenger business and internationally acknowledged brands of the late 1960s and 1970s, 'British Rail' and 'InterCity'. The Mark 2 was an important part of this transition: the coach embodied the intangible emotions, attitudes and values expressed by the concept 'styling' as well as being safe and comfortable when operating as part of a – by British standards – high-speed train.

BR's mechanical engineers also played a critical role in this success, not least because the Mark 2's innovative, integrated structure was a major engineering achievement. Although

for around a decade from the mid 1950s the two specialisms disputed the boundaries of their expertise, in retrospect one of the important achievements of the Mark 2 was that eventually it required collaboration. By the mid 1960s engineers had undoubtedly ceded some jurisdiction to industrial designers: no longer were the former responsible for all aspects of a coach's design, as they practically had been up to the second world war. The increasingly competitive business environment in which the railways operated demanded knowledge, expertise and skills in the 'soft' factors that even between the world wars engineers were beginning to acknowledge lay outside their competence. In this particular and limited sense the (mechanical) railway engineer of the mid 1960s was professionally diminished. An interesting question is therefore whether in the immediate post-war years British railway engineers could have maintained a greater degree of jurisdiction by expanding their expertise to include the 'soft' factors to which industrial designers increasingly laid claim. It was perhaps not quite inevitable that the latter group would succeed in persuading the BTC that it had the critical capacity to turn railway coaches into desirable, commodified mobile spaces capable of competing with cars and planes. With hindsight it is clear that BR's engineers made a critical strategic error in the 1950s by downplaying the significance of styling or – what amounts to the same thing – reducing it to the functionalist mantra of 'what works, looks right'.

Historical contingency played a crucial part in allowing industrial designers to reap many of the benefits of BR's new commercial order. Backed by the state in the shape of the CoID, private-sector businesses such as the DRU and individual consultants skilfully exploited the opportunities presented by the – state-funded – Modernisation Plan. They convinced the highest levels of the railway's management that only industrial designers could effectively use market research to develop a new coach – and more generally a new railway – that would appeal to potential customers through a combination of visual styling and

innovative facilities. In the early 1960s the Design Panel cemented its position by imaginatively marketing its own practice and thus securing high levels of public approbation for what in terms of coach design amounted to little more than a statement of intent. By contrast engineers relied on important but short-term, internal arguments about the practical difficulties of incorporating all the Design Panel's thinking into the Mark 2 bodyshell. By then it was too late to deny the long-term significance of what industrial designers were trying to achieve – in the future both professions had little option but to work together.

Yet the rapprochement between BR's industrial designers and mechanical engineers in the 1960s was not the final word on the subject. Similar jurisdictional battles emerged in later periods, especially after the privatisation of Britain's railways in the 1990s. Indeed there is evidence of similar disputes in other countries, for example with the recent design of luxury railway vehicles in Japan.⁷⁸ Changing technologies, environmental considerations, commercial markets and customer expectations mean that designing passenger carriages – always ensembles of mechanical engineering and passenger amenities – requires an evolving mix of skill sets, potentially threatening the jurisdiction of incumbent experts and offering opportunities for insurgent specialists. Railway carriages are microcosms of the societies through which they move, and as such their design in the future will prove as contested a field of professional jurisdiction as in the past.

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- 1 Gregory Votolato, *Transport Design: A Travel History* (London, Reaktion, 2007), p. 9.
- 2 John White Jr., *The American Railroad Passenger Car* (Baltimore, Johns Hopkins University Press, 1978); David Jenkinson, *British Railway Carriages of the 20th Century*, 2 vols (Wellingborough, Patrick Stephens, 1988 and 1990).
- 3 John Johnson and Robert A. Long, *British Railways Engineering 1948–80* (London, Mechanical Engineering Publications, 1981); David Lawrence, *British Rail: Designed 1948–97* (Manchester, Crécy Publishing, 2016), pp. 159, 168, 170.
- 4 Michael Harris, *British Rail Mark 2 Coaches: The Design that Launched InterCity* (Glossop, Mallard Venture, 1999).
- 5 Andrew Abbott, *The System of Professions: An Essay on the Division of Expert Labor* (Chicago, University of Chicago Press, 1988).
- 6 Leah Armstrong, ‘Steering a Course between Professionalism and Commercialism: The Society of Industrial Artists and the Code of Conduct for the Professional Designer 1945–1975’, *Journal of Design History*, 29:2 (2015), 161–79.
- 7 Jeffrey L. Meikle, *Twentieth Century Limited: Industrial Design in America, 1925–1939* (Philadelphia, Temple University Press, 1979), pp. 7–83, esp. pp. 7–18 ; Guy Julier, *The Culture of Design* (London etc, SAGE Publications, 2nd edn, 2008), pp. 39–53; Arthur J. Pulos, *American Design Ethic: A History of Industrial Design to 1940* (Cambridge MA, MIT Press, 1983); Paul Jodard, *Design Heroes: Raymond Loewy* (London, HarperCollins, pbk edn 1994); Armstrong, ‘Professionalism and Commercialism’.
- 8 See e.g. Ric Morgan, *The Train of Tomorrow* (Bloomington and Indianapolis, Indiana University Press, 2007), on the immediate post-war design efforts of the giant US General Motors Corporation.
- 9 Bryan Stone, ‘Interoperability: How Railways Became European’, in M. Burri, K. T. Elsasser and D. Gugerli (eds), *Die Internationalität der Eisenbahn 1850–1970* (Zürich, Chronos, 2003), pp. 237–43.

- 10 Charles Loft, *Government, the Railways and the Modernization of Britain: Beeching's Last Trains* (London, Routledge, 2006).
- 11 Jenkinson, *Carriages*, vol. 1, pp. 7–32.
- 12 Colin Divall, 'Civilising Velocity: Masculinity and Marketing of Britain's Passenger Trains, 1921–39', *Journal of Transport History*, 3rd ser., 32:2 (2011), pp. 164–91.
- 13 S. Warner, 'The Design and Construction of Carriages and Wagons', in A. R. Bell et al., *Railway Mechanical Engineering*, vol. 1 (London, Gresham Publishing, 1923), pp. 87–260; Jenkinson, *Carriages*, vol. 2, pp. 21–81; Brian Haresnape, *British Rail 1948–83: A Journey by Design* (Shepperton, Ian Allan, 2nd edn 1983), pp. 19–20.
- 14 A. J. Mully, *Streamlined Steam: Britain's 1930s Luxury Expresses* (Newton Abbot, David & Charles, 2nd edn, 2002). On similar developments in the USA, see Nicholas P. Maffei, 'Both Natural and Mechanical: the Streamlined Designs of Norman Bel Geddes', *Journal of Transport History*, 3rd ser., 30:2 (2009), pp. 141–67.
- 15 Haresnape, *British Rail*, pp. 20–1, 31–2.
- 16 The National Archives, London (hereafter TNA), RAIL 268/164, GWR, *The Streamline Way* (1934), pp. 4–5.
- 17 Noel Carrington, *Industrial Design in Britain* (London, Allen & Unwin, 1976), pp. 35–9.
- 18 Johnson and Long, *Engineering*, pp. 278–80.
- 19 *Ibid.*, p. 277–81; Haresnape, *British Rail*, p. 69; K. Parkin, *British Railways Mark 1 Coaches* (Penryn, HMRS/Atlantic Transport Publishers, 1991), pp. 7–29; TNA AN 97/124, Carriage Standards Committee, Minutes.
- 20 Johnson and Long, *Engineering*, p. 281.
- 21 Parkin, *Mark 1*, pp. 24–9, 30–1, 76–85; Haresnape, *British Rail*, p. 69.
- 22 Parkin, *Mark 1*, pp. 9, 76; Haresnape, *British Rail*, p. 69.
- 23 Lesley Whitworth, 'Inscribing Design on the Nation: The Creators of the British Council of Industrial Design', *Business and Economic History On-Line* 3 (2005),

thebhc.org/sites/default/files/whitworth.pdf (accessed 23 January 2018).

- 24 Michelle Cotton, *Design Research Unit* (Köln, Koenig Books, 2011), pp. 11–35.
- 25 Patrick Maguire and Jonathan Woodham, ‘Introduction: Politics and Design in Post-war Britain’, in P. Maguire and J. Woodham (eds), *Design and Cultural Politics in Postwar Britain: Britain Can Make It Exhibition of 1946* (London, Leicester University Press, 1997), p. 11.
- 26 Paddy Maguire, ‘Designs on Reconstruction: British Business, Market Structures and the Role of Design in Post-War Recovery’, *Journal of Design History*, 4.1 (1991), p. 26.
- 27 *Design*, 75 (1955), p. 7.
- 28 *Design*, 81 (1955), pp. 10–46; G. Russell, *Designer's Trade: Autobiography of Gordon Russell* (London, Allen & Unwin, 1968), p. 275.
- 29 T. R. Gourvish, *British Railways 1948–73: A Business History* (Cambridge, Cambridge University Press, 1986), pp. 137–64.
- 30 Haresnape, *British Rail*, pp. 92–3.
- 31 Russell, *Designer's Trade*, p. 275.
- 32 TNA AN 192/601, Design Panel/Industrial Design Panel, Terms of Reference, Constitution, Membership etc.,; Haresnape *British Rail*, pp. 93, 120; Gourvish, *British Railways*, pp. 146, 154.
- 33 Haresnape *British Rail*, p. 93.
- 34 *Ibid.*, p. 92.
- 35 R. C. Bond, *A Lifetime with Locomotives* (Cambridge, Goose & Son, 1975), p. 254.
- 36 Johnson and Long, *Engineering*, pp. 60–6, 509–10, 610; Gourvish, *British Railways*, pp. 150–1.
- 37 Johnson and Long, *Engineering*, p. 69.
- 38 Cotton, *Design Research Unit*, pp. 63, 107; Avril Blake, *Misha Black* (London, The Design Council, 1984), p. 37; Russell, *Designer's Trade*, p. 276; Haresnape, *British Rail*, p. 93; Black, *Misha Black*, pp. 63, 74; Lawrence, *British Rail*, pp. 105–9.
- 39 *Design*, 106 (1957), p. 25.
- 40 Harris, *Mark 2*, p. 16.

- 41 *Ibid.*, pp. 10–11, 15–17; Parkin, *Mark 1*, p. 114–9.
- 42 Johnson and Long, *Engineering*, pp. 63–5.
- 43 Harris, *Mark 2*, pp. 5, 19–21; Parkin, *Mark 1*, pp. 38–41; K. Parkin, *British Railways Mark 1 Coaches: Supplement* (n.p., HMRS, 2006), p. s1. The LMS developed similar all-steel coach in 1926 but the design was not perpetuated, probably because it would have meant investing in the company's recently modernised workshops. Jenkinson, *Carriages*, vol. 2, p. 31.
- 44 Harris, *Mark 2*, p. 19.
- 45 *Ibid.*, pp. 10, 14.
- 46 Johnson and Long, *Engineering*, p. 63.
- 47 Harris, *Mark 2*, pp. 12–13, 19, 21–2.
- 48 TNA, AN 160/561, memo by Williams to Summerson, 11 June 1963., quoted in Harris, *Mark 2*, p. 26.
- 49 Harris, *Mark 2*, pp. 21–3.
- 50 Brian Haresnape, 'New BR Carriages to Compete for the Long-Distance Passenger', *Modern Railways*, 17 (March 1963), pp. 163–72; Peter Merriman, *Driving Spaces: A Cultural Historical Geography of England's M1 Motorway* (Oxford, Blackwell, 2007), pp. 141–99; David Jeremiah, *Representations of British Motoring* (Manchester and New York, Manchester University Press, 2007), pp. 163–203; Loft, *Government*, pp. 149–60.
- 51 *Ibid.*, pp. 119–20; Lawrence, *British Rail*, pp. 85, 105, 172–3.
- 52 Gourvish, *British Railways*, p. 347.
- 53 *Ibid.*, pp. 307–47; Haresnape, *British Rail*, p. 120.
- 54 *Ibid.*, pp. 93, 101–2; Lawrence, *British Rail*, pp. 110–55.
- 55 TNA AN 100/117, Design Panel, 'First Design Conference', 4–8 July 1960, folders 11, 14.
- 56 *Ibid.*, folder 15.
- 57 *Ibid.*, folders 17–18; Harris, *Mark 2*, p. 17.
- 58 *Ibid.*, pp. 17–18, 26, 34–5.

- 59 British Transport Commission, *Annual Report 1962* (London, BTC, 1962), p. 24; British Railways Board, *Annual Report, Statement of Accounts and Statistics for the Year 1963* (London, HMSO, 1963), p. 8; British Railways Board, *Annual Report* (London, HMSO, 1965), p. 11; G. F. Allen, 'Blueprint for BR Passenger Travel', *Modern Railways*, 22 (September 1965), pp. 482–4.
- 60 *Design*, 106 (1957), 25; TNA AN 173/1, Research Project Ltd., 'Evaluation of the XP64', 1960. BR had been exploring the use of market research from around 1957. TNA AN 172/126, British Transport Commission, 'Market Research: Traffic Research'.
- 61 Harris, *Mark 2*, p. 27.
- 62 Johnson and Long, *Engineering*, p. 284; Harris, *Mark 2*, pp. 28–31; Lawrence, *British Rail*, pp. 159–61, 168–9.
- 63 Harris, *Mark 2*, p. 29; Parkin, *Supplement*, p. s19.
- 64 TNA AN 84/69, Design Panel, 'Fourth Design Conference', 9–13 July 1962.
- 65 *Railway Magazine*, April 1963, p. 234; Harris, *Mark 2*, p. 30.
- 66 G. E. Williams, 'British Railways: Design for Comfort', *Railway Gazette*, 1 March 1963, p. 247.
- 67 'Design Policy: Enter an Androcles', *Design*, 171 (1963), p. 44.
- 68 *Railway Magazine*, April 1963, p. 234.
- 69 Brian Haresnape, 'New BR Carriages to Compete for the Long-Distance Passenger', *Modern Railways*, 17 (March 1963), 163–72; TNA AN 160/621, Design Panel, 'Programme of Work December 1962–July 1963'; Harris, *Mark 2*, p. 30.
- 70 *Ibid.*, pp. 34–7, 170–1; Parkin, *Mark 1*, pp. 38–41; Parkin, *Supplement*, p. s19.
- 71 Harris, *Mark 2*, pp. 26, 34–9, 144; Johnson and Long, *Engineering*, p. 285; Gourvish, *British Railways*, pp. 521–2.
- 72 Richard Beeching, 'Design in British Railways', Supplement to *Financial Times*, 27 April 1964, p. 2.
- 73 *Ibid.*; Lawrence, *British Rail*, p. 158.
- 74 Harris, *Mark 2*, pp. 38–40, 45–9, 55–8, 144.

75 Jacob Meunier, *On the Fast Track: French Railway Modernization and the Origins of the TGV, 1944–1983* (Westport Ct and London, Praeger, 2002), p. 82; Christopher P. Hood, *Shinkansen: From Bullet Train to Symbol of Modern Japan* (London and New York, Routledge, 2006); J. Whitelegg, S. Hultén and Torbjörn Flink (eds), *High Speed Trains: Fast Tracks to the Future* (Hawes, Leading Edge Press & Publishing, 2003).

76 TNA AN 160/562, Minutes of the Design Panel, 19 May 1966.

77 Harris, *Mark 2*, pp. 46, 84; Stephen Potter, *On the Right Lines? The Limits of Technological Innovation* (London, Frances Pinter, 1987), pp. 93–115.

78 Comments from practitioners, MSc programme in Railway Systems Engineering and Integration, University of Birmingham, UK, September 2017; ‘Mitooka Eiji: “Ressha Ryoko” wo Ippen saseta Otoko’, *Themis*, November 2017, pp. 94–95