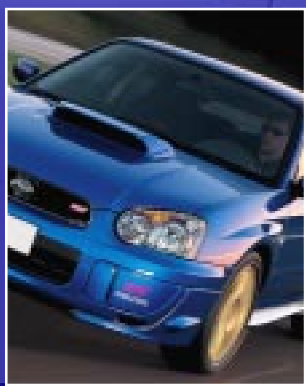
Automotive 4WD transmissions: technology, markets, suppliers and manfacturers - forecasts to 2010



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Automotive 4WD transmissions: technology, markets, suppliers and manufacturers – forecasts to 2010

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by Jeff Daniels

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About the author

Multiple award-winner Jeff Daniels preceded his career in the automotive industry with a degree and background in Aeronautical Engineering. He went on to various journalistic and editorial roles including roles with Motoring Which? and CAR magazine.

After some time spent as PR manager for Datsun in the seventies he returned to Autocar as Technical Editor before another PR spell for Citroen UK before going freelance in 1979.

He has since produced countless articles, reports and commentaries, mainly on technical aspects of the industry. His customers include the Economist Intelligence Unit, the Financial Times, Automotive Engineer, just-auto.com, European Automotive Design, Motor Industry Management, and other newspapers and specialist magazines.

He has also written a number of books ranging from "British Leyland - the Truth About the Cars" (1980), Modern Car Technology (2002 - for which he won the Pierre Dreyfus Award as UK Motoring Journalist of the Year), and *"Driving Force - the history of the Passenger Car Engine"* (2003). He continues to work as a journalist, author, translator and broadcaster.

Introduction

By 2004, the main world markets had long since arrived in a situation where all retail vehicle buyers were aware of 4WD, mainly through the consistently strong growth in sales of vehicles ostensibly intended for off-road operation - the so-called recreational vehicles (RVs) and sport-utility vehicles (SUVs). Consequently, the market for 4WD transmission systems had also grown, not only in size but also in variety and in the sophistication of its more advanced technologies.

This report sets out to deal with aspects of the 4WD transmission market and technology, downstream of the main gearbox (manual or automatic). It therefore concentrates on the centre differential, final drives, propeller shafts and associated components.

Chapter 1 of the report examines the historic background leading to the growth of the *“consumer”* 4WD market in particular, and goes on to establish the basic requirements for any 4WD transmission system for a light-duty vehicle. Chapter 2 discusses the basic technology of 4WD - the technologies applicable to all of these categories except the electric hybrid - while Chapter 3 considers the various devices now used, or available, to achieve a higher degree of control. It also provides an overview on the electric hybrid 4WD concept. Chapter 4 surveys the major specialists in the 4WD transmissions area, while Chapter 5 surveys currently available vehicle ranges by manufacturer.

Chapter 1 Background and basic requirements

Historical background

While a four-wheeled motor vehicle will perform perfectly well for most purposes so long as two of its wheels are driven, traction is much improved when all four wheels are driven. This improved traction allows poor terrain to be crossed more slowly and carefully, with less chance of becoming immobilised, and confers the ability to negotiate steeper gradients. Full use of these abilities calls for significant drive torque to be available at very low speed, hence 4WD vehicles for *"off-road"* use are generally provided with a step-down transfer gearbox which allows the overall gearing to be significantly lowered when necessary.

The advantages of the light-duty 4WD vehicle for off-road operation was first fully realised during the Second World War with the emergence of the Willys Jeep. The value of such vehicles for agricultural, industrial, forestry and construction industry use (as well as military) created a ready market for war-surplus vehicles and encouraged a handful of vehicle manufacturers to develop new designs more suited to civilian use. Thus the later 1940s saw the emergence of the earliest Land Rovers and more advanced *"civilianised"* Jeeps. Other interpretations of the concept emerged in the early 1950s, notably the Toyota Land Cruiser BJ of 1951 and the original Nissan Patrol of 1952).

Although developed to meet a civilian need (though often with their commercial viability enhanced by way of military orders) such models were still essentially working vehicles. It was only during the later 1960s that the concept began to emerge of a working 4WD vehicle with a sufficient degree of *"civilisation"* to appeal to the more general consumer. This trend was accelerated in the early 1970s by the appearance of the Range Rover whose sales consistently exceeded the planned figure. By the end of the 1970s the number of models competing for this new market had risen considerably. It certainly was a new market, not least in that many of the 4WD vehicles sold into it spent little if any time off-road, except perhaps in North America where the *"all terrain"* environment is easier to access. In short, consumers were buying these vehicles almost entirely on the strength of their *"tough, aggressive"* appearance and some perceived but essentially *"fringe"* advantages: greater mass leading to improved survival in a collision, higher eye-line affording better driver visibility. This was the generation of 4WD models to which the term recreational vehicle (RV) was first applied. The major American manufacturers had created their own models for the RV market in the form of the Chevrolet Blazer and Tahoe (and their other GM-badged siblings), the Ford Explorer, and the Dodge Durango.

Table 1: World Vehicle Production by Area (000s) with 4WD Shares and Volumes, 2000 to 2010 for Asia, NAFTA and EU:

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Asia											
%4WD											
Units 4WD											
NAFTA											
%4WD											
Units 4WD											
EU15											
%4WD											
Units 4WD											
Total 4WD (Triad)											
(World)											

Sources: Global Insight forecasts; just-auto.com estimates

Table 1 represents just-auto's predictions based on 4WD production-share forecasts by Global Insight to 2008, extrapolated to 2010. It makes the assumption that the vast bulk of 4WD production will continue to take place in the *"triad"* vehicle manufacturing areas but also gives a total output figure based on a xx% contribution from elsewhere (some production already takes place in India for example). The just-auto.com predictions are based on total vehicle production numbers and on known or anticipated new model introductions, and an estimation of their effect on the market.

The table suggests that a slow but steady increase in 4WD share of total production will take place in all three main vehicle producing areas, with near-parity in NAFTA on the one hand and Japan/Korea on the other, and the EU15 lagging well behind. Total world production of light-duty 4WD vehicles is forecast to rise from xxx million in 20xx to xxx million in 20xx. This xx% increase may seem relatively modest but it must be set against a xx% increase from 20xx to 20xx. Our prediction is in fact that the period of most rapid growth in 4WD sales is now past and that future growth will be at a more modest rate as the market within the *"triad"* approaches saturation in terms of 4WD market share, even if the overall growth in vehicle sales ensures some growth in 4WD also. Beyond 20xx, it seems most likely that 4WD market shares will stagnate. The interest will by then have shifted from volume growth to *"technology growth"* with the adoption of increasingly sophisticated 4WD transmission systems, discussed in Chapter 3.

Since table 1 deals with production rather than sales shares, it does not reflect the fact that a substantial part of Japan/Korea production will be exported to the other two areas during the period in question. It is in fact likely that by 2010, Japan/Korea will export 4WD vehicles representing xx% of that area's total output, three-quarters of it to the NAFTA region and the remainder to Europe and the rest of the world. This implies that by 2010, the 4WD share of the Japan/Korea market - as distinct from production - will be around xx%, while in NAFTA it will be around xx%. In Europe, 4WD imports from Japan/Korea will be at least partly (and potentially, largely) offset by exports from Europe to NAFTA, both of road-going models from Audi, Jaguar and others, SUVs from Land Rover, from Honda's UK operation, and possibly others, and *"crossover"* models from Audi, Saab and Volvo.

Table 2: 4WD system production volumes (000s) by category ('basic', 'sophisitcated', 'fully active', road-going', and 'electric hybrid') 2000 to 2010

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Basic											
Sophisticated											
Fully Active											
Road-going											
Electric hybrid											
Total											

Source: just-auto.com estimates

Table 2 shows the anticipated breakdown of production between these five classes to 20xx. The likely pattern of technical development indicates that between the first three (off-road/SUV) categories, there will be an effective shift from the simplest systems to the most sophisticated. The shift will be two-stage, with a move from simple to sophisticated, and from sophisticated to fully-active, but the next effect will be that the top-end *"fully active"* type of 4WD transmission will account for much of the volume increase to 20xx, while the production share of the simpler systems will begin to decline. Road-going 4WD shows only a small increase in share, almost entirely generated within European production, while electric hybrids, starting from a zero base in 20xx, are likely to claim a small but increasing and by no means insignificant share by 20xx, entirely in NAFTA and Japan.

The lack of European interest in the electric hybrid 4WD is due to the technology finding its main application in *"hybridising"* large SUVs and light trucks to increase the fuel-efficiency of their operation and therefore to enable them to remain within CAFE limits (in the USA). There is virtually no European interest in such vehicles, whereas their evolution may become an essential part of the US scene, and is likely also to benefit from the Japanese passion for new concepts and advanced technology, whether or not it is strictly necessary in Japanese domestic conditions.

The pace of evolution should not be over-estimated. Even by 20xx, basic 4WD transmission with no sophisticated devices will still account for the largest share of the market, although that share will be little more than xx%. By far the next largest share will be accounted for by sophisticated transmissions, in other words those which control the distribution of torque among the four wheels but do so with internal devices fitted to the differentials. The remaining off-road classes, fully-active and electric hybrid, will still be small (xx% and xx% of total production respectively) by 20xx but they will by that time be showing consistent growth in volume.

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