INTERIM [4] AUTOMOTIVE

Beratung & Management für international produzierende Industrien *consulting & management for international manufacturing industries*

FUTURE TRENDS OF CONTINUOUS VARIABLE (CVT) WITH RESPECT TO DOUBLE CLUTCH TRANSMISSIONS (DCT)

Results of LinkedIn discussion started May 15, 2009,
statement status October 1st, 2009

Executive summary

The sample of 10 answers was small, but with qualified and differentiated contents:

- 75% of participants see future DCT advantage vs CVT
- DCT expected to conquer market share by better performance mid-term
- CVT stays popular on the small car market, DCT better for performance vehicles
- Americans esteem smothness and fuel economy of the CVT and see DCT in performance cars
- Europeans prefer agility and fuel economy and expect the DCT as better solution
- Fuel economy advantage reference to conventional automatic transmissions
- Driver‘s system experience in his own car influences his preference for CVT or DCT
- Both systems are expected to have a future, but with necessary technical refinement and cost reductions

The question

„*Future trends of Continuous Variable (CVT) with respect to Double Clutch Transmission (DCT)*

New technology of DCT is gaining rapidly market share from conventional torque converter planetary automatic transmissions (ATX) and CVT. Main reasons are faster and multiple gear changes, wider ratio-spread and fuel economy.

What is your opinion about mid-term and long-term technical and market future of CVT applications in passenger cars?“

Question was submitted on May 15, 2009 on four LinkedIn * member groups as discussion:

- Automotive Management Professionals
- Auto OEM Network
- Automatic Transmission Professionals
- Automatic Transmission Engineers

* http://www.linkedin.com

3 of 4 panel experts feel trend of DCT advantage vs. CVT

experts USA:	*sector:*	*LinkedIn group:*	*trend to:*
strategic management professional	automotive supplier	**Automotive Management Professionals**	**CVT**
quality assurance professional	automotive supplier	**Automotive Management Professionals**	**CVT**
General Manager	automotive supplier	**Automotive Management Professionals**	**DCT**
Vice President - Sales and Business Development	automotive supplier	**Auto OEM network**	**DCT**
Product Planning Manager	OEM automotive	**Automotive Management Professionals**	**DCT**

experts Europe:	*sector:*	*LinkedIn group:*	*trend to:*
consultant, Britain	transmission design	**Automotive Management Professionals**	**DCT**
analyst Germany & India	software for auto OEM	**Auto OEM network**	**CVT small, DCT big cars**
automatic transmissions function developer, Rumania	OEM automotive	***Automatic Transmissions Professionals***	**DCT**
independent consultant, Germany	automotive consulting	all 3 groups	**DCT**
consultant, Britain	automotive consulting	***Automatic Transmissions Professionals***	**DCT**

All see necessity and potentials for improvement on both systems

PRO DCT:

- fuel economy potential 8% to 10%
- direct mechanical coupling
- minimal torque interruption
- instant response, agility
- minimal driving losses
- customer-intuative working principle

PRO CVT:

- Smoothness
- gearless operation
- scales by higher installed production capacity
- small cars and city usage profile

CONTRA DCT:

- cost
- harshness (but potential for smoothness)
- performance & sports car image (USA)
- basicly an automated manual transmission

CONTRA CVT:

- no gear shift feeling („rubber band“)
- constant NVH drone at any speed
- limited power capability
- calibration delicate
- complex torque control

Full detail statements from North America:

USA, supplier	If the DCT can compete with the CVT on cost and provide better performance it will have a chance. US consumers were not happy with the earlier versions of the CVT (in Ford US vehicles, for example). Ford has improved the applications, however, with calibration updates.
USA, supplier	I currently have a CVT in one of my vehicles. It takes a little getting used to, not feeling and hearing the gear shifts. It is remarkably smooth and the gas mileage is excellent! Not knowing about the DCT, all I can say is that if it can compete on the same level it will do great. I absolutely love the CVT.
USA, supplier	DCT - if done well - is a superb transmission that can cater to the Sunday driver and to the enthusiast as well. The direct mechanical coupling afforded by a clutch is a huge advantage over any design with a torque converter. VW / Audi did a great job with their first six-speed DSG. I can't wait to try out their upcoming seven-speed DSG gearbox that's coming for longitudinal engine applications.
	It's a real shame that the Chrysler / Getrag transmission deal fell apart. It would have given Chrysler a leg-up in this vital area. Minimal driveline losses, instant response and the fuel savings potential make this design a winner.
USA, supplier	The vehicle sales (by type) in national / contentinental markets will determine the ratio of CVT to DCT. DCT started in performance vehicles because of the improved acceleration that it offers. I have seen numbers in the range of 8% fuel economy for DCT, all other factors being equal. In the US, customers generally want some performance, that is as long as gasoline costs around $2.50 or less per gallon. With new government fuel economy regulations coming up, automakers would probably prefer to offer DCT in order to help meet government requirements and customer preferences. Though OEMs will have to convince transmission makers to invest in DCT production (currently there is much more capacity for CVT than DCT).
USA, OEM	Many customers still struggle with the "rubber band" feeling of a CVT. In order to optimize either performance or economy a CVT should hold the engine rpm relatively constant (at the peak torque or peak efficiency point). This type of calibration yields a constant NVH drone from the engine while the vehicle speed is changing. The customer perception is often that something is slipping excessively, even when it is functioning properly. Some OEM's have actually calibrated CVT's to simulate shifting across step ratios, which kind of defeats the whole point of being continuously-variable.
	DCT is effectively an automated manual transmission, so it enjoys the manual transmission efficiency of no oil pump or torque converter losses. The double-clutch technology is a clever way of staging shifts so as to minimize the torque interruption characteristics typical of a manual gearbox. The VW DSG versions are quite good -- nearly as pleasant as a traditional planetary gear set AT with a torque converter.
	DCT has an advantage over CVT in that it works in a customer-intuitive way.
	My original point is simply that when CVT's do their job well, they function in a way which is non-intuitive for the customer. Most customers expect the engine speed (and NVH feedback) to increase as the vehicle speed increases, with shift events occuring along the way. I have heard many claims from CVT advocates about the tremendous smoothness potential, but many customers just find the experience weird. Therefore, DCT has an inherent advantage in matching the customers expectations in that it is still a step-ratio gearbox.
	One further thought -- remember the entire existence of the transmission is due to the fact that the internal combustion engine has historically only operated well over a fairly limited rpm range.
	In order to make an analysis of the long-term viability of either of these transmissions, I think one should consider what new ICE technologies will become more widespread in the future, allowing the engine to function over a much wider rpm range. Also, there is the impact of electric-hybridization. As battery technology improves the hybrids of the future could trend to become more and more like pure electric vehicles with the ICE playing a smaller and smaller role.

Full detail statements Europe & RoW

Germany & India, software for OEM	As efficient engine operation and fuel economy is becoming critical, the industry is looking for alternatives. While DCT gives a power boost due to un-interrupted flow of power from the engine to driving wheels (Fuel economy is also improved), CVT with its gearless operations are more fuel efficient, but lacks large power transfer capabilities (Not suitable for heavier powerful cars). I think the future of CVT can still be seen for fuel efficient and small cars (for better comfort and pleasure in city traffic), while DCT gains popularity in medium and upper-medium models. And what goes better with hybrids- CVT or DCT ?
Rumania, OEM	I don't see a bright future of the CVT, at least not in Europe. From the technical point of view you need a very, very complex torque control in order to protect the transmission and the fuel economy is similar to a dry clutch, electric control DCT. And as I know european clients are used to manual gearbox and a transition to CVT means a big change concerning transmission behaviour.
Britain, consultant	I was watching a RAI Italy regional program on saturday and the focus was with Fiat's research center in Torino. They showed their new DCT, which they said would save the average consumer 10% over a conventional AMT.
Britain, consultant	The short answer, for Europe at least, is that CVT share will fall, despite Renault's plans to use Jatco CVTs, and the DCT share will grow at a reasonably strong rate. In theory the CVT has advantages in terms of CO2 (fuel economy), but the reality is that many OEMs have tried CVTs and then given up on them. Getting the most from a CVT requires careful calibration, all assuming you don't have reliability/manufacturing issues and you don't alienate your customers. Even Audi and Mercedes-Benz (A/B-Class) will drop their reasonably popular CVTs in favour of DCTs, in the next few years.
Germany, consultant	DCT will dominate in future, as efficiency, user acceptance, technology progress and cost are expected to improve more than the potentials of the CVT

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(listed in chronological entry order)

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