**Research Question: How does dual clutch transmission affect fuel efficiency, car performance…?**

**What will the future be improvements of DCT?**

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|  | **Source/Evidence/ Data #1** | **Source #2** | **Source #3** | **Source #4** | **Source #5** |
| **Citation** | W.Hua, V.Hua, and L.Guogiang, “Change strategy(dual-clutch transmission)” in Advance Material Reseach, Vol 490, Iss 1, pp 86-90,2012. | S.Bickerstaffe, ” Speeding up development( Four speed electric dual-clutch transmission for electric vehicle)” in Automotive Engineer, Vol 37,Iss 4, pp 18-19, May 2012. | S.Bickerstaffe, “A step change(dual-clutch transmission)” in Automotive Engineer, Vol 38, Iss 9, pp 37, Nov 2013. | Paul D.Walker and N.Zhang” Control of gear shifts in dual clutch transmission powertrains” in Mechanical system and signal processing, Vol 25, Iss 6, pp1923-1936, Sep 2011. | B.Warner,“BorgWarner cuts dual-clutch cost” in Automotive Engineer, Vol 33, Iss 4, pp 43,April 2008. |
| **Purpose** | Improving design of dual clutch transmission by reduction of it weight and its shifting time | To design a light, simple, fuel-efficient engine with improved power and speed | to improve from six-speed dry-clutch DCTs in term of performance, speeds,first-gear ratios and acceleration to compete in the market. | Demonstrate the role of powertrain control for engine and clutch in limiting of shrift transients for DCT include hydraulics system model | In order to emerge markets, BorgWarner comes up with several idea to cut the the cost of DCT |
| **Why is the study necessary?** | Because in order to be well-performance and less fuel efficiency. New DCT must be developed | Consumers’ expectation continues to rise. The cons about the first-generation models EVs (lackpower, not efficient in high speed) need to be addressed. | Even though DCTs address the market’s need for fuel  efficient cars but earlier models of DCTs still lacks in performance and needs to be refine. | Design a good system that can maximize  Discontinuties of speed  Torque  Inertia change | While Dual-clutch transmission still a high-end technology to apply to a vehicle, BorgWarner have to find a way to reduce its cost and complexity.  More suitable to the market |
| **Methods** | They make transmission less weight by   * changing some components * replacing electromechanical system by electrohydraulics system | Electric motor is connected to each of the gearbox’s two input shafts and eliminates the need forclutches. Torque comes from electric motors instead of a combustion engine. | Getrag is trying to   * increase first-gear ratio for better acceleration replacing * new friction material for a smoother shift. * expanding the front-   wheel drive to maximize the use of space for motor. | * Present of method is follows   Control method focus on:   * Integration od clutch torque * Engine speed * Torque control technique | Way to cut the cost of DCT is making   * Power split device * Low torque vehicle |
| **Results** | They successfully made improvements for DCT for :   * shifting time * the transmission weight. | Creating a smaller, more efficient motor with some carry-over components in the prototypes can  reduce cost significantly while producing much more powerful and faster cars. | Their model is used in Ford Fiesta, AMG SLS, BMW M3, and the LaFerrari  Hybrid. A 48V hydrid is planned for mass production. | * Inaccuracy for clutch torque from hydraulic system. * Increase vibration in the system above nominal result. * Extension of transient period during shifting. | In order to make price of DCT more affordable B.Warner uses power-split device which will limit:   * Performance of the car(speed) * Only apply to a low torque vehicle with small engine |
| **Discussion/Conclusion** | Engineer will have to improve DCT again in future because   * technology will change. * Electric car will be used widely in the future. | The design is not entirely finished by has a hopeful outcome. One-speed gearbox is the answer to  consumers’ need and can be applied to all-wheel drive not just small electric cars. | There are giant competitions in developing this technology such as Daimler, Aisin, and the dominating ZF. But with such high potential in the engine, it is anybody’s game. | It is possible to minimize the torque hole by using optimal torque profile. | They are still working for improvement of power-split device for more stable control, higher torque application and more fuel efficiency |
| **How can this help my senior project?** | This article helps me to have a better outlook about dual-clutch transmission. For a racing car, the weight of transmission is a important point which affect formula car performance. Shifting time is another significant aspect, which needs a lot of attention to bring leisure to driver. | Understand concept of transmission in high performance Electronic vehicle(EV)  Knowing a different way to design a dual-clutch transmission which is electric motor is connected to each gearbox’s two input shaft without clutches. | * Hybirdsation with more gears makes Dual-clutch transmission more fuel efficiency . * To understand concept of design a new generation of DCT could help to save fuel economy, gain more torque and lose weight | Building a good system with improvement of powertrain to reduce lockup discontinuities. | Cost is one of biggest problem in this project. Even though, this article show me the way to reduce cost of DCT, ensure our project budget is not excessive, It does not help me a a lot because of car performance mainly determined. |