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グローバル化とモノづくり

Globalization and Monozukuri

副社長 Exective Vice President 薄葉 洋 Yo USUBA

テクニカルレビューNo.10の特集テーマ『グローバル化』です．その巻頭言の執筆を考えたとき思い浮かんだのが，2005年に出版され，2006年に日本語訳もされた『フラット化する世界』(The World Is Flat: A Brief History of the Twenty-first Century)です．ジャーナリストであるトーマス･フリードマン(Thomas L. Friedman)が21世紀はじめに起こった巨大な社会変化を著したベストセラーです．以下に，日本語版の見開きの文章(注1)を引用します．

日本経済が停滞している間に，世界の仕組みは大きく変わった．新しい通信テクノロジーの出現によって，地球上のあらゆる場所にいる人間との共同作業が可能になり，インドや中国へのアウトソーシングが始まった．ブログやGoogleはインターネットに接続する個人にグローバルな競争力を与え，ウォルマートやUPSは人々の想像を超えた新ビジネスを展開している．いまや，個人の働き方，企業のビジネスモデル，さらには国家のシステムが猛烈な勢いで変わろうとしているのだ．この劇的な大変化こそ，「世界のフラット化」である．

それから5年後の現在，2010年には，アウトソーシング先であった中国･インドは，今度は巨大なマーケットへと更なる変化を遂げています．

『フラット化する世界』では，インターネットなどのIT技術の革新と水平分業というアプローチでフラット化が進む様子が紹介されていました．当然，この変化は，私たちのモノづくりの取り組みにも大きく影響を与えています．自動車産業の一翼を担うジヤトコも，多くの企業同様，自動車先進国であった米国･欧州での営業活動の拠点を立ち上げたあと，1998年韓国にJatco Korea Engineering(JKE)を立ち上げ開発業務のオフショアを開始しました．また，生産活

"Globalization" is the theme of the special feature in this No. 10 issue of the JATCO Technical Review. What came to mind as I thought about writing this preface was a book entitled The World is Flat: A Brief History of the Twenty-first Century, written by Thomas L. Friedman, an American journalist. Published in 2005, this bestseller discusses various momentous social changes that have taken place at the beginning of the 21st century. The following paragraph is quoted from the dust jacket of the Japanese translation[(1)] that came out in 2006.

"Global systems have changed profoundly during the period while Japan's economy has been stagnant. The appearance of new communication technologies has made it possible for people all over the world to work together on collaborative projects and gave rise to the practice of outsourcing work to India and China. Blogging and Google give individuals connected to the Internet global competitiveness; Wal-Mart and UPS are developing new businesses beyond people's imagination. The way people work, corporate business models and even national systems are now changing at a breakneck pace. These dramatic and immense changes aptly illustrate 'the flattening of the world'."

Today, five years later in 2010, outsourcing destinations like China and India are being further transformed into gigantic markets.

In The World is Flat, Friedman uses the information technology (IT) revolution typified by the Internet and the horizontal division of labor as two approaches for depicting the ongoing flattening of the world. Naturally, these changes have also substantially affected our monozukuri (i.e., manufacturing) activities at JATCO, which plays an important role in the automotive industry. Like many other companies, JATCO first established local bases

動では，2005年にメキシコ，2009年に中国とCVTの生産拠点を広げてきました．その中で培われたジヤトコのグローバル化の取組みを，今回の特集としています．

自動車や自動変速機などの製品は『擦り合わせ』（Integral）型アーキテクチャーの製品と呼ばれます（注2）．関係する部署が，相互に連携しモノづくりをする『統合型モノづくり』を強みに，日本の製造業は『擦り合わせ』（Integral）型アーキテクチャーの製品に高い競争力を与えてきたのです．この強みを，どうやってグローバル化するモノづくりの中に生かしていくのか？これが私たちの取り組む一つ目の課題です．

もう一つのグローバル化での取り組み課題は，自動変速機マーケットの拡大への対応です．

今まで自動変速機（2ペダルトランスミッション）の主要マーケットは，米国・日本でした．しかし，欧州もCO_2削減の為の運転最適化と快適な運転環境を求め，2ペダルトランスミッションの比率が拡大してきています．欧州のお客さまは，残念ながらトルクコンバーターやCVTの運転フィーリングを好しとしません．欧州のお客さまにとって，エンジンとMTがクラッチでつながり，エンジン回転と車速が同期して変化することが自然であり好ましいと感じるからです．

一方，冒頭の中国・インド市場のお客さまのほとんどは，はじめて自動車を購入されるかたになります．この場合には，お客さまの運転の好みよりは，その市場や道路環境で2ペダルトランスミッション本来の価値「快適な運転」を提供できるかが重要な要件となります．

お客さまの2ペダルトランスミッションへの好みや要求が，世界各地の道路環境や交通環境の中で形作られることを考えると，カーメーカーだけでなく，自動変速機メーカー自身も世界の道路・市場環境，お客さまの運転への好みを熟知する必要があるのです．

このように，グローバル化は「モノづくり」に対し新たなチャレンジをもたらしました．私たちジヤトコは，モノづくりへの情熱を持って，グローバル化への取組みをさらに進めていきます．

for sales activities in the United States and Europe, representing the world's leading automobile markets. Subsequently, we initiated offshore development activities by founding JATCO Korea Engineering Corporation (JKE) in Seoul, Korea in 1998. On the manufacturing front, we expanded our CVT production centers by opening a plant in Mexico in 2005 and another plant in China in 2009. The special feature of this issue focuses on the experience and knowledge we have gained through these moves to globalize our operations.

Products like vehicles and automatic transmissions are said to have an "integral type" of product architecture.[(2)] Japanese manufacturers have created highly competitive integral architecture products backed by strengths in "integrated monozukuri" in which the departments involved work closely together to carry out manufacturing activities. How can these strengths be used effectively in globalized monozukuri operations? This question is the first issue that we are striving to address at JATCO.

A second issue that we must address in the globalization of our operations is how to cope with the expanding automatic transmission market.

The principal markets for automatic transmissions (two-pedal transmissions) have so far been the United States and Japan. However, the percentage of vehicles fitted with a two-pedal transmission is also increasing in Europe in connection with the optimization of driving operations for reducing CO_2 emissions and demands for more comfortable driving. Unfortunately, European customers do not appreciate the driving feel obtained with a torque converter or a CVT. The reason is that they think it natural and preferable for the engine speed and vehicle speed to change in synchronization in a powertrain system where the engine and manual transmission are linked by the clutch.

Customers in emerging markets like China and India, on the other hand, are mostly people who are buying a vehicle for the very first time. One critical factor here is whether two-pedal transmissions can deliver their intrinsic value of "driving comfort" in these markets with their existing road environments. This question is more important than customers' personal driving preferences.

Customers' preferences and demands for two-pedal

注1）伏見威蕃訳『フラット化する世界』（上・下巻）日本経済新聞社

注2）「日本のものづくりと情報技術」東京大学大学院経済学研究科教授 藤本隆宏 2007年7月

transmissions are formed in the context of the road and traffic environments found in local markets around the world. Considering this fact, not only the automakers but also automatic transmission manufacturers themselves must be thoroughly familiar with road and market environments worldwide as well as with customers' driving preferences.

In this regard, globalization presents a new set of challenges for our monozukuri operations. At JATCO, we intend to move forward with further efforts to globalize our activities, drawing upon our passion for monozukuri.

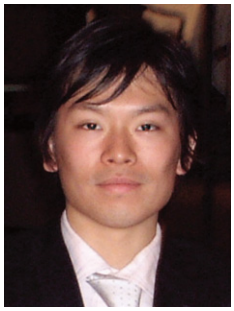
References

(1) Thomas L. Friedman, The World is Flat, Translated into Japanese (two volumes) by Iwan Fushimi, Tokyo: Nikkei Inc., 2006.

(2) "Information Technology and Manufacturing Industries in Japan," an article by Takahiro Fujimoto, Professor, Graduate School of Economics, University of Tokyo, July 2007 (in Japanese).

全日本空輸株式会社（ANA）～新たなグローバル領域への挑戦～

All Nippon Airways' New Challenge in the Global Market



鴻巣　令明*
Noriaki KONOSU

1. はじめに～航空業界トレンド～

航空業界は，今，大転換期を迎えている．レガシーキャリアと言われる老舗航空会社とLCC（ローコストキャリア）と呼ばれる新規航空会社との激しいシェア争いを繰り広げており，昨今レガシーキャリアの淘汰やLCCの飛躍について報道されるようになった．今まで想像もできない運賃やサービスを武器にLCCとレガシーキャリアであるANAがどのように戦っていくのか，非常に難しい経営の舵取りを迫られている．これは，航空業界のみならず，自動車業界におけるガソリン車からHV（Hybrid　Vehicle）車，EV（Electric Vehicle）車へとシフトしている状況に近いのではないかと感じている．羽田空港国際化を始めとした大幅な首都圏発着枠の拡大やオープンスカイ(*)の進展により，LCCを含む海外エアラインとの大競争時代に突入したが，今後まさに，ANAはこの変化について行けるのか試される大転換期を迎えており，『変化に対応出来るものだけが生き残る』という進化論の世界を強く意識し，『変化なくしては，滅びる』という危機感を持たなければならないとANAグループ全社員が感じている．一方，厳しい情勢ではあるものの，危機感のみを募らせることなく，『ピンチをチャンス!』に変えるべく，ANAグループ3万人の知恵と経験を生かし，必ずこの競争時代を勝ち抜いていきたいと強い信念をもち挑んでいきたいと感じている．

***オープンスカイ：航空会社が自由に路線，便数を決定できる協定．現行は，就航する国との間で決定される．**

1. Introduction: airline industry trends

The airline industry is currently at a major turning point. Fierce market share competition has been unfolding between long-established airlines known as legacy carriers and newly founded companies called low-cost carriers (LCCs). The shakeout among legacy carriers and the dramatic advances of the LCCs have often been reported in the news recently. The LCCs are using previously unimaginable low fares and service as their business weapons. The question of how a legacy carrier like ANA can compete effectively with such LCCs is an extremely difficult issue for the management of our business. It appears to me that not only the airline industry but also other industries are facing a similar transition. For example, the automotive industry is undergoing a shift from conventional gasoline engine vehicles to hybrid vehicles (HVs) and electric vehicles (EVs). The number of arrivals and departures at airports in the Tokyo metropolitan area is being expanded, notably by the recent inauguration of more regular international flights at Haneda Airport. That development and the progress of "Open Skies"* talks have suddenly ushered in a new age of intense competition with overseas carriers, including LCCs. ANA is facing a momentous turning point that will truly test our ability to cope with these changes in the coming years. We are well aware of the world depicted in the theory of evolution in which only those capable of adapting to change survive. All members of the ANA Group feel that we must have a sense of urgency in that unless we change, we will perish. At the same time, we must take advantage of the wisdom and experience of the 30,000 members of the ANA Group to transform this pinch into an

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2. 競合他社と伍していくエアラインになるために

ANAは，長らく国内線を主力とした経営戦略をとってきたが，2002年に基本戦略構想を作成し，グループ経営ビジョンとして『アジアNo.1』のエアラインを目指してきた．一方，リーマンショックに端を発した世界的な不景気により2008-2009年に2期連続最終赤字を経験し，非常に厳しい舵取りを迫られている．この情勢を乗り切るために，新たにチャレンジする領域として『国際線事業を成長の柱とした世界市場への挑戦!』を掲げており，羽田国際化を始め，新規路線の開拓やスターアライアンスと言われる航空連合と連携し，路線のネットワークの拡大や乗り継ぎなどの利便性を高め，より多くのお客様に支持されるアジアを代表するエアラインを目指している．この挑戦を実現するための原動力として社員一人ひとりの成長に期待しており，そのキーワードとして『グローバリゼーション』，『イノベーション』，『人財（材）』を推進したいと考えている．今後，世界のエアラインと対等に戦っていくためには，グローバルな視点と斬新な発想力を武器に世界のエアラインと伍していく熱意を持った人材を育てることが競争力の源泉になると考えているからである．

3. 航空機整備概要と整備士養成について

航空機整備は，全て法令に定められた整備規程によって実施しており，規程と言っても多種多様あるため，日本国が定める航空法に則った規程や航空機製造メーカーの整備マニュアル，航空機製造国が定める法令など多くの規程を全てクリアしなければならない．このように多くの規程を遵守し，航空機整備を実施しているが，航空機整備の間隔や深度なども細かく規程に定められている．自動車であれば，2～3年に1度車検があるが，航空機に関しては，飛行時間や離着陸回数，年月などさまざまな基準や間隔で点検や整備を行っている．整備の体系としては，大きく【運航整備】，【定時整備】に大別され，運航整備は，航空機が毎回出発・到着するタイミングにおいて航空機の健全性を確認する整備業務のことを言う．一方，定時整備は，車検と同様，整備間隔を定めて定例的に実施するものを言う．

opportunity, instead of merely heightening the sense of urgency, even though the situation is severe. We intend to tackle this challenge with the strong conviction that we will definitely succeed in this fiercely competitive age.

*Open Skies refers to an agreement whereby airlines are free to determine their routes and number of flights by themselves. Under the present system these matters are determined by the countries served by the airline service.

2. Building an airline that ranks alongside competitors

For many years domestic routes constituted the core of ANA's corporate strategy. However, in 2002 the company formulated a fundamental strategic vision that set the goal of being the number one airline in Asia as the Group's business objective. However, due to the global recession triggered by the collapse of Lehman Brothers, ANA experienced two consecutive years of losses in fiscal 2008 and 2009, putting severe pressure on the management of our business. In order to overcome this situation, we set a new challenge for ourselves of aggressively entering the global market, making the international flight business the pillar of our future growth. Our aim is to become the airline representative of Asia and one that is favored by ever larger numbers of customers. This is to be accomplished by expanding our network of regular flights and enhancing passenger convenience, including providing better connections. This will involve developing new routes, especially international flights from Haneda, and partnering closely with the global airline alliance called the Star Alliance. The growth of every employee is looked to as the driving force for accomplishing this challenge. The key concepts we intend to pursue here are globalization, innovation and human resources. In order to compete equally with the world's airlines in the years ahead, we need to develop human resources who possess the zeal to make ANA rank alongside other international carriers, drawing upon global perspectives and the power of novel ideas as our springboard. Such people will be the fountainhead of our competitive strength, which is why much is expected of them.

定時整備は，大きく3つのカテゴリーに分かれ，【A整備】，【C整備】，【HMV整備】があり，それぞれ航空機の飛行時間･発着回数，製造後の経過時間によって設定されている．（Fig. 1）

Fig. 1-1

Fig. 1-2

Fig. 1-3

Fig. 1-4

3. Overview of aircraft maintenance and development of maintenance technicians

Aircraft maintenance is carried out entirely in accordance with the maintenance regulations prescribed by law. There are many different types of rules and regulations, all of which must be met. They include the regulations prescribed in the Civil Aeronautics Act promulgated by the Japanese Diet, the procedures stipulated in the maintenance manuals issued by aircraft manufacturers, and the laws and regulations adopted by aircraft manufacturing countries, among others. Aircraft maintenance is thus performed by strictly observing these manifold regulations.

Aircraft maintenance intervals, scope and other matters are also specified in detail in various regulations. For automobiles, a safety inspection is conducted once every two or three years. However, aircraft are inspected and serviced according to various standards and intervals related to flight hours, number of takeoffs/landings and elapsed time since manufacture. The maintenance system can be broadly classified as operational maintenance and regularly scheduled maintenance. The former refers to maintenance work performed to confirm the airworthiness of an aircraft at the time of every takeoff/landing cycle, while the latter refers to maintenance work done regularly at certain specified

Fig. 1-5

Fig. 1-6

また上記の整備を行う整備士は，国家資格と社内資格の両方をそれぞれの機種毎に取得する必要がある．例えば，ジャンボジェットで知られているBoeing747-400の資格を有しているものは，B747-400の整備作業後に航空機を運航することが出来るか否か最終判断する権限を有しているが，該当機種の資格を持っていない整備士は，その判断を行うことが出来ない．そのため，ほとんどの整備士が3～4機種の国家資格と社内資格を有している．

国家資格は，入社後4年目に国家資格受験が始まり，約2年間かけて取得する．その後，入社10年目までに4機種を取得することが会社の人材育成方針として定められており，受験をしたほとんどの社員が，『大学受験の時よりも勉強した』というほど合格するまでの道のりは，まさに茨の道である．整備士にとって，資格や技術を切磋琢磨する姿勢は当然だが，さらにANAでは整備士を育てる観点として「チームワーク」と「ANAマインド」の醸成に力を入れている．Boeing747型機の定時整備では，毎日100名ほどの整備士が約1ヶ月かけて整備している．一人ひとりの技術力の高さも大切であるが，チームワークを始めとした整備士一人ひとりの結束力が，航空機整備の品質向上に大きく寄与すると考えている．そして整備士全員が，『ANAグループ全体のチームワークによって創り出される航空機こそが，世界で最も安全で安心な航空機である!』と強い信念を持って日々の厳しい作業環境下の中，整備業務に従事している．

また整備部門（グループ会社含む）で共有している言葉として「ANAマインド」というものがある．これは，他社エアラインや整備会社では培うことが出来ないANA独自の付加価値をつけて整備することを強く意識しており，常にお客様が快適で安心できる航空機を提供できるように心がけて整備作業を行っている．例えば，客室整備を行う時は，整備作業によって発生する汚れやゴミが残っていると，それを見たお客様が不愉快になるだけでなく，『航空機の安全性に不安を感じるのではないか』と考え，ゴミが1つもないことを確認してから航空機をドックアウト(*)させることを徹底している．また客室内の窓も年月が経つと擦れてスクラッチと呼ばれるひっかき傷が発生する．これは，航空機の安全性には何ら影響はな

maintenance intervals, similar to vehicle safety inspections.

Regularly scheduled maintenance can be broadly divided into the three categories of "A Check," "B Check" and "HMV (Heavy Maintenance Visit) Check". These maintenance checks are specified according to the flight hours, number of takeoff/landing cycles and the elapsed time since manufacture of each type of aircraft. (Fig. 1)

Maintenance technicians who service aircraft must acquire both national and in-house qualifications for each aircraft model they work on. For instance, technicians who are qualified to service Boeing 747-400 jumbo jets have the authority to make a final judgment as to whether an airplane can be flown or not after the completion of maintenance work. However, maintenance technicians who are not qualified to do maintenance work on this type of airplane cannot make such judgments. Accordingly, nearly all maintenance technicians possess both national and in-house qualifications for servicing three to four types of aircraft.

The process of obtaining a national qualification begins with a national certification test that a technician undergoes in the fourth year after joining the company. It generally takes about two years to obtain a national qualification. The company's personnel development policy specifies that technicians should subsequently obtain qualifications to service four types of aircraft by their tenth year with ANA. The path to acquiring these qualifications is truly an arduous one. Nearly all of the employees who have taken the qualification tests say that they studied harder to pass these tests than they did for their university entrance examinations. Naturally, maintenance technicians have to work diligently to acquire the necessary qualifications and technologies. In addition to becoming qualified, the company's perspective for developing maintenance technicians places emphasis on fostering teamwork and the ANA mindset.

In the case of a Boeing 747, about 100 maintenance technicians work every day for roughly one month in order to service one plane completely. While it is important for every technician to have high technical skills, we believe that teamwork and solidarity on the part of maintenance technicians contribute

く，スクラッチが増えても交換するエアラインは，滅多にない．しかし，ANAでは，お客様がスクラッチによって，外の景色が見えにくくなってしまう前に，交換するように規程に定めている．また技術力，経験，知識に加え，『お客様に徹底的に拘るANAマインド』を全て兼ね揃えた整備士養成にANAは力を入れており，その一例として，先輩が新入社員に対して『常に自分の家族が乗っている航空機だと思って整備の仕事をするように意識をしなさい』と，新入社員の時から常に緊張感を持って仕事をする姿勢が身につくように指導している．

***ドックアウト：整備作業完了後，格納庫から航空機を出し，運航便として使用すること**

4. 次世代航空機（B787）の新しいテクノロジーについて

B787は次世代航空機と言われるほど，現存航空機と比べ，技術革新が進んでいる．

自動車の車体は，鉄が主流であるように，現行航空機はアルミ合金が主流となっている．しかしB787では，重量軽減による燃費改善を目的に炭素繊維を始めとした複合材が約50%使用されている．（Fig. 2，Fig. 2-1）

Fig. 2 Carbon fiber for weight reductions

そのため，重量軽減による燃費向上に大きく寄与するだけでなく，アルミ合金よりも炭素繊維材の方が，材料強度が高いため，現行よりも少ない構造部材で製造するこができる．機体構造部材が強度を増したことで，客室内を現行よりも広く設計することが出来るとともに客室内の与圧を下げることができ，現行機よりも機内の快適性が飛躍的に向上された．また，客室ウインドウも大きく設計することができ，今までよりもより景色を楽しむことができるようになった．さらに

substantially to enhancing the quality of aircraft maintenance. As they pursue their daily maintenance activities in a rigorous work environment, all of the maintenance technicians possess the strong conviction that the airplanes serviced through the teamwork of the entire ANA Group are without a doubt the safest and most secure aircraft in the world.

One concept shared in common by everyone in the maintenance division, including Group companies, is the ANA mindset. Maintenance personnel are keenly aware that their aircraft servicing work creates unique ANA added value that cannot be produced at other airlines or aircraft maintenance companies. They consciously strive to carry out their maintenance tasks so as to ensure the provision of aircraft in which passengers can always travel comfortably and securely. For instance, the work of cleaning and maintaining the cabin areas can stir up dust and dirt, which, if left behind and seen by passengers, would not only cause them discomfort, it might make them feel anxious about the safety of the plane. Therefore, after maintenance work has been completed, an airplane is not taken out of the hanger and returned to service again until a thorough check has been made to confirm that not even one speck of dust remains in the cabin. Moreover, with the passage of time cabin windows may develop small scratches as a result of being scraped by something. Such scratches do not have any effect on aircraft safety and not many airlines replace the windows even if scratches become more numerous. However, ANA has a rule that windows must be replaced before scratches make it difficult for passengers to see the outside scenery.

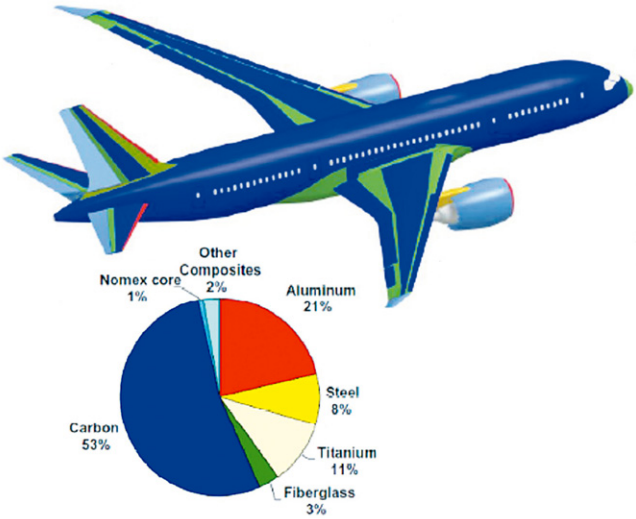

Fig. 2-1 The structual members of the aircraft body

シェードと言われる日除けパネルが，電気的にウインドウの明暗をつけることができるようになったため，日除けパネルを全てなくすことができた．（Fig. 3）

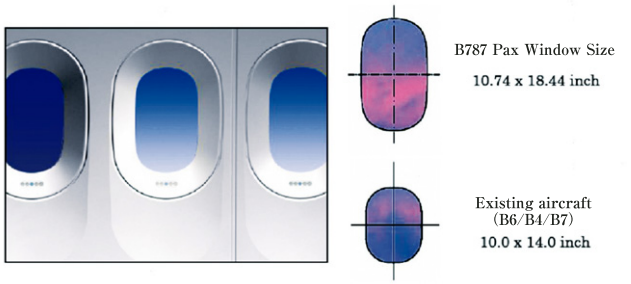

Fig. 3 Cabin windows design

また現行航空機は，客室空調を調整するためにエンジンからの圧縮空気（高温）と上空の冷気を混ぜて機内の温度調整をしていたが，B787は，新たにエアコンシステムを導入しており，家庭エアコンと同じ仕組みを採用している．そのため，エンジンから圧縮空気を取らなくなったことで，エンジン出力を抑えることができ，結果的に燃費抑制することができた．

B787は，各システムとの電気信号を現行のMetal Wire（銅線）からFiber Optic Cable（光ファイバーケーブル）に変更しており，現行Wireよりも電磁誘導ノイズの影響に強く，高速かつ大容量の情報を伝達できるため，ケーブル量を大幅に減らすことができた．（Fig. 4）

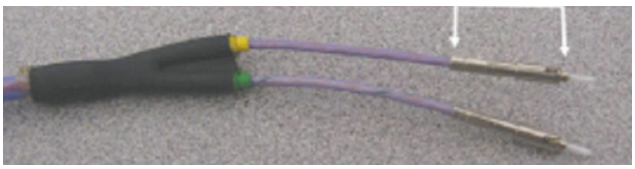

Fig. 4 Fiber Optic Cable

また整備士が，航空機システムのコンディションを確認する時や，トラブルシュートを実施する際のサポートシステムとしてTool-Boxシステムを導入した．これは，整備士のノートパソコンと機体システムを無線で繋ぎ，航空機システムの健全性確認や不具合を発見した場合のトラブルシュートをノートパソコンからインターネットを介してBoeingのマニュアルをリアルタイムに閲覧しながら整備作業ができるようになった．また，このTool-Boxシステムは，整備作業マニュアルもオンライン化されており，今までの紙のモノクロマニュアルから3Dのカラーで図面と現物を確認するこ

ANA emphasizes the development of maintenance technicians who combine technical skills, experience and knowledge with the ANA mindset that is completely devoted to passenger care. As one example in this regard, more experienced personnel advise new employees to think that their own family members are aboard the airplane they are servicing and to have that awareness at all times as they perform their maintenance tasks. In this way, the practice of always being vigilant while doing one's job is instilled in maintenance personnel from the time they are new employees.

4. New technologies of the next-generation Boeing 787

The Boeing 787 features ample technical innovations over existing aircraft to be aptly called a next-generation airplane. The body of existing aircraft is generally made of aluminum alloys, similar to the use of steel as the principal material of the automobile body. In contrast, carbon fiber and other composites are used for over 50% of the 787 body for the purpose of improving fuel efficiency through weight reductions (Figs. 2 and 2-1).

Not only do carbon fiber composites help to improve fuel efficiency substantially by lightening the aircraft weight, they also have higher material strength than aluminum alloys, enabling the 787 to be manufactured with fewer structural members than existing airplanes. Because the structural members of the aircraft body are stronger, the cabin can be designed larger than that of current aircraft. Moreover, the cabin can be pressurized at a lower level for a dramatic improvement in cabin comfort compared with existing airplanes. Cabin windows can also be designed larger in area to allow passengers to enjoy the outside scenery more than ever before. Another notable feature of the 787 is that the light-dark condition of the cabin windows can be controlled electrically, making it possible to eliminate the previous window shade panels completely (Fig. 3).

Existing aircraft air-condition the cabin by mixing hot compressed air from the engines with cold outside air in order to regulate the cabin temperature. The 787 adopts a new air-conditioning system that works in the same way as a home air-conditioner. This means there is no need to obtain compressed air from the

とが出来るようになったため，ビジュアル的に理解することが容易になり，整備作業も飛躍的に効率化が図れるようになった．（Fig. 5）

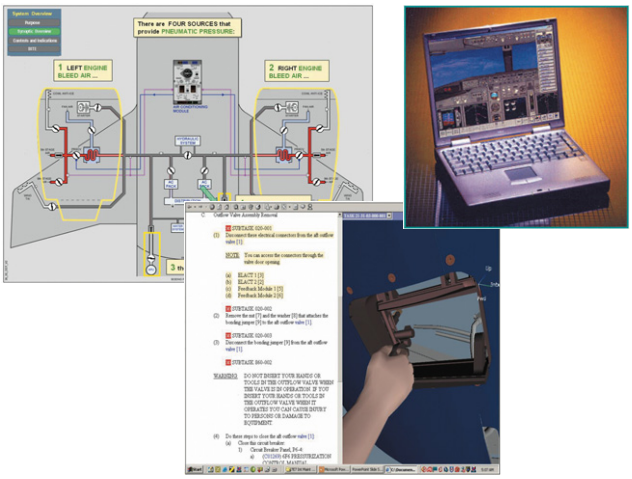

Fig. 5 Tool - Box system

5. B787を始めとしたANAの技術力発信

再三の納期延長となっているB787であるが，2011年下期には，世界で唯一Boeing787を旅客機として運航しているエアラインになっているはずである．B787は，当初導入時期よりも約3.5年遅延してデビューする予定であるが，ANAは，B787開発の発表後の2004年に世界で初めてB787を50機発注したローンチカスタマー(*)（B787を世界で始めて受注したエアライン）としてB787の設計・製造段階から携わり，より良い航空機設計・開発に貢献してきた．お客様にとって身近なものでは，世界で初めて機内トイレにウォシュレットを採用したことや，当初は機体の重量軽減のため，コックピットウィンドウからワイパーを外すことが決定されていたが，運航乗務員の視界性を維持するためにANAとして必要と考え，ワイパー設置の再設計をさせるなど，ANAとしてB787の設計・開発に携わるにあたり，最も拘った点として航空機製造メーカーでは知り得ない，ANA（エアライン）だからこそ持ち備えている経験・知識・情報を駆使して，『お客様にとって最高の航空機を創る』ことに徹底した．通常，航空機製造・開発において『安全』『品質』『快適性』の要素をいかに満たすことが出来るかが重要視されるが，更にANA独自の考えとして『あんしん』という要素をB787に盛り込むことに努めた．このようにANAは単なるエアラインとして留まる

engines, making it possible to hold down engine output, which has the effect of suppressing fuel consumption.

The electrical harnesses of all the systems on the 787 adopt fiber optic cables instead of conventional copper wires. Because optical fiber cables are more resistant to electromagnetic noise than existing metal wires, large volumes of information can be transmitted at high speed, enabling the amount of cables used to be reduced markedly (Fig. 4).

A toolbox system has also been adopted that maintenance technicians use to check the condition of the aircraft systems and which also functions as a troubleshooting support system. This toolbox system provides a wireless connection between a maintenance technician's personal computer and the aircraft systems. Maintenance technicians can now access Boeing manuals via the Internet from their personal computers and view the manuals in real time while doing maintenance work, including checking the soundness of the aircraft systems and troubleshooting detected problems. The maintenance manuals available online via this toolbox system make it possible to check actual parts against 3D color diagrams, rather than referring to monochrome paper manuals. This makes it easier to understand parts visually, thereby increasing the efficiency of maintenance work dramatically (Fig. 5).

5. ANA's technological strengths typified by the 787

After repeated delivery delays, the 787 is now scheduled to debut approximately 3.5 years behind its initial introduction date. In the second half of 2011, ANA expects to be the only airline in the world operating Boeing 787 passenger jets. Following Boeing's announcement of the development of the 787, ANA was the first airline in the world to order the airplane in 2004. ANA became the launch customer* of the 787 by placing an order for 50 planes. As such, we have been involved with the 787 since the design and development stage, contributing to the design and engineering of a better aircraft. In terms of passenger comfort and convenience, the lavatories on the plane will be the first in the world to adopt washlettes. In addition, it had originally been decided to remove the cockpit windshield wipers as

ことなく，積極的に航空機製造メーカーに技術提案を行い，より安全でお客様にとって快適性の高い航空機を提供できるようにWorking Together（協働）をこれからも製造メーカーなどを牽引できるエアラインとして航空業界全体を活性化していきたい．（Fig. 6，Fig. 6-1）

***ローンチカスタマー（launch customer）：Boeingに対して，B787（当時：7E7）について，メーカーに製造開発を踏み切らせるだけの充分な規模の発注を行い，その新型機製造計画を立ち上げる（ローンチする）後ろ盾となる顧客（カスタマー）のこと指す．**

Fig. 6 Boeing 787

Fig. 6-1 Boeing 787

6. 最後に

航空機，鉄道，自動車は，いつの時代も移動手段の選択要素として移動時間やコストが重要視されてきたが，近年においては，CO_2の排出量に関しても移動手段を選択する要素になりつつある．自動車業界のみならず，航空業界に関してもCO_2削減に向け，燃費の良いエンジン開発やより軽い航空機開発

part of the weight reduction measures. At ANA, we felt that the wipers were essential for ensuring good visibility by the flight crew, so we had Boeing redesign the plane with windshield wipers.

In the process of being involved in the design and development of the 787, the aspect we were most concerned about was to ensure that the best plane would be created for our passengers. Toward that end, thorough use was made of the unique experience, knowledge and information that we had accumulated as an airline and which the airplane manufacturer could not possible know. Ordinarily, in the development and manufacture of aircraft, top priority is given to the question of how to satisfy the elements of safety, quality and comfort. In addition to those aspects, we strove to incorporate the element of "peace of mind" into the 787 as our own concept. In this way, we went beyond our simple position as an airline and actively made technical proposals to the aircraft manufacturer in working together to create an airplane that will be safer and more comfortable for passengers. In the future, we want to continue working together to energize the entire aviation industry in our capacity as an airline capable of leading aircraft manufacturers and others.

*Launch customer refers to a customer that supports the launch of an aircraft production plan by placing a purchase order sufficiently large enough to convince the manufacturer (Boeing in this case) to go ahead with the development and production of the plane (initially the 7E7, but later redesignated as the 787). (Fig. 6, 6-1)

6. Concluding remarks

Travel time and cost have traditionally been key factors that have always been considered in selecting among air, rail and road modes of transportation. In recent years, the amount of carbon dioxide (CO_2) emitted has also become a factor in the selection of a means of transportation. Like the automotive industry, the airline industry is also working hard to develop more fuel-efficient engines and lighter aircraft in order to reduce CO_2 emissions. I think that both industries, though in different lines of business, are facing similar circumstances. Incidentally, various

に力を入れており，異業種であるものの置かれている情勢は似ていると感じている．航空機にもさまざまな部位に変速機を使用しており，FLAP（補助揚力装置）やLanding-Gear（着陸装置）などもAT変速機と同様，遊星歯車の原理を使い，機械的に可動させているものある．

創り(**)上げる製品は異なるものの最終的にお客様に最高のサービスを提供するというゴールはANAと御社で共通していると感じている．

業種・業界は異なるものの今後を担う若手エンジニアの育成に交流を深めるなど今後も両社で切磋琢磨できる取り組みなどで貢献できれば，幸いである．

****ANAでは，作る＝創ると設定しています．**

aircraft components also make use of a transmission. Flaps, landing gear and other parts are able to move mechanically by using the principle of a planetary gear set, like that of an automatic transmission.

Although the products that ANA and JATCO create are different, I believe that we share the ultimate common goal of providing our respective customers with superior service. Even though our businesses and industries are different, all of us at ANA would be very happy if we could contribute to some significant undertakings by both companies, such as strengthening mutual exchanges in connection with the development of young engineers who will be tomorrow's engineering leaders.

生産のグローバル化 ～地域性の生産への影響～

Globalization of Manufacturing—Influence of National Characteristics on Manufacturing

執行役員　佐藤　朋由
Corporate Vice President　Tomoyoshi SATO

抄　録　弊社は，メキシコ，中国と生産工場の海外現地化を進めてきた．本稿では，海外での生産方法について，特に「人」に焦点をあて，日本との違いについて考察してみたい．

Summary　JATCO has been proceeding with the globalization of manufacturing through the establishment of CVT assembly plants in Mexico and China. This article considers differences in manufacturing methods between our overseas operations and Japan, focusing in particular on people.

1. はじめに

弊社は，2005年11月からメキシコのJATCO Mexico S.A. de C.V.（以下JMEXとする）にて，2009年4月から中国のJATCO Guangzhou Automatic Transmission Ltd（以下JGZとする）にて，それぞれ生産をスタートさせ本格的なグローバル生産時代を迎えている．ここでは，日本，中国，メキシコの地域性を考慮した上で，生産にはどんな工夫がなされたかを考えてみたい．

最初にお断りしておくが，地域性には文化や価値観などに根ざすものが多く，可能な限り事実に基づきステレオタイプにならぬよう注意するが，若干客観性を欠いた内容になることは，ご容赦願いたい．

2. 各地域の「人」

日本，中国，メキシコそれぞれの地域性に違いはあるが，生産に影響する最も大きな因子は「人」であり，今回は「人」に焦点をあてて話を進めて行く．

まずメキシコの「人」である．ご存知のように非常に陽気な人達である．一年中晴天の続く国では当然の事かもしれない．物事に取り組む姿勢も同様で，前向きでモチベーションが高い．反面，あきらめるのが早かったり，時間にルーズであったりする．その侵略された歴史や米国との戦いの歴史の影響か，自尊心が強く，人前で怒られることは極端に嫌う．

1. Introduction

JATCO launched CVT production at JATCO Mexico S.A. de C.V. (JMEX) in November 2005 and at JATCO Guangzhou Automatic Transmission Ltd. (JGZ) in April 2009, thus ushering in an age of full-scale global manufacturing for the company. This article describes some of the innovative measures implemented in our manufacturing operations, taking into account national characteristics in Japan, Mexico and China.

At the outset, I would like to note that national characteristics are often rooted in culture and values, among other aspects. I have carefully tried to eschew stereotypes and base my comments on factual observations, but they may be somewhat lacking in objectivity, for which I ask the reader's understanding.

2. People of Mexico and China

There are differences in national characteristics between Japan, China and Mexico, but the factor that has the biggest influence on manufacturing is people. Here, I would like to focus the discussion on people.

Let us begin by looking at the people of Mexico. As is well known, Mexicans are very cheerful people. That may be natural since they live in a country where sunny weather prevails the year round. This same bright

教育水準について，日本の「人」はそのレベルを疑うことが多いが，決してそんなことはない．何より学ぶことに貪欲で，目標が明確であれば，彼らはしっかりと考え自ら答えを出す．忘れてはならないのは日本との関係である．1608年に千葉県の御宿で難破したメキシコの船を日本人が救助して以来，日本との交流が続いていると，こちらでは教育されており，彼らの日本人に対するイメージは良い．彼らは日本人を真面目で思慮深い人達と見てくれることが多く，尊敬してくれていると言っても良い．

次に中国の「人」である．有名な中華思想で分かる様に，メキシコと同様自尊心は強く，人前で叱られることは極端に嫌う．向上心が強く，自分自身の成長は大事にする．また，納得や理解をすれば物事にはとても真面目に取り組む．そのことを鑑みても目標はやはり明確にする必要があり，曖昧な目標では彼らの取り組みも疎かになりがちである．さらに，社会主義市場経済下で政府の意向が多大に経済活動に影響することや，両国の歴史的関係も影響して，中国の「人」は理解しにくい部分もある．

以上，両国の「人」について簡単に述べたが，共通して言えることがある．

・自尊心が強く，人前で叱られることを嫌がること．
・明確な目標があれば，それに向かっていくこと．
・自分の成長を大事にすること．

である．

3. 日本の「人」

日本人は，阿吽の呼吸で相手の意図することを理解したり，それを要求したりする．「門前の小僧習わぬ経を読む」と言われるように，教えられなくても自分で学ぶことが美徳とされる．教えるときには，教えられる側の尊厳を無視してまで人前で叱りつけることがあるなど，日本人は彼らに合わない文化を持っていることを理解するべきである．問題解決が得意だと言うことも，もう一つの問題点である．もちろん大事なことなのだが，長所を伸ばしてやろうと言う姿勢に欠け，悪いところばかり見てしまう．日本では，同一教育水準の人達との接点が多く，単語一つとってもほぼ同じ意味で理解されており，しかも難解な意味の単語を平気で使っている．X軸・Y軸などがどっ

disposition is also seen in their approach to doing things, as Mexicans are highly motivated and have a positive outlook. On the other hand, they can be quick to give up and lax about time. Mexicans have high selfesteem and extremely dislike being scolded in front of other people. Those traits might be influenced by Mexico's history of being invaded or its history of conflict with the United States. While Japanese people might question the educational standards in Mexico, the levels are certainly not low. Mexicans have a strong desire to learn, and when the objective is clearly defined, they consider the matter thoroughly and come up with an answer by themselves. One aspect that should not be overlooked is the relationship between Mexico and Japan. In 1608, a ship from Mexico was wrecked off the coast of Onjuku in Chiba prefecture and the crew was rescued by the villagers. That event led to continuous exchanges with Japan and is taught to school children in Mexico, so they have a favorable impression of Japanese people. Mexicans generally see Japanese as being earnest and thoughtful, and it would be safe to say that they respect Japanese people.

Next, let us take a look at the people of China. As can be understood from the well-known term Sinocentricism, Chinese have strong self-esteem and extremely dislike being scolded in front of other people, just like Mexicans. Chinese are highly ambitious and place great value on their own personal advancement. Once they understand or are convinced of something, they tackle it very earnestly. Keeping that in mind, it is essential to define objectives clearly, as Chinese are apt to neglect their efforts if objectives are vague. Moreover, in China's socialist market economy, the government's intentions have an enormous impact on economic activities. Owing in part to the influence of the historical relations between Japan and China, there are certain aspects of Chinese people that are hard to understand.

The foregoing discussion has briefly described the people of Mexico and China. They share the following points in common.

・They have strong self-esteem and dislike being scolded in front of others.
・They work hard to achieve clearly defined objectives.
・They value their own advancement.

ちを向いているのかを海外で皆が理解していると思ってはいけない．日本人が当たり前と思っていることも海外では当たり前ではないことを，日本人は理解すべきである．

そういうことを理解しないで一生懸命仕事を教えて，つまり教えた気になって，理解してくれない現地の方に苛立つ日本の「人」を沢山見た．

日本人は，本当に自分の言っていることが相手に伝わっているのか慎重に確認すべきだし，教える時は自分の暗黙知も形式知化するくらい考え抜いて教えなければならない．そして，相手の尊厳を考えて教えることが必要であり，何より，「人」の長所を上手く引き出してあげることが大事である．

4. グローバルな生産方法

以上，地域ごとの「人」の違いを述べてきた．これ以外に労働法や労働契約など地域特有のものは存在するが，「人」に関しては日本の方が特殊に思える．生産を定着させるには，2項で述べた地域共通の原則と3項で述べた日本の「人」の弱点を理解した上で方策を練れば，海外においても日本の方法は通用する．

当然モラルや規律・躾は必要である．日本では既に定着しているこれらのものは，やはり導入する意味がある．食べ物を持ち込まないことや清掃を徹底させることは，機械の安定を実現し夾雑を防止する．制服はだらしなく着用すると怪我に繋がるなど，その意味合いが理解されれば当然のように守らせることが出来る．

次に，明確な目標値を与えることである．定量的に計れるものをしっかりと与え，それが常に見えるようにしておく．モチベーションを上げるために，トップマネジメントが褒める，叱咤激励することも重要である．

もう一つは，考えさせることだ．向上心が高く自分の成長を何より望んでいる彼らには，常に考えさせ小さな改善を繰り返させる．それにより個々人が成長を感じられ，高いモチベーションが維持される．繰り返される小さな改善がやがて早くなり，大きな改善と繋がる．

3. People of Japan

Japanese tend to understand another person's intentions on the basis of a unity of feeling and action and demand similar behavior in others. Learning on one's own rather than being taught is regarded as a virtue in Japan, as can be seen in the Japanese proverb, "a shop boy near a temple will chant a sutra untaught." Japanese should recognize that they have certain cultural traits which are not in accord with the sensibilities of others. One example is the notion that in the process of teaching something you sometimes go so far as to ignore the dignity of the ones being taught and scold a person in front of others. Another problematic point is the belief that Japanese are good at problem-solving. Naturally, solving problems is important, but there is a tendency to see only the bad things and to lack a posture of trying to build on another person's strong points. In Japan, people who have attained the same level of education share many things in common. The meaning of a single vocabulary word, for instance, will be understood by everyone in virtually the same way. Moreover, people do not hesitate to use words that are difficult to understand. However, Japanese should not think that all people in other countries automatically know in which direction the x-axis or the y-axis points. Japanese should realize that some things they take for granted are not always taken for granted overseas.

I have seen many Japanese who did not comprehend that point and became irritated with local people for not understanding something that the Japanese person was trying hard to teach them.

Japanese should carefully confirm that what they say is really being communicated to another person. When teaching others, Japanese should at least think through a way of teaching that transforms personal implicit knowledge into formal knowledge for others to understand. Furthermore, it is necessary to consider the other person's dignity when teaching. Above all, it is important to skillfully bring out the strong points of others.

5. 海外生産上の工夫

ここでは，JMEXの事例について紹介する．JMEXには，躾の10カ条と呼ばれるものがある．詳しくは省くが，生産エリアへの食物持ち込み厳禁や，制服の着用方法など10項目のルールが決められており，定期的に遵守状況をモニターしている．

Fig. 1 JMEX Activity Board

次に活動板である．JMEXでは活動板を多用しており，しかもその使用方法は全てのラインで統一されている（Fig. 1）．横に3分割された上の部分にはQ.D.C（Quality, Delivery, Cost）それぞれの各ラインの現状がグラフで貼られている．全ラインで同一の指標を定義してあり，フォームも統一してある．二段目以降は，何を問題として扱ったか，それをどう改善しようとしているかを説明するデータと解析結果を表示している．二段目以降は自由掲載だが，マネジメントがレビューする際に使用する．右の下には，前述の躾を計測したデータが貼り付けてある．これによって各ラインの現状は一目で分かる様になっており，指標が統一されているので比較も容易となっている．

上記の活動版を用いた社長，生産部門トップ，工長，リーダによる定期的なレビューミーティング（Fig. 2）を通じて課題解決を図っている．JMEXでは，全てのライン及び検査・保全などのサポート部隊も1回/月ブラボーさんと菊川社長のレビューを受けている．トップはこの活動板で目標との乖離を理解し，各工長やリーダに解決を促している．

その他，QRQC（Quick Response Quality Control）と呼ばれる朝のミーティング方法，現場管理グルー

4. Global Manufacturing Methods

The previous sections described various differences among the people of the three countries. In addition to those points, there are other characteristics that are peculiar to each country such as labor laws and employment contracts. It seems to me that Japan is an exceptional case when it comes to people. In the process of establishing manufacturing operations overseas, Japanese methods will also work in other countries if the approach taken is devised on the basis of the shared principles described in Section 2 and an understanding of the weak points of Japanese explained in Section 3.

Naturally, morals, order and discipline are necessary. There is significance in instilling these aspects that are firmly rooted in Japan. For example, not bringing food into the workplace and cleaning work areas thoroughly ensure the stable operation of equipment and prevent foreign matter from getting into products. Wearing one's uniform in a slovenly manner can lead to injuries. If the meaning of such actions is properly understood, other people will also observe them as a matter of course.

Another important thing is to give people clearly defined goals. Assigned goals should be measurable quantitatively and should always be visible. In order to heighten motivation, it is important for top executives to praise employees and give them inspiring pep talks.

Still another important aspect is to get people to think. Many employees are ambitious and desire most of all to advance themselves. Managers should always get them to think about ways of implementing small improvements repeatedly. In that way, every individual will feel a sense of personal advancement and will remain highly motivated. Before long, repeated small improvements will be made more quickly and lead to major improvements.

5. Innovations in Overseas Manufacturing Operations

Here, I would like to describe some examples at JMEX. JMEX has a work code called the ten articles of discipline. While I will not go into the details here, these articles specify rules about such things as not bringing food into production areas and the proper

プによる改善の具現化，全員参加の提案制度，生産性ボーナスと呼ばれる報奨制度などの仕組みを有している．これらの仕組みは内容こそ地域に合わせた形になっているが，発想は日本独自のものであり日本の生産方法と大きな違いはない．但し，いずれも4項で述べた躾，モラル，具体的目標値，考えさせることをより具現化した形に変形させ定着させている．

6. おわりに

以上，地域性，特に地域の「人」がどの様に生産方法に影響しているかを考察してきた．確かに地域毎に「人」の違いは存在する．しかしながら，「人」がモチベートされるには，地域には関係のない共通の原則も同時に存在する．その原則を上手に使えば，日本の生産方式は海外にも充分移植可能であり，その意味において生産に地域ごとの差はないと言えるのであろう．

Fig. 2 Management review

way of wearing a uniform. How well employees are observing these rules is monitored periodically.

Another example is the JMEX Activity Board (Fig. 1). JMEX uses many Activity Boards and the way they are used is unified across all the production lines. The board is divided horizontally into three rows. Graphs are posted in the top row to show each line's present status with regard to QDC (Quality, Delivery, Cost) targets. Unified QDC indexes are defined for all the lines and the forms used are also unified. From the second row down, data and the results of analyses are shown to indicate what issues have been addressed and what improvements were attempted. The production lines are free to post whatever they want in the second and third rows, but this space is also used to present the results of management reviews. The lower right area is for posting measured data about the discipline articles mentioned earlier. The information posted on an Activity Board makes it possible to know the status of every line at a glance. Lines can also be compared easily because unified indexes are used.

Activity Boards are used in efforts to resolve problems at regular management review meetings attended by the president, the manufacturing division head, foremen and team leaders (Fig. 2). All of the lines and also support teams, including inspection and maintenance, undergo a monthly review by Subdirector General Jose Luis Bravo Zarza and JMEX President Kikugawa. Top management can tell from the Activity Boards if lines are deviating from the specified goals and urge the foremen and team leaders to implement solutions.

Other JMEX systems include a morning meeting called Quick Response Quality Control (QRQC), the practice of instituting improvements through shop floor control groups, a suggestion system for all employees and an incentive system called productivity bonuses. While the details of these various systems have been tailored to match national characteristics, the ideas originated in Japan and the approaches do not differ appreciably from the manufacturing methods used in Japan. However, the ideas mentioned in the previous section regarding discipline, morals, setting definite goals and getting people to think have been instituted in more concrete and different forms from what is found in Japan.

6. Concluding Remarks

This article has considered how national characteristics, especially people, influence manufacturing methods. To be sure, people differ from one country to another. However, at the same time, common principles unrelated to nationality also exist for motivating people. If those principles are skillfully used, Japanese manufacturing methods can be fully transplanted to overseas operations. In that sense, one can safely say that there are really no national differences in manufacturing.

オートマチック車のグローバルな状況について

Global situation of Automatic Transmission vehicle

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抄　録　本稿では，グローバル市場でのオートマチック･トランスミッション搭載車の状況について調査し，グローバル状況を考察した．今後の市場をつかむためには，主に中国や新興国向けの廉価トランスミッションと日米市場の燃費競争を勝ち抜くミッションの開発が重要である．

Summary　This article describes the global situation for automatic transmission vehicles based on a study of their present status in various markets around the globe. In order to capture market share in the future, it will be essential to develop low-cost transmissions primarily for China and other emerging markets and fuel-efficient transmissions that can win the fuel economy battle in the Japanese and American markets.

1. はじめに

日本国内やアメリカ市場ではオートマチック･トランスミッション車（以下AT車）の比率が90%を超え，普通の乗用車でマニュアル･トランスミッション車（以下MT車）が選べない状況があたりまえの状況となっているが，30年前の状況はまったく逆の状況であった．AT車は価格が高く，燃費が悪い，運転もしにくいということで，AT車を選ぶ人は少数派であった．当時のATは3速が主流でクラッチ操作が苦手の人たち＝運転の下手な人の車というイメージが強かった．

しかし，その後交通状況の変化（渋滞のひどさ）などと，ATの技術の進歩により北米，日本ではAT化が進み現在に至っている．しかし，ヨーロッパでは半数以上がMT車という状況もあり，地域により特色がある．本稿では，各地域の特色から今後のAT車の動向を考察した．ATの種類としては，いわゆる遊星ギアを用いた多段AT（以下STEP AT），CVT，デュアルクラッチトランスミッション（以下DCT）オートメーティッドMT（以下AMT）がある．

1. Introduction

The percentage of vehicles equipped with an automatic transmission (AT vehicles) in the Japanese and American markets exceeds 90% today, creating a situation where it is taken for granted that a manual transmission is probably not available on ordinary passenger car models (MT vehicles). This situation is the exact opposite of what it was 30 years ago. At that time buyers choosing AT vehicles were in the minority because such cars were expensive, their fuel economy was poor, and they were thought to be hard to drive. Three-speed units were the mainstream ATs then, and there was a strong impression that AT vehicles were for people who were not good at operating the clutch, i.e., who were poor drivers.

However, changes in traffic conditions, such as worsening congestion, and advances in AT technology since then have promoted the diffusion of ATs in North America and Japan, resulting in their predominance today. There are distinct regional differences regarding transmission usage, however, as MT vehicles account for over half of the vehicle population in Europe. This article considers future trends in AT vehicles, based on such regional characteristics. The types of ATs considered here are multi-speed ATs (referred to as stepped ATs) built with planetary gearsets, continuously variable

2. グローバルな全体状況

調査会社の分析による，2008年の実績と2020年での予想をグローバルな全体車両生産台数とそのトランスミッション別の状況をまとめたものをFig. 1に示す．この図から見てもわかるように，従来，日米欧の3地域での区分けで状況を語ることが多かったが，昨今の各国の経済発展の状況を見ると，日-含む韓国，米-北米，欧のほかに，所謂BRICs（ブラジル-含む南米諸国，ロシア，インド，中国）を無視するわけにはいかない状況であることがわかる．特に，中国の伸び率は3倍にもなり，最も重要な地域であることがわかる．

2. Overall Global Situation

Figure 1 breaks down the total vehicle production volume in each region of the world in 2008 by the type of transmission used and shows the corresponding projections for 2020. These data are based on an analysis done by CMS Worldwide, a market research company. Previously, global vehicle production was often discussed largely in terms of the three major markets of Japan, America and Europe. However, as the statistics in this figure make clear, in addition to Japan (including South Korea), North America and Europe, the markets of the so-called BRICs (Brazil (plus other South American countries here), Russia, India and China) cannot be ignored today. This is particularly true for China, which has become the most important market, where the vehicle production volume is projected to grow threefold from 2008 to 2020.

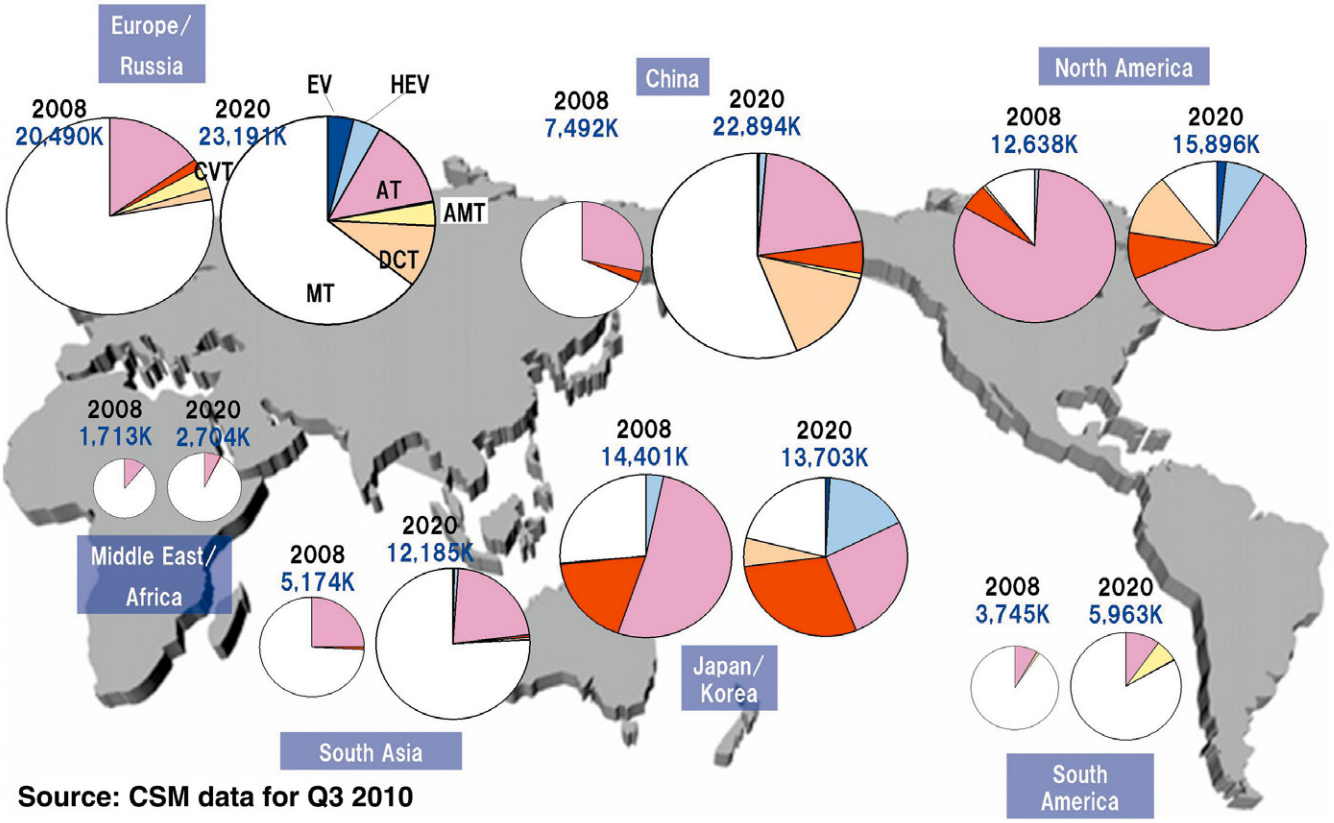

Fig. 1 Actual and projected vehicle production volumes and percentage of AT vehicles

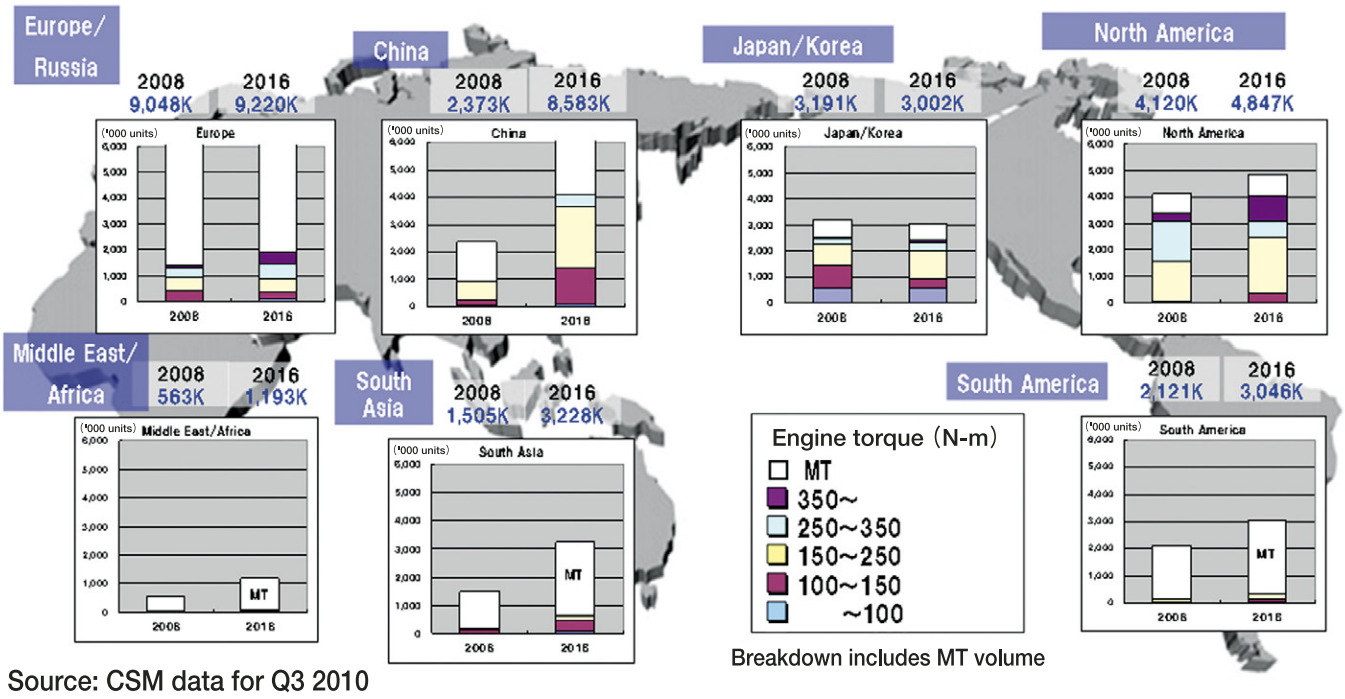

Fig. 2 Change in percentage of AT vehicles and their breakdown by engine torque

3. 地域ごとの状況

ここでは，各地域の状況について個別に説明をする．地域ごとの2008年と2016年のMT車の比率とAT車のエンジントルク別の内訳をFig. 2に示す．このデータを用いて以下に各地域毎の状況を説明する．

3.1. 日本と韓国の状況

日本はすでにAT車比率が95%を超えアメリカとならぶ2大AT車大国である．ただし，絶対的な台数が飽和している現在これ以上伸びる状況ではない．しかし，技術面からいえば，非常に厳しい競争環境になっている．また，特色のひとつに，他地域と異なりCVT車の比率が高いことやスモールカーのAT車比率が高い．特に日本固有の軽のゾーンは，従来イニシャルコストとランニングコストの両面が安価であることで買われていたため，3速か4速のSTEP AT車の設定が主流であったが，ここ2〜3年では，CVT車が多く設定されてきた．昨今のECOカーブームのなか，CVT=燃費がよいというイメージがあることで，CVT車というネームバリューがつき，売れるといった状況も日本だけの特徴的な状況である．装備をMT車に対して充実させ，お買い得感を増やすといった，カーメーカーの販売戦略もあり，他の地域とかなり違っ

3. Situation in Each Region

This section looks at the situation in each region separately. Figure 2 shows the volume of MT vehicles and a breakdown of the AT vehicle volume by engine torque in each region in 2008 and in 2016. The situation in each region is explained below on the basis of these data.

3.1. Situation in Japan / Korea

The percentage of AT vehicles in Japan already exceeds 95% of new car sales. Japan and the U.S. rank together as the two markets where AT vehicles are most predominant. This figure will not rise above the present level though, as the absolute vehicle volume is now saturated. From the standpoint of transmission technology, however, an extremely competitive environment exists among different AT types. Other distinctive characteristics different from other regions are the high percentage of CVT-equipped vehicles and the large ratio of small cars fitted with an AT. In Japan's unique minivehicle segment in particular, consumers have traditionally purchased these vehicles both for their low initial cost and low running cost. Accordingly, 3-speed and 4-speed stepped ATs were previously the mainstream gearboxes, but many models have offered a CVT these past two or three years. Amidst the recent boom in eco-friendly

た状況となっている．ただし，最近はやはりハイブリッド（以下HEV車）が30Km/Lを超える燃費のよさと，国からの補助金対象により，脚光を浴びている．今後は，安価なHEVの普及により，燃費がよいからといって価格をむやみに上げることができない，厳しい市場であることは間違いない．

韓国の状況は，最近AT車比率が急激に上昇してきており，昨年はAT車比率が90%を超えている．これは，都市部における渋滞のひどさと韓国経済の発展によるものと考えられる．都市部は路上駐車が多いことと一般的に都市部の幹線道路以外は道が狭いため，1Lクラスの車両が多く走行している．最近このクラスのAT車の比率も上昇してきており，日本と非常に似通った市場となってきている．また，音の問題など日本人との性能の要求値が異なっており，性能の目標値に対しては注意する必要がある．さらに，CVT車については，最初に市場投入されたゴムベルトCVTの耐久性がなく，お客様がすぐ壊れるものというイメージ持ってしまったため，カーメーカー側も採用に対し懸念をもっている状況もある．

3.2. アメリカ（カナダ，メキシコ含む）の状況

もう一方の2大AT大国のアメリカであるが，全需は伸びると予想されているが，AT車比率は殆んど変わらない（Fig. 2参照）．Fig. 1を見ると，DCTが増え，CVTが微増している．実際にFORDのDCTやFIATと傘下に入ったクライスラーなどがDCT採用，もしくは計画しており，エンジントルクで150～250Nmでの採用が増えると予想される．これに対し，日本車は主にCVT車を投入する計画であり，CVTとDCTの戦場となることに間違いない．CVTは現在でも市場で評価されており，これからDCTの車両が投入され，燃費以外での性能で受け入れられるかがキーとなる．特に発進時の性能が重要な市場で，DCTの性能が受け入れられるかが分かれ目になると考えられる．また，アメリカの特徴として大型トラックの市場があり，ここはFRミッションの多段化が進むと考えられる．大型トラックはBIG3の独壇場であり，各社自社もしくはパートナーを選びSTEP ATの多段化が進むと考えられる．

vehicles, CVT-equipped cars have sold well because of their widespread reputation for efficiency, owing to the public's impression that a CVT equals good fuel economy. This sales situation is another characteristic found only in Japan. The automakers have also adopted a sales strategy of providing enhanced equipment features on CVT-equipped models compared with MT vehicles, so as to heighten the impression of value for money. This situation is also quite different from other regions. However, as might be expected, hybrid electric vehicles (HEVs) have been in the limelight recently because of their excellent fuel economy exceeding 30 km/L and the government's subsidy program for the purchase of eco-friendly cars. Without a doubt, the spread of low-cost HEVs in the future will create a fiercely competitive market situation in which manufacturers will not be able to raise their prices unduly simply because a vehicle has good fuel economy.

In South Korea, the percentage of AT vehicles has risen rapidly in recent years, surpassing 90% in 2009. This increase can presumably be attributed to the worsening of traffic congestion in urban areas and to the ongoing growth of the Korean economy. A lot of 1-liter class vehicles are on the road in urban areas due to the widespread practice of parking on the street and the general prevalence of narrow streets except for arterial roads. The percentage of AT vehicles in this class has also risen in recent years, resulting in a market that very closely resembles Japan's. Korean customers' demands for performance, including quietness, differ from those of consumers in Japan, making it necessary to pay careful attention to performance targets. The first CVT-equipped vehicles put on the market in Korea had a rubber belt drive system that lacked durability, so Korean buyers have the impression that CVTs soon break down. That image has made automakers cautious about adopting CVTs on vehicles sold in Korea.

3.2. Situation in America (including Canada and Mexico)

While overall vehicle demand is projected to increase in America, the second market where AT vehicles predominate, the percentage fitted with an AT is not expected to change much (Fig. 2). The transmission breakdown in Fig. 1 indicates an increase in DCTs and a slight rise in CVTs. An

3.3. 欧州（含むロシア）の状況

車両全体では大きな市場であるが，AT車比率は低い．将来的には30%程度になると予想されている．種類としてはやはりDCTの増加が予想されている．これは，DCT自体が欧州生まれの技術であること，つまりもともとMTの技術，生産が優位な欧州で伸びることは，簡単に想像できる．しかし，高トルクエンジンのFR車用のミッションはSTEP ATが伸びる市場である．

欧州でAT車が受け入れられない原因のひとつには，トルクコンバーターのすべりが，MT車のクラッチすべりに似ており，ミッションが壊れたというイメージを受けることがあると思われる．これは，ドライバーの意にそわない挙動ということで，古くからいわれている．しかしながら，DCTが登場し欧州以外で新しい技術として受けられているが，思ったよりも伸びがない．渋滞も大都市ではひどいが，自動化が進まない．これは，ひとつは価格の差があると考えられている．Cセグメント以下の車両ではやはりMTとATの価格差は大きいものととられる．また，壊れたときに走行不能になるケースが多く，前兆もなく壊れるといったイメージがいまだ強いのかもしれない．しかしながら，ATの多段化や効率の向上などの研究が盛んな場所も欧州，特にドイツが中心であることも，事実である．

3.4. 中国の状況

中国での状況はAT比率は30%超えたところである．2016年の予想では比率は変わらないものの，全需の伸びが3倍にもなるためこれにより，AT車の台数が伸びる．Fig. 1からわかるようにDCTが大きく伸びると予想されているが，これは中国政府の新技術採用の補助によるものが大きい．DCTに対し国が新技術と認めており，これを研究や開発するものに対する援助金が払われ多くの企業がこれを元に採用を検討しているためである．しかし，現実的に車両に採用するとなると，かなりの技術的な課題が表面化している．ひとつは価格の問題である．中国におけるMTの価格は非常に安く，これに対しATは2倍以上の価格となり，車両価格にこの差を乗せると非常に高価になってしまう点である．この価格差による購買意欲の鈍化を中国の地場メーカーは心配している．

increase is forecast for the use of DCTs on vehicles in an engine torque range of 150-250 N-m. This is related to the actual adoption of DCTs or plans for their use by Ford and Chrysler, the latter now allied with Fiat, among other automakers. With the Japanese automakers mainly planning to supply CVT-equipped vehicles, the American market will undoubtedly become a battleground between CVTs and DCTs. At present, CVTs already enjoy a good reputation in the market. As DCT-equipped vehicles are launched in the coming years, a key question will be whether their other performance attributes besides fuel economy will be accepted by consumers. In this market where start-off acceleration capability is especially important, DCT performance in this regard will likely be the telling factor of their acceptance. Another feature of the American market is the prevalence of large pickup trucks. It is projected that more speed ranges will be added to the transmissions used in the rear-wheel-drive systems of these vehicles. Large pickup trucks have traditionally been the exclusive segment of the U.S. Big Three automakers. The automakers or their selected transmission maker partners are expected to add more speed ranges to their stepped ATs.

3.3. Situation in Europe (including Russia)

Europe is a large market in terms of the total vehicle sales volume, but the percentage of AT vehicles is low. It is projected that AT vehicles will account for around 30% of total vehicle sales in the future. In terms of transmission type, an increase in DCTs is forecast in the coming years. The reason is that the DCT is a technology that originated in Europe. In short, it was originally an MT technology, so it is easy to imagine that DCT sales will increase in Europe where production of this type of gearbox enjoys an advantage. However, stepped ATs are expected to increase in this market as the transmission for rear-wheel-drive vehicles with a high-torque engine.

One presumed reason why AT vehicles are not well accepted in Europe is that the slipping of the torque converter resembles the slipping of the clutch on an MT vehicle, which gives the impression that the transmission is broken. It has long been pointed out that this behavior runs counter to the driver's wishes. However, the DCT has been accepted as a new

海外のメーカーは，価格差を室内装備などの仕様差に付け替えているといった価格戦略を持っているが，地場メーカーの車両はもともと安価であるため，海外メーカーのようにできない．また，ATはエンジンとの強調制御が必要であり，古い制御の中国製のエンジンでは対応が難しいこともある．これに対し，従来からエンジン制御は欧米の制御開発会社が大半を占めており，ATの制御も手を出してきている．もともと，自前で制御開発や認証試験の実施までできる会社がなく，この領域はすべて外資がやっていることもあり，地場のメーカーが主導権を握れない状況である．このような中で，実際は250Nm以下のエンジンを積む小型車が増えることもあり，比較的安価な4速STEP ATがまずは主流となると考えられる．

一般的には第3規制を2016年にクリアするためには4速ATが中心である現状ではかなり厳しい状況であると考えられていた．実際の規制が緩和されるか，中国の地場メーカーには優遇措置が取られるなどの憶測がされていた．しかし，すでに第3規制をクリアしたと公表された車両の中に4速AT車が何車種かが含まれている（Fig. 3）．これらの車両は，ファイナルギア比をハイ側に持っていくことにより動力性能をある程度犠牲にしてクリアしている．排気対応を実際にやっている欧米の制御部隊の知恵と考えられる．また，もうひとつの課題に，製品輸入の関税の高さがある．20%を超える関税が部品にかけられては，部品の輸入は限られる．ATはもともと高価な部品であり，関税を逃れるために，多くの会社がAT工場を建設することになると考えられる．

このような状況の中，ここ数年は，安い車両が売れることには間違いないので，MTとの価格差が少なくなり，リーズナブルなものになれば，急激に進むと考えられる．人口規模が非常に大きいので，台数だけを見れば，GDPが上昇するにつれ，AT車の台数は増えていくが，全体台数は廉価車で伸びていくので，AT市場の争いは厳しいものとなるだろう．

technology in markets other than Europe, but sales have not risen as much as was expected. Even though traffic congestion is terrible in big cities in Europe, a switch to automatic shifting has not progressed. One reason for this is probably the price difference. There is a large price difference between an MT and an AT on vehicles in the C segment and lower. Additionally, when an AT breaks down, it often makes the vehicle undriveable. European drivers may still have a strong impression that an AT suddenly breaks down without any warning. Nonetheless, it is also a fact that a lot of research is done in Europe, particularly in Germany, concerning the improvement of AT efficiency, the addition of more speed ranges and other aspects.

3.4. Situation in China

In China, over 30% of new vehicles today are equipped with an AT. The forecast for 2016 shows no change in the percentage of AT vehicles, but since the total vehicle demand is projected to triple, it will increase the number of AT vehicles accordingly. As seen in Fig. 1, the percentage of DCTs is expected to rise substantially. This is largely due to the support provided by the Chinese government for the adoption of new technologies. The government recognizes the DCT as a new technology and provides financial assistance to those engaged in related R&D activities. Many companies are considering adopting DCTs on that basis, which explains the projected increase. However, the actual adoption of DCTs on production vehicles will bring quite a few technical issues to the surface. One such issue is price. The price of MTs in China is exceptionally low, whereas ATs cost twice as much or more. When that difference is added to the price of a vehicle, it makes the vehicle extremely expensive. Domestic manufacturers in the Chinese market are worried that this price difference may dampen consumers' desire to purchase a vehicle. Overseas manufacturers have adopted a pricing strategy of offsetting the price differential though specification differences, including interior equipment features. However, domestic manufacturers cannot do that because their vehicles are low-cost products from the beginning. In addition, today's ATs require cooperative control with the engine, but it is difficult for the old control systems of Chinese-made engines to accommodate that

Foreign/ domestic	Manufacturer	Model	Displacement (cc)	T/M	Vehicle weight (kg)	Fuel economy (L/100 km)
Foreign capital	CHONGQING CHANGAN SUZUKI	ALTO	996	4AT	915	6.2
	GUANGQI HONDA	CITY (without Sunroof)	1497	5AT	1134	6.8
		CITY (with Sunroof)	1497	5AT	1148	6.8
	BEIJING HYUNDAI	VERNA	1396	4AT	1065	6.5
			1396	4AT	1065	6.2
	DONGFENG YUEDA KIA	FORTE	1591	4AMT	1210	7.1
		RIO	1399	4AT	1158	6.6
			1599	4AT	1160	6.8
	SHANGHAI GM	SAIL	1206	5AMT	1030	5.9
			1399	5AMT	1070	6.1
	SHANGHAI VOLKSWAGEN	LAVIDA	1390	7DCT	1325	6.5
		OCTAVIA	1390	7DCT	1380	6.4
			1390	7DCT	1326	6.1
		SUPERB	1390	7DCT	1480	6.7
Domestic	ANHUI LIANGHUAI VANGTIAN	TONGYUE RS	1299	5AMT	1060	6.3
		TONGYUE	1299	5AMT	1100	6.3
		YUEYUE	1075	5AMT	915	5.7
	GWPICKUP	FLORID	1298	5AMT	1080	6.5
	LUACHEN - JINBEI	JUNjie FRV	1499	4AT	1215	6.9

Foreign/ domestic	Manufacturer	Model	Displacement (cc)	T/M	Vehicle weight (kg)	Fuel economy (L/100 km)
Foreign capital	FIRST AUTOMOBILE WORK SHOP - VW	SAGITAR	1390	7-Speed DCT	1425	6.4
		MAGOTAN	1390	7-Speed DCT	1460	6.5
		BORA	1390	7-Speed DCT	1335	6.4
		GOLF	1390	7-Speed DCT	1370	6.0
			1598	7-Speed DCT	1295	6.6
	JIANGXI CHANHE - SUZUKI	WAGON R+	1372	5AMT	900	6.0
						6.1
	SHANGHAI GM	EXCELLE	1598	6AT	1405	7.4
					1410	7.6
					1475	7.8
	TFTM	COROLLA	1598	4AT	1280	7.2
					1290	7.2
	BEIJING BENZ	BENZ C180	1597	5AT	1615	7.7
	BEIJING HYUNDAI	ELANTRA	1591	4AT	1215	6.8
	CHANGAN - FORD - MAZDA	NEW FIESTA	1498	4AT	1120	6.7
					1130	6.7
		MAZDA 3	1598	4AT	1244	7.2
					1256	7.2
Domestic	CHERY	QQ3	812	5AMT	900	6.2
	CHONGQING CHANGAN	BENNI MINI	999	5AMT	870	5.7

Fig. 3 Vehicles complying with China's Phase III fuel economy standards
Specifications of vehicles qualifying for subsidies (two-pedal vehicles only)

3.5. その他の地域

その他の地域ではインド主体の南アジア地域と南米が大きな市場となる．両市場ともFig. 1，2を見てわかるようにMT車の市場である．これは，やはり廉価な車両が今後も伸びる市場であり，AT車の価格差が影響する．中国のように政府の援助もなく，特に南米は欧米，日韓のカーメーカーのみの市場であり，地場のメーカーが存在しない．各メーカーとも現地での生産をしているが，MTが主流である．道路状況はどこの都市でも渋滞は激しくなってきており，自動化の要望は高いが車両が高くなるため，部分的な車両でしか搭載されない．この地域も中国と同様にMTと価格差の少ないATが投入できれば，シェアは伸びていくと考えられる．日本や韓国のようにある程度時間がたち，経済レベルが上昇するまでは，ATに払うお金はないと考えられる．

requirement. In this regard, most engine controls have traditionally been created by European and American companies engaged in control system development, and they have also taken on the development of AT control systems. There are no domestic Chinese companies that are capable of developing control systems by themselves and conducting homologation testing. Activities in this area are done entirely by foreign capital companies, and domestic manufacturers are not in a position to take the initiative. Against this backdrop, small cars fitted with engines generating 250 N-m of torque or less are actually increasing at present. It is expected that relatively inexpensive 4-speed stepped ATs will be the mainstream transmission initially.

The general thinking has been that the 4-speed ATs that are currently the principal automatic gearboxes will have a difficult time complying with the Phase III fuel economy standards by 2016. It has been speculated that either the standards would be relaxed or some preferential measures would be adopted for domestic Chinese manufacturers. However, among the vehicles that have been publicly announced as complying with the Phase III standards, there are several models equipped with a 4-speed AT (Fig. 3). These AT vehicles comply with the standards as a result of sacrificing power performance to some extent by setting the final gear ratio on the high side. Presumably, this indicates the wisdom of the control system teams of the European and America manufacturers that have already dealt with exhaust emission regulation compliance.

Another issue is the high duties levied on imported products. The importation of auto parts is limited because they are subject to duties of over 20%. Because ATs are originally expensive parts, it is projected that many companies will avoid these high import duties by building AT assembly plants in China.

Given these circumstances, there is no doubt that low-cost vehicles will sell well in the next few years. If the cost difference with MTs can be reduced to make the price of ATs more reasonable, they can be expected to spread rapidly. Looking only at the volume of vehicles, the number of AT vehicles will increase in the coming years as China's GDP continues to rise, owing to the enormous size of the population. However, since the overall vehicle

4. まとめ

1. AT車の伸びる市場としては，中国が一番と考えられる．しかし，廉価かつ第3規制クリアが重要な要件である．
2. 基本的に台数の多い，日米は燃費のよさが重要なポイントであり，ATの全需は増えないものの，AT内での過激な争いが続く．
3. ヨーロッパのAT比率の急激な上昇は望めない．AT（CVT）は，スリップに対するイメージや運転性が改善されてもMT車に代わるものとならない．引き続き調査，検討が必要である．

population will expand mainly due to the increase in low-cost vehicles, fierce competition can be expected in the AT market.

3.5. Situation in other regions

Large markets in other regions include South Asia centered on India and South America. As seen in Figs. 1 and 2, both of them are primarily MT vehicle markets. It can be expected that low-cost vehicles will also increase in these markets in the future, and the cost difference of AT vehicles will be an influential factor. Unlike China, there is no government support, and only European, American, Japanese and Korean automakers are active in the South American market where there are no domestic vehicle manufacturers. All of these automakers build vehicles locally and MTs are the mainstream transmission. Traffic congestion is severe in cities everywhere in both regions, and there are strong demands for automatic shifting, but ATs are available only on some models because of the higher vehicle cost. Like the Chinese market, it is projected that the introduction of ATs that are closer to MTs in price would increase the share of AT vehicles. Similar to the situation in Japan and South Korea previously, consumers probably will not spend money for an AT until the economic level has risen further as time goes on.

4. Conclusions

1. China is presumably the market where AT vehicles will see the most growth in the coming years. However, low cost and compliance with the Phase III fuel economy standards will be critical requirements.
2. Fuel economy is the key point in the Japanese and American markets where there are basically large AT vehicle populations. While AT vehicle demand will not increase further, fierce competition among different types of ATs will continue.
3. A sharp increase in the percentage of AT vehicles in Europe cannot be expected. Even if the public impression of AT (CVT) slipping and driveability are improved, it will not lead directly to the replacement of MT vehicles. Continued research and study will be needed to promote greater use of ATs.

カオスの国の自動車への熱い想い

Chaos and Energy in India

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佐藤　雅志**　Masashi SATOH

抄　録　2008年秋のリーマンショック後，急速に落ち込んだグローバルの新車販売台数は，予想以上に早く回復した．但し，その構造は大きく変化し，これまで自動車市場を牽引してきた日米欧のマーケットに代わり，BRICSを中心とした新興国マーケットの拡大が目覚しい．JATCOも2009年に年間販売台数が世界No.1となった中国市場にいち早く生産拠点を作り，客先からの需要に応えることで生産台数を大きく伸ばしている．今後，Globalなマーケットでお客さまに我々JATCOの商品を購入して頂くには，中国と同様に他の新興国マーケットについても現地のニーズを早急に把握し，弊社の商品及び事業戦略にフィードバックすることが重要である．今回，その一貫として，中国とならんで市場が急拡大しているインドの自動車マーケットを調査した結果について報告する．

Summary　Global sales of new vehicles plummeted sharply after the collapse of Lehman Brothers in September 2008, but recovered more quickly than expected. However, the structure of the global market has changed profoundly. Instead of the Japanese, American and European markets that previously led the automotive industry, remarkable sales expansion is now being seen in emerging markets, especially in the BRIC countries. JATCO early on established a production base in the Chinese market, which became the world's largest in terms of annual vehicle sales in 2009. The volume of our transmission production in China has risen substantially so as to meet the demand from customers. In order to get customers in global markets to purchase our JATCO products in the coming years, it will be important to identify local needs quickly in other emerging markets and feed that information back to our product development activities and business strategy, just as we have done for the Chinese market. As part of that effort, we conducted a survey of India's vehicle market, which has been expanding rapidly like China's market. This article describes the results of the survey.

1. インド情報（一般概況）

1. Overview of India

インドの一般概況及び経済指標をTable 1に示す．人口11億8千万人，面積は日本の約9倍と非常に大きく，多言語，多民族，多宗教の国家である．2025年には中国を抜き，世界一位の人口となると考えられる一方，高齢化が急速に進む中国，日本と異なり，富士山型の人口構成が2050年ぐらいまで続く見通しである．すなわち，豊富な労働力と消費力が今後長期的に継続し，将来の成長ポテンシャルが非常に高いことがインドの特徴である．

加えて良くも悪くも“民主主義の国”＝決まるまでが遅いが決めたことを着実に実行するという特徴もある．

General details about India and its economic indicators are given in Table 1. India has a population of 1.18 billion people and an immense land area about nine times larger than Japan. It is a country of many languages, ethnic groups and religions. It is projected that India's population will exceed China's in 2025 to become the world's largest. Unlike China and Japan where the population is aging rapidly, the composition of India's population in terms of age is expected to retain its pyramid shape until around 2050. This means that an abundant labor pool and consumption capacity will continue for a long time in

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** 商品開発室　Product Development Department

Table 1 Overview of India

Item	Details
Population	1,186,170,000 (2008)
Area	3.29 million km^2 (approx. nine times larger than Japan)
Languages	Hindu (official), English (semi-official), 21 other major languages
Ethnic groups	Indo-Aryan, Dravidian, Austro-Asiatic, etc.
Religions	Hinduism, Islam, Christianity, Sikhism, Buddhism, Jainism
Government	Federal system of 28 states and 6 directly administered union territories
GDP	Approx. $1.2 trillion; $1,016 per capita; growth rate of 7-8% (2008)
Exchange rate	1 rupee = 1.8 yen (as of October 2010)
Interest rate	Benchmark interest rate of 6%
Trade balance	Deficit of $117.1 billion (estimate for fiscal 2009)

2. インド自動車Market

2.1. メーカー別シェア

2010年度上期乗用車販売台数は前年比33%増の117万台6千台であり，年間200万台を超える見通しである．

Fig. 1に2008年度のメーカー別販売台数シェアを示す．マルチスズキが40%以上を占め，Hyundai, Tataが続く．特に，近年，Hyundaiのシェア向上が目覚しく，インドの有名な映画スターをイメージキャラクターに抜擢するなどでシェアとイメージを向上させている（モーターショーでも現代のブースが一番賑わっていた）．エンジントルク150Nm以下の小型車が中心のマーケットだが，BMWやBENZ等の高級車も売れており，BENZやBMWがノックダウン工場を現地に持っている．また，近年，東欧を初めとして小型車の輸出拠点として重要性が増しており，Hyundaiはインド工場での生産台数の半数以上を輸出しており，日産を初めとしてVW，GM，TOYOTA，HONDA等も小型車の生産拠点としてインドでの現地生産量を増やす計画となっている．

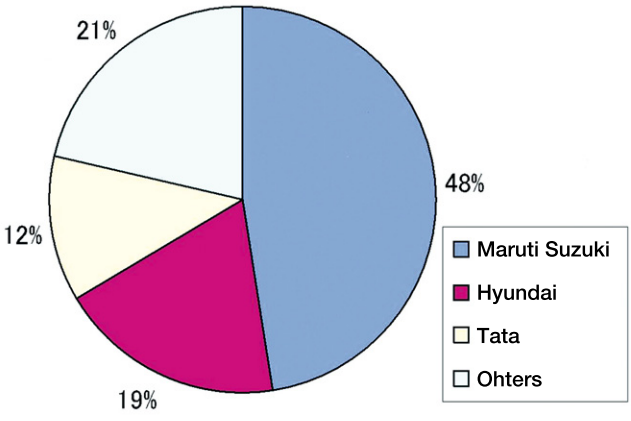

Fig. 1 Breakdown of India's vehicle market

the coming years. Accordingly, one characteristic feature of India is its very high potential for future growth. In addition, India is a democratic country, which has both positive and negative aspects in that decision-making takes time, but once a decision is made, it is faithfully executed.

2. Vehicle Market in India

2.1. Market share by automaker

Passenger car sales in the first half of fiscal 2010 rose 33% year-on-year to reach 1,176,000 units. Unit sales for the year are expected to surpass two million vehicles. Figure 1 shows a breakdown of the market share by automaker in fiscal 2008. Maruti Suzuki accounted for well over 40% of the total unit sales, followed by Hyundai and then Tata. Hyundai's market share in particular has risen noticeably in recent years. The company has chosen famous Indian movie stars to represent its brand image, thereby improving its corporate image and market share. (Hyundai's booth always attracts the most visitors at auto shows.) While small cars with an engine torque of 150 N-m or less form the bulk of the market, luxury brands like BMW, Mercedes-Benz and others also sell well. Mercedes-Benz and BMW also have knock-down production plants in India.

India's importance as an export base for small cars especially to Eastern Europe has been increasing in recent years. Hyundai exports over half of all the vehicles produced at its Indian plant. Nissan, VW, GM, Toyota, Honda and other automakers also see India as a base for producing small cars and are planning to increase their local production volumes.

2.2. Customer needs

For the purpose of studying Indian customer needs and the market potential for two-pedal vehicles, interviews were held with local vehicle manufacturers, suppliers and dealers, and a questionnaire was conducted among 488 users in six cities.

The most important aspects customers consider when buying a vehicle are (1) fuel economy, (2) style, (3) space, (4) initial price, (5) and driving comfort, as shown in Table 2.

Gasoline costs 44 rupees (80 yen) per liter and

Table 2 Factors considered when purchasing a vehicle
（Plural answers）

Factor	Very important
Fuel economy	55%
Style	52%
Space	44%
Initial price	41%
Driving comfort	35%
Acceleration	31%
Safety	20%
Engine displacement	20%
Maintenance cost	10%
Type of transmission	5%

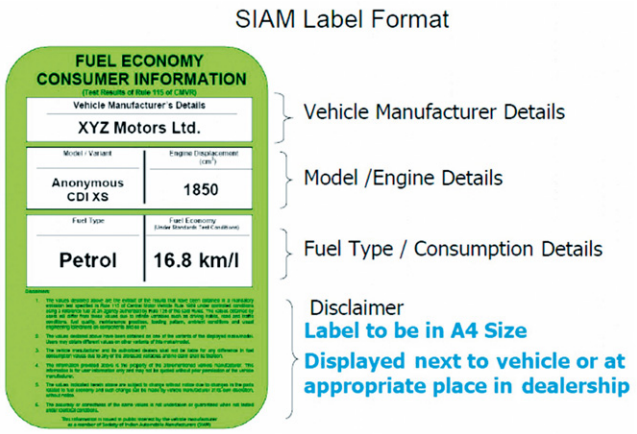

Fig. 2 Fuel economy label

2.2. カスタマーニーズ

インドのカスタマーニーズ及び2ペダルマーケットの可能性を調査する為，現地のカーメーカー，サプライヤー，ディーラーからの聞き取り調査及びユーザーアンケート（6都市 488名）を実施した．

車両購入重視度は，①燃費→②スタイル→③初期費用→④運転の快適性→⑤加速の順（Table 2）である．

ガソリン44Rs（80円）/L，軽油37Rs（70）円/Lだが，物価の違い（約10倍）を考慮すると燃料代が非常に高価（800円/Lぐらいの感覚）であることから，燃費への関心事が高いものと思われる．従って，走行距離が長い人は，車両価格が高くてもディーゼル車を購入するし，給油も満タンにはせず10Lぐらいずつこまめに給油するのが一般的である．

インド自工会の自主対応としてFig. 2のようなラベルの貼り付けが始まり（2011年から義務化），モード燃費値を顧客に知らせることがルール化されている．但し，カタログ燃費を信用している人が少なく，友

diesel fuel 37 rupees (70 yen) per liter. Considering that commodity prices in Japan are about ten times higher than in India, the cost of fuel is extremely high (it would seem like about 800 yen/L in Japan). That is probably why fuel economy ranks as the highest concern. Accordingly, people who drive long distances buy diesel vehicles even if the vehicle price is higher, and there is a general practice of refueling in small amounts of around 10 liters each time instead of filling up the tank.

The Society of Indian Automobile Manufacturers (SIAM) took the initiative to voluntarily adopt a rule of informing customers of a vehicle's fuel economy obtained under the Indian test cycle. The information is provided on a fuel economy label (Fig. 2) that becomes obligatory in 2011. Few people, however, trust the fuel economy figures given in catalogs. Rather, they place importance on the real-world fuel economy information that they hear from friends or acquaintances. Reportedly, when people consider purchasing a vehicle, they check the actual fuel economy by asking someone who is driving the same model. One characteristic of the Indian market is the exceptionally strong influence of word-of-mouth communication, owing to the widespread prevalence of mobile phones and close community ties (probably stemming from the caste system). Along with efforts to improve real-world fuel economy, it is also important to strengthen communication with customers.

2.3. Market potential for two-pedal vehicles

Currently, nearly all of the vehicles sold in India are fitted with a manual transmission (MT vehicles) and two-pedal vehicles account for only about 3% of the total. However, we got the impression that there are strong latent needs for two-pedal vehicles in view of India's traffic conditions, characterized by frequent congestion and many instances of vehicles cutting in unsafely. In fact, the questionnaire results revealed that drivers who own two-pedal vehicles think that automatic transmission (AT) vehicles are superior to MT vehicles in terms of driving ease and their excellent acceleration and start-off performance. Dealer sales people also voiced the same opinion. Another aspect is that two-pedal vehicles are popular among women drivers who are becoming more

知人から聞いた実用燃費を重視し，車両を購入する際は，同じ車に乗っている人に実用燃費を確認して購入を検討するそうだ．携帯電話が普及していることと，コミュニティーが非常に強い（カースト制度の影響と思われる）ことから，口コミの影響力が非常に高いことがインドの特徴であり，実用燃費の向上とともにお客様とのコミュニケーション力のUPが重要である．

2.3. 2ペダルマーケットの可能性

現在はマニュアル車（以下MT車）がほとんどを占め，2ペダルのシェアは約3%と低い．但し，インドの道路事情（渋滞が多い，無理な割り込みが多い）から2ペダル車に対する潜在ニーズは高いと感じた．実際，2ペダル車両を保有するドライバーからは，運転のし易さ，加速及び発進性の良さでAT車はMT車に対して優れるとのアンケート結果が出ており，ディーラーのセールスマンからも同様の指摘を受けている．また，都市部で女性ドライバーが増えてきており，2ペダル車が好評を得ている．これらの背景もあってか，Hyundaiがオートマチックトランスミッション（以下AT）の適用車両を増やしており，モーターショー及び雑誌等でアピールしている．業界No.2として，Topのマルチスズキに対する差別化戦略のため，2ペダルを1つの魅力として訴求しようとしているのかもしれない．その結果，Hyundaiの小型車i10では，AT搭載比率が約10%と高くなっており，今後急速に2ペダルマーケットが伸びる可能性がありそうだ．

この動きを最大手のマルチスズキも感じており，昨年から一時撤退していたAT車の適用をSX4やA-Starで再開しているが，Hyundaiと比較してMTに対する価格差が大きいこととデリバリーに時間がかかる

numerous in urban areas. Perhaps, because of these factors, Hyundai has been expanding its lineup of AT commercial vehicles and has been widely publicizing them at auto shows and in magazines, among other ways. As the number two automaker in the Indian market, Hyundai may be trying to promote two-pedal vehicles as one its attractions for strategically differentiating itself from the top manufacturer, Maruti Suzuki. As a result, about 10% of Hyundai's small i10 cars are now equipped with an AT, which is a higher percentage than before. This suggests that there is a potential for rapid growth of the two-pedal vehicle market in the future.

This trend has also been noticed by Maruti Suzuki, India's largest automaker. Although it temporarily discontinued adopting ATs on its vehicles in 2009, it again resumed offering an AT on the SX4 and A-Star models in 2010. Compared with Hyundai, there are large price differences between Maruti Suzuki's AT and MT vehicles, and its AT vehicles require a long delivery lead time. Hyundai can soon deliver AT vehicles, but Maruti Suzuki's lack of AT vehicle inventories means that customers have to wait a long time to get an AT car. These issues may be the reasons why the percentage of Maruti Suzuki's AT vehicles has not increased as much as Hyundai's.

It is presumed that a large market for two-pedal vehicles can be created in the coming years by responding to the needs of Indian customers. That will involve resolving various issues to promote the diffusion of AT vehicles, including eliminating price differences with MT vehicles and addressing delivery lead time and maintenance issues.

Incidentally, the Mitsubishi Outlander fitted with a JATCO CVT is sold in the Indian market. While the sales volume is still small, the paddle shifter on this

Hyundai i10

Hyundai i20


Outlander (4.44 million yen)

（Hyundaiはすぐに AT車を納入可能だがマルチはAT車の在庫がなく，長い期間待たなくてはならない）ことがネックとなり，HyundaiほどAT車比率は伸びていないようだ．

今後，MT車とAT車の価格差や，デリバリー及びメンテナンス対応等のAT車普及に向けた課題を解決し，インドのお客さまのニーズに答えていくことで，新たに大きな2ペダルマーケットを創出出来ると思われる．

ちなみに，現地では，三菱アウトランダーがJatco製CVTを搭載して走っている．台数は少ないがパドルシフトが好評だそうである．また，MT車は4万kmでオイル交換が必要だが，CVTはメンテナンスフリーである点も顧客及びディーラから好評であった．同じ商品でも，お客さまの使われ方が異なることによって，違う魅力を感じてもらっていることに驚くとともに当社の商品が我々が知らないうちに活躍していることをうれしく感じた．

3. インドマーケットについて

今回，ニューデリー，プネー，ムンバイの3都市を調査したが，道路環境及び使われ方はそれぞれであり，大きな国であるだけに将来的には地域に応じた対応が必要になると感じた．また，インフラの整備が遅れていることがインドの最大の課題だが，調査時（2010年1月）も高速道路，地下鉄，空港などが建設ラッシュで道路環境は急速に変化していくものと思われ，継続した調査が必要と感じた．また，小型車＆廉価車が中心のマーケットではあるが，高級車もかなりの台数が販売されている．インタビューや現地のタクシー運転手と話しをする中で，ToyotaやHondaに対するブランドイメージが非常に高く，今は現地の安い車しか購入できないが，いずれはそういう車を購入したいというエネルギーを強く感じた．

Jatcoとしても，価格一辺倒ではなく，性能及び品質も含めたTotalの商品価値でお客様からの信頼を勝ち取ることが将来にわたってインドマーケットで成長していく上で重要と思われる．

vehicle is apparently popular with customers. For MT vehicles, the transmission fluid should be changed every 40,000 km, but CVT-equipped vehicles are maintenance free, which is another point that is highly appreciated by customers and dealers alike. It was surprising to learn that customers who use the same product in different ways find different features to be attractive. It was also a pleasure to know that, unbeknownst to us, JATCO products are actively being used in the Indian market.

3. Indian Market

The survey conducted this time in the three cities of New Delhi, Pune and Mumbai revealed that the traffic environment and ways of using vehicles differed in each city. The simple fact that India is such a big country means it will be necessary to take steps in the future to meet different local market requirements. One of the biggest issues facing India today is the delay in building infrastructure. At the time the survey was conducted in January 2010, a construction boom was under way to build expressways, subways, airports and other facilities that will probably bring rapid changes in the traffic environment. We got the impression that a follow-up survey will be necessary. In addition, while small cars and low-priced cars make up the bulk of the market, quite a few luxury cars are also being sold. The interviews and also conversations with taxi drivers indicated that Toyota and Honda have very high brand images in India. We were impressed by the strong desires people expressed to buy such vehicles at some future point, although they can only afford to purchase low-priced local cars at present.

This suggests that winning customers' trust on the basis of the total product value, including performance and quality aspects as well, rather than focusing exclusively on price, will be a key factor in JATCO's growth in the Indian market in the coming years.

4. Globalization

The two weeks we spent in India conducting this local market survey made us aware once again of the following three points.

4. グローバル化について

今回，インドマーケットの調査にあたり2週間現地調査を行う中で下記3点を改めて認識した．

1. 実際に自分の目で見ることの大切さ

インドは狭い道路で渋滞ばかりしているイメージを当初持っていた．確かにニューデリーでは渋滞が多いもののムンバイなどでは幹線道路が整備されており，都市によって状況が異なる．新興国マーケットは変化が激しく日々状況が変化することもあり，自分の目で最新の情報を見て感じることの重要性を改めて感じた．

2. 固定観念の打破

インド＝安い車で初期費用が重要というイメージを強くもっていたが，今回の調査で燃費に対するお客さまの関心が非常に高く，初期費用だけでなく燃料代を含めた車のライフTotalでの費用をシビアに計算していることに驚かされた（流石，数字に強いインド人）．また，自動車雑誌や口コミによって，様々な情報をお客さまがもっていることが分かった．新興国マーケットにはとにかく安い商品をというイメージを我々は持ちがちだと思うが，情報がグローバルで共有されている現代社会の中で，各地域の最適商品については，固定概念に捕らわれずにお客さまのニーズを把握し，適切な技術を投入していく姿勢が大切であると気づかされた．

ちなみに，インドでは，クラクションを鳴らす人が多いのは有名で，確かにニューデリーなどは凄い騒ぎであった．

これも当初，インドのドライバーは，道を譲れ!とみんなが自己主張しているものとばかり筆者は思っていた．しかし，現地でインドの方に理由を聞くと，インドのドライバーは前しか見ずに運転をするので（後ろは見ない），後ろにいる車がクラクションを鳴らして教えることがルールになっているそうだ．実際，インドのトラックの後ろ側には“ HORN PLEASE（クラクションを鳴らしてね）”と書いてあり，“ 俺は後ろをみていないから後ろにいる時はクラクションを鳴らして教えろ! ”と主張している．クラクションを鳴らすのは，道をあけろ!というドライバーの自己主張だけでなく，後ろを走っている車からの要求ということであり，これも我々の常識では思いもよらないことではないだろうか？

1. The importance of seeing things with one's own eyes

Initially, we had the impression that roads in India were narrow and always congested. To be sure, there is a lot of traffic congestion in New Delhi, but the situation differs depending on the city. Mumbai and other cities, for example, have built a network of arterial roads. Changes take place quickly in emerging markets, and the circumstances are changing almost constantly. We felt anew the importance of getting the latest information by seeing things with one's own eyes.

2. Breaking down preconceptions

We were under the strong impression that the Indian market means cheap cars and that the initial price is the most crucial factor. In conducting the present market survey, we were surprised to learn that customers are very concerned about fuel economy and that they rigorously calculate the total cost of a vehicle over its entire lifetime, including the cost of fuel, and not just the initial price. (Perhaps, that is not surprising since Indians are good at mathematics.) We also found that consumers have a lot of information about vehicles, thanks to car magazines and word-of-mouth communication. We are apt to have the impression that emerging markets usually mean low-cost products. This survey made us aware of the importance of striving to introduce the best products in each region by ascertaining customer needs and providing the right technologies to meet them. One must not stick to preconceived notions in today's society where information is shared globally.

India is well-known as a place where drivers often honk their horns. To be sure, the traffic noise in New Delhi and other cities was horrendous.

Initially, we merely thought that honking the horn was just a form of self-assertion by drivers, telling others to give way. However, when we asked Indians about the reason, we were told that drivers in India only look ahead of their vehicle while driving and not behind it; so there is a rule that drivers of following vehicles are supposed to honk their horn to alert preceding drivers to their presence. In fact, we saw signs on the back of Indian trucks saying "Horn Please". Because truck drivers do not look back, this is a plea to other drivers to honk the horn and make their presence behind the truck known. Honking the horn is not just a form of self-assertion by drivers to

3. グローバル競争

現代が2ペダルマーケットを自ら創出しようと仕掛けていたり，MagnaのインドR&Dセンターではエンジニアが昼夜勤務を行い，米国，欧州，インドで24時間体制で開発を行っている事が今回の調査で分かった．

彼らのエネルギーを強く感じるとともに，改めて我々はグローバルな競争環境におかれていること，彼らに勝つ為に我々も強い意志と広い視野をもたなければならないと危機感を持った．日本の競合メーカーや，日本国内のエンジニアとの競争だけでなく，Globalなエンジニアと世界No.1を目指さなければならない．

5. 最後に

Fig. 3にムンバイの有名な屋外洗濯場“ Dhobi Ghat ”の写真を示す．奥にそびえる高層ビルと機械化が進む現代でも手作業で洗濯する洗濯場のコントラストが印象的である．超高級車と旧式の3輪自動車，高層ビルとスラム街，高級レストランと路上のバナナ売り等，両極端の文化が共存しているのがインドの特徴だ．しかもそれらが暗黙のルールでお互いに干渉しあわずに共存している不思議な社会である．法律的にはカースト制度はなくなっているが，実際にはまだ歴然として残っており，その影響なのかもしれない．帰国後，インドの方とその印象を話しをしたところ，“ 日本でも派遣切りとか差別はありますよね． ”と切り返され，はっとさせられた．車社会においても，インドでは小型車が多く走っているが，最近は日本を始めとして先進国でも小型車へのシフトが起こっているのが実情であり，どちらが未来を先取りしているのか分からないなと感じさせられる．もしかするとインドの方が進んでいるのかもしれない．

宗教も言葉も多種類の物が混在しながら，強いエネルギーを感じる不思議な国であり，今回の調査で大きなカルチャーショックを受け，自分の固定観念を打ち壊すにのに良い機会となった．

今回の調査でインドと日本の共通点を1つ見つけることができた．調査中にインドモーターショーを訪れたのだが，会場の周囲にモーターショーを見たい人達が大勢押しかけ大混雑しているのを見かけた．結局，混乱をさけるためにモーターショーの一般公

tell others to clear the road, it is also an action that is requested of following drivers. This practice is probably not something that would occur to us based on what is common sense in Japan.

3. Global competition

Through this market survey we learned that Hyundai is endeavoring to create a two-pedal market by itself and that engineers at Magna Powertrain's R&D center in India work day and night shifts. That enables Magna to pursue development activities around the clock in North America, Europe and India.

We were deeply impressed by their energy and once again realized that we are operating in an environment of global competition. That awareness produced a sense of urgency that we too must have strong determination and broad vision in order to defeat our competitors. Our competition is not solely with other rival Japanese manufacturers and other engineers in Japan, but rather with global engineers, and so we must set our sights on being No. 1 in the world.

5. Concluding Remarks

Figure 3 is a photograph of Dhobi Ghat, the well-known outdoor laundry area in Mumbai. There is an impressive contrast here between the advance of mechanization typified by the soaring high-rise buildings in the background and this laundry area where people still wash clothes by hand. One distinct characteristic of India is the coexistence of two extremely opposite cultures: super luxury cars and old-style three-wheeled vehicles, high-rise buildings and slums, and fancy restaurants and roadside banana stands. Moreover, it is a fascinating society in which these extremes coexistent without interfering with each other, owing to certain unwritten rules. Although the cast system has legally been abolished, it obviously still remains and may be influencing these extreme opposites. After returning to Japan we were discussing our impressions with Indians, who retorted much to our surprise that discrimination also exists in Japan such as the abrupt dismissal of temporary workers. There are many small cars on the road in India, and there has also been a shift to small cars in Japan and other developed countries recently. It is hard to tell which market is actually anticipating the

開の期間を短縮するはめになったほどである．車に対する嗜好や運転マナー等，日本とは異なるところも多くあるが，スポーツカーや高級車の前に集まって写真を撮っている人々の姿や，自分の愛車を自慢気に話すインドの方々と話をして，車に対する想いや車が好きということは万国共通なのだと改めて感じた．その点で，車業界で働く我々は，人を魅了する車というGlobal共通の想い（共通言語）を持って，お客さまとコミュニケーションができる訳で，他の業界に比べて恵まれていると感じた．

今後もグローバルな市場に飛び出して，車という共通言語で色々な人と自信を持って話をしていきたいと思う．

Fig. 3 Dhobi Ghat with high-rise buildings

future. Perhaps, the Indian market is more advanced in this respect.

India is a mystifying country that imparts an impression of powerful energy amidst its mixture of many different religions and languages. This market survey provided an excellent opportunity to break down personal preconceptions though the profound culture shock that we experienced.

There are many aspects in which Indians differ from Japanese, including vehicle preferences and driving styles. Yet, this market survey showed that a love of cars is one point shared in common in both countries. During our stay in India we visited an Indian auto show. There was a lot of congestion around the venue, as large numbers of people thronged there to see the exhibits. The crowds were so huge, the organizers wound up shortening the period of public admission in order to avoid turmoil. Seeing people taking photos in front of sports cars and luxury models and hearing Indians talk proudly about their favorite car made us feel once again that people in all countries share a passion and affection for cars. In the sense that cars fascinate people, we have a common global language with which we can communicate with customers. In that respect, because we work in the automotive industry, we feel more fortunate than people in other industries.

We want to continue to survey global markets in the future, talking to many different people with the confidence that we share a common language in cars.

■ Authors ■

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グローバル視点でのお客さま志向トランスミッション開発

Developing Transmissions Tailored to Customer Preferences from Global Perspectives

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抄　録　常に世界のお客さまに喜んでいただける商品を提供するために，グローバルに市場調査を展開している．

本編では，グローバル市場調査の結果を商品開発に反映する際の課題と，その改善事例について紹介する．

Summary　Market studies are conducted globally in order to consistently provide products that please customers worldwide.

This article describes issues that must be addressed when incorporating the results of global market studies in the product development process and an example of an improvement made to acceleration performance.

1. はじめに

お客さまへ世界一品質の商品を提供するためには，お客さまの定性的な市場要求を，定量的な目標値として，開発業務に反映させる必要がある．

当社では既に，強度設計に関しては，市場要求値が反映されてきているが，成熟国が主であり，今後の2ペダルの需要拡大が見込まれる新興国の要求を把握していくことが，当面の課題の一つである．

一方，運転性能に関しても，お客さまの感性を定量的な開発目標値に反映させることを促進させている．

本稿では，市場要求を人間工学の視点も用いて分析し，定量化して開発目標に落とし込み，製品にフィードバックした事例を紹介する．

1. Introduction

In order to provide customers with products having the best quality in the world, we must reflect their qualitative market requirements into our product development activities as quantitative targets.

At JATCO, we have already reflected market requirements into the strength design of our products, principally for mature vehicle markets. One issue that we need to address at present is to identify clearly customer requirements in emerging markets where demand for two-pedal transmissions is expected to increase in the near future.

Meanwhile, we are also working to reflect customers' sensibilities regarding driving performance into quantitative product development targets as well.

This article describes an example in which market requirements were analyzed from human engineering perspectives, quantified, included in specific product development targets and then fed back and incorporated into our products.

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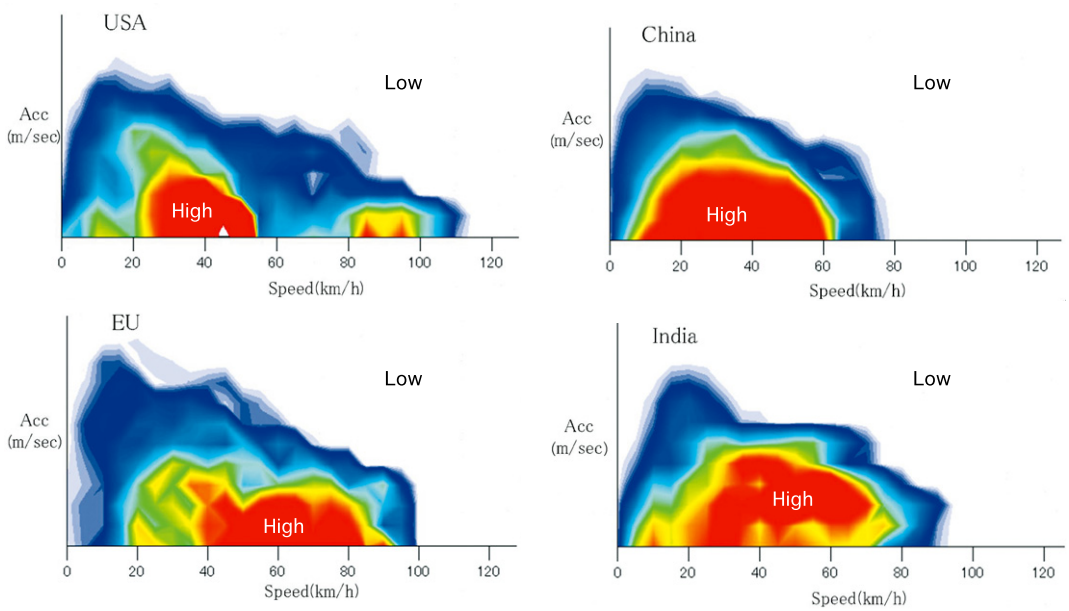

Fig. 1 Distribution of acceleration speed in various markets

2. グローバル市場調査

市場要求把握のため，グローバルに調査を実施している．その結果，例えば，成熟国と新興国で，要求される加速度の違いも，明確になってきた（Fig. 1）．

これは，各国の要求に応じて，車両性能の最適化をおこなう必要があることを示している．

3. 市場要求把握

3.1. お客さま要求分析

近年，環境意識の高まりにともない，燃費性能に優れるCVTを搭載した車両が増加している．CVTは，STEP ATと比較して変速の自由度が大きいため，車両性能の自由度も大きい．よって，各市場での最適性能を実現することが可能である．当社では，運転性能と燃費性能の両立を目指し，市場でお客さまが不満に思っている運転性項目について最適化に取り組んだ．

Fig. 2は，ある市場でお客さまが公道走行にて不満に思う走行条件を示す．お客さまの不満は，踏み込み加速時の指摘が多い．また，アクセル全開の加速に比べ，中開度域の加速条件で不満の割合が高い．

特に，燃費性能の要求が高く，運転性能確保も大排気量車に比べ難しい小排気量車では，追い越し加速や合流等の走行条件下で，ダウンシフト量を

2. Global Market Studies

We have been conducting market studies globally for the purpose of identifying market requirements. The results have made it clear that there are important differences between mature and emerging markets, for example, with respect to customer demands for acceleration performance (Fig. 1).

The study results have indicated that vehicle performance must be optimized so as to meet specific customer demands in each market.

3. Identifying Market Requirements

3.1. Analysis of customer demands

As a result of the growing awareness of environmental concerns in recent years, an increasing number of vehicles are being equipped with CVTs that provide outstanding fuel economy. Because CVTs have greater freedom for ratio changes than stepped ATs, they allow more degrees of freedom for vehicle performance. This feature of CVTs can be used to obtain the optimal vehicle performance in each market. At JATCO, we have been striving to optimize the aspects of driving performance that customers find unsatisfactory in real-world driving, with the aim of achieving high levels of both driveability and fuel economy.

Figure 2 lists various public road driving situations in which surveyed customers in a certain market

大きくとってギヤ比で駆動力を得る変速仕様設定になりやすい．

一方，燃費性能向上のために，アップシフトのタイミングを早め，エンジン回転を低く抑える方法がある．

CVTは，STEP ATに比べ，ギヤ比を連続的に速く大きく変速できる反面，アップシフトによって，ギヤ比が小さくなり，変速段毎に決まったギヤ比で走行するSTEP ATに比べて駆動力が急速に低下する．これが，加速不足の指摘に結びついていると考えられる．

expressed dissatisfaction with either AT or CVT performance. Many customers complained about acceleration performance in response to accelerator inputs. More of them complained about acceleration performance during medium acceleration than during hard acceleration under a wide open throttle condition.

Small-displacement vehicles in particular, for which there are strong demands for good fuel economy, have a harder time providing satisfactory driving performance than large-displacement vehicles. Acceleration performance under driving conditions such as passing and merging with traffic tends to be obtained by adopting transmission specifications that downshift considerably to a gear ratio capable of delivering the required driving torque.

On the other hand, one approach for improving fuel economy is to advance the upshift timing so as to keep the engine speed at a low level.

Compared with stepped ATs, CVTs can change the gear ratio quickly, continuously and in large increments. On the negative side, an upshift to a smaller gear ratio is accompanied by a sharper decline in driving torque than in the case of stepped ATs, which propel the vehicle at a fixed gear ratio in each speed range. This decrease in driving torque is

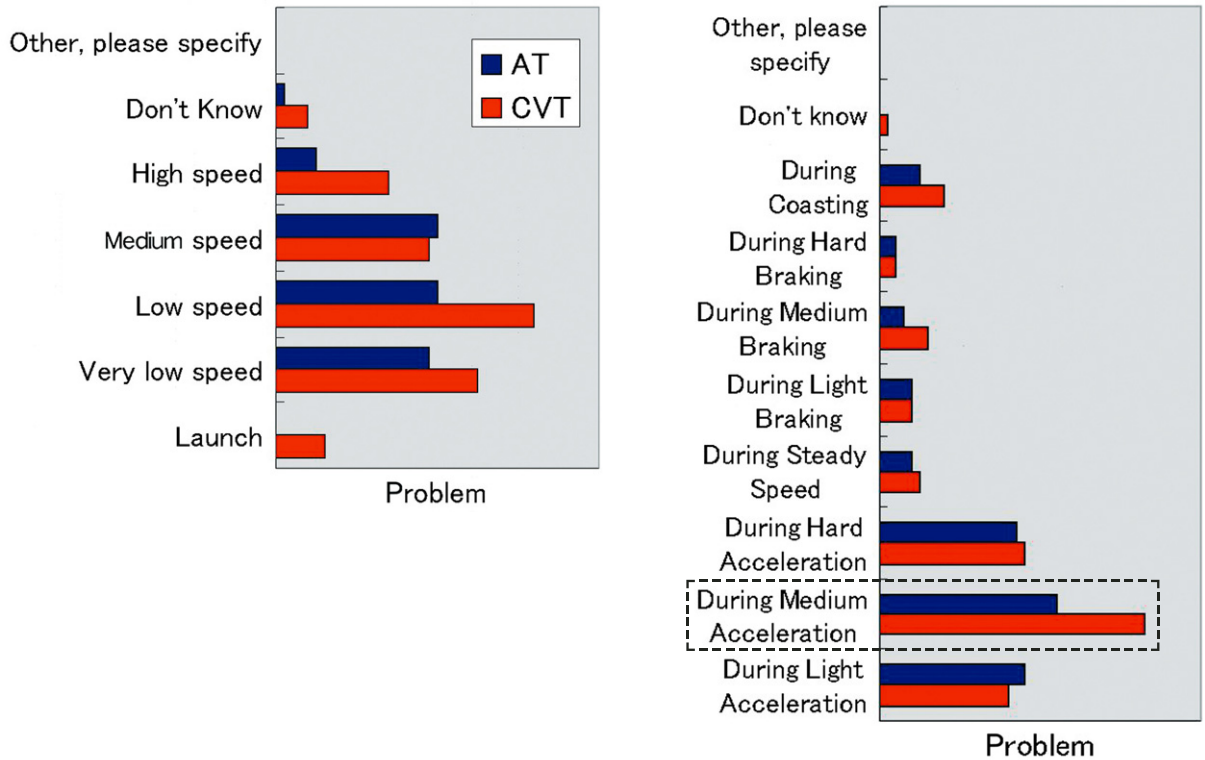

Fig. 2 Customer complaints about AT / CVT performance

次に，市場での交通の流れに沿った運転時のアクセル操作をFig. 3に示す．小～中排気量車は，大排気量車と比べてアクセルの踏み込み開度が大きく，加速意思を持っている時間が長いことがわかる．

この結果から，車両仕様，車速･アクセル開度毎で求められる時間加速感の持続量が推定できる．

市場での使われ方を分析した結果をもとに，お客さまの不満の多いアクセル中開度域について，CVT車の加速感持続の最適化を実施した．

presumably associated with customer complaints about insufficient acceleration.

Figure 3 shows examples of the operation of the accelerator pedal in three classes of vehicles when traveling with the flow of traffic in real-world driving. The results indicate that the accelerator pedal is depressed to a greater extent in small- and medium-displacement vehicles than in large-displacement vehicles. This means that the driver's intention to accelerate continues for a longer duration in the former vehicles.

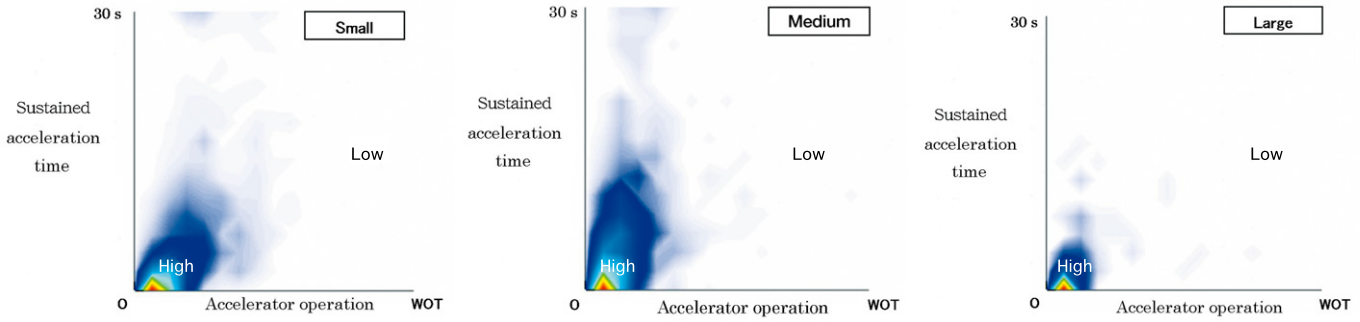

Fig. 3 Acceleration time

3.2. 加速感を構成するパラメータ

ドライバーはアクセルを踏み込むとき，これから受けるであろう刺激に対し，期待値を持って運転している．

期待値は，過去の運転経験と，車両仕様から想像する性能から構成されていると推測する．実際の運転時に受ける刺激は，人間の感覚器を通して脳に伝えられ，期待値に対する達成度が加速感に対する評価となる．

加速時に受ける刺激

･音の変化（エンジン回転）:聴覚

･加速度:三半規管＋視覚

人間は変化を感じる特性を持っているので，各感覚器に対する加速時の刺激変化の記憶が期待値となる．

一方，人間の記憶の仕組みとして，刺激の組み合わせパターンが短期記憶として保存されている．加速感はこれに相当すると考えると，過去に受けた刺激の組み合わせを運転時に感覚器で感じることができれば，加速状態であると認識すると推測する[1)]．

実際の加速シーンでは，アクセルを踏み込むとエンジン回転が上昇し，加速度が増加する．加速度が大きいとき，ヘッドレストから頭が離れていると，慣性でドライバの頭が後ろに動く．このエンジン回転上

These data make it possible to estimate the length of time drivers want a feeling of acceleration to continue in relation to the vehicle specifications and each speed level and accelerator pedal position.

Based on this analysis of how vehicles are driven in the real world, we optimized the feeling of sustained acceleration in CVT-equipped vehicles in the medium acceleration range, which was a source of dissatisfaction for many of the surveyed customers.

3.2. Parameters constituting a feeling of acceleration

When drivers depress the accelerator pedal, they expect to feel a certain pattern of stimulation as a result.

It is assumed that this expectation comes from their previous driving experience and the power performance they imagine from the vehicle specifications. The stimulation actually received during real-world driving is transmitted to the brain by means of the human sensory organs. The feeling of acceleration is evaluated on the basis of the extent to which the expectation is fulfilled.

Stimulation received during acceleration:

- Auditory: change in sound with rising engine speed
- Motion (semicircular canals) & visual: rate of acceleration

昇，加速度，慣性が，加速のときにドライバーが受ける刺激のパターンである．

また，人間の基本姿勢は直立であり，慣性で頭が後ろへ動くと，姿勢を維持するために視覚で水平線を仮想して直立を維持しようとする[2]．視覚による補正は，両目を閉じて片足で長時間立てないことで証明されている．

CVTでは，ダウンシフトが完了すると，アップシフトのフェーズに移行するが，このとき，加速時の刺激が少ないと，これに反する状態が起きて違和感になる（Fig. 4）．

Because of the human capability to perceive change, memories of changes in stimulation detected by the sensory organs during vehicle acceleration form the expectation of acceleration.

The human memory works to retain the patterns of combined stimulation as short-term memory. Assuming that a feeling of acceleration corresponds to this pattern, it is posited that a driver recognizes a state of acceleration while driving, if the sensory organs perceive this pattern of combined stimulation experienced in the past.[1]

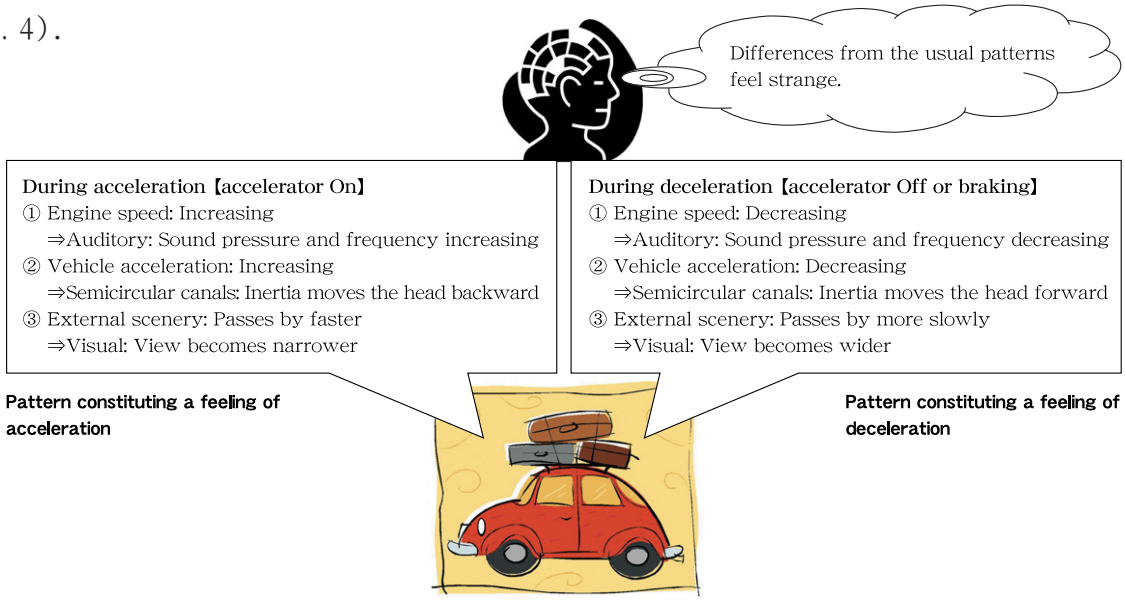

Fig. 4 Stimulation patterns during driving

具体的には，

①『エンジン回転が上昇していない』

②『加速しているのに頭が前に動く』

が上げられる．

①は，タコメータの動きを除くと，エンジン回転の変化がドライバーの弁別域に対し，小さいことに起因する．②については，アップシフト時のドライバ頭部の動きから（Fig.5），前後加速度減少が姿勢補正に影響を与えていると推測する．

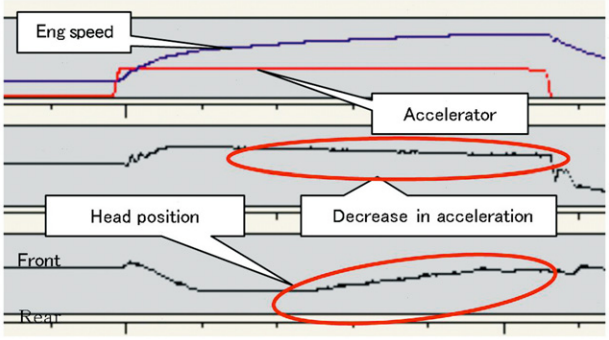

Fig. 5 Movement of the head during acceleration

In an actual acceleration situation, a driver depresses the accelerator pedal, causing the engine speed to rise and the rate of vehicle acceleration increases. Under a condition of rapid acceleration, the driver's head leaves the head restraint and inertia moves the head backward again. This rise in engine speed, rate of acceleration and inertia form the stimulation pattern that the driver perceives during vehicle acceleration.

Additionally, when the head is moved backward by inertia, the driver visualizes a virtual horizon in an effort to keep the head upright and maintain the basic upright posture of the human body.[2] This visual compensation is proved by the fact that a person cannot stand on one leg for a long period of time with both eyes closed.

After a CVT has completed a downshift, it switches to the upshift phase. If there is little stimulation during acceleration at that time, it gives the driver a

3.3. 管理項目抽出と目標値の設定

3.2. での検討結果に基づき，管理項目を「エンジン回転変化率」と「加速度偏差」とした．これを指標のX軸，Y軸とする（Fig. 6）．

また，加速感が持続する時間については，市場走行データとドライバの感覚保存時間から設定した．

目標値については，まず，「エンジン回転上昇」では音圧と周波数が変化するが，どちらの上昇が加速をイメージさせるか音のみを聞かせ，30名にパネラ評価をおこなった[3]．

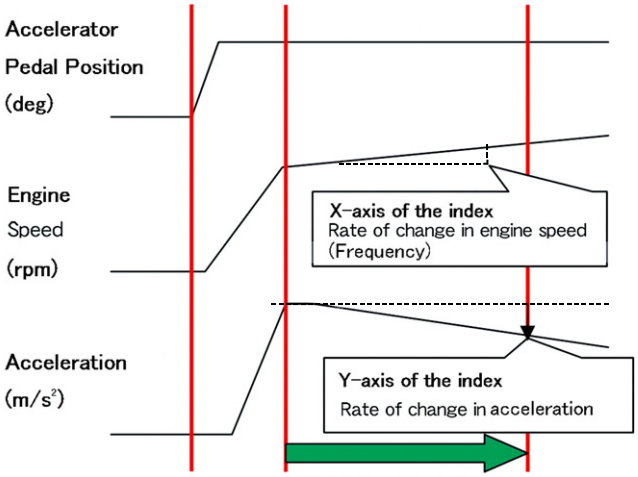

Fig. 6 Control points of the waveform pattern

その結果，周波数変化が支配的との結果が得られた（Fig.7）．そこで，周波数変化率について弁別閾値を検証し，弁別可能な周波数変化率以上を変速速度の目標値として設定した．

[Confirmation method using headphones]
(1) Engine sound with uniform sound pressure rises slowly together with the engine speed.
(2) Engine speed (frequency) rises slowly and engine sound has uniform sound pressure.
Panelist responds upon perceiving a feeling of acceleration.

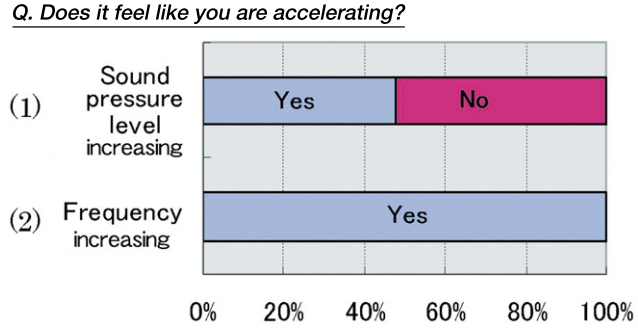

Fig. 7 Panelist evaluation of sound

strange feeling because the perceived conditions are contrary to the expectation of acceleration (Fig.4).

Specific examples of such perceptions are:

(1) The engine speed does not rise.

(2) The head moves forward even though the vehicle is accelerating.

The cause of the first perception is that the change in engine speed is smaller than the driver's differential threshold, excluding the movement of the tachometer needle. It is inferred from the movement of the driver's head during an upshift, which is shown in Fig. 5, that the second perception is related to the fact that the decrease in longitudinal acceleration influences the compensation for the body's upright posture.

3.3. Identification of control items and setting of target values

Based on the study results presented in the preceding section, the rate of change in engine speed and deviation in the rate of acceleration were set as the control items. These items were taken as the x-axis and y-axis of the evaluation index (Fig. 6).

The duration for sustaining a feeling of acceleration was defined on the basis of real-world driving data and drivers' perception retention time.

The perception of a rise in engine speed involves increases in sound pressure and frequency. In order to set a target value, it was necessary to determine which increase gives an impression of acceleration. An evaluation was conducted in which different sounds alone were presented to 30 panelists.[3]

The results showed that the change in frequency was the dominant factor (Fig. 7). Therefore, an investigation was made of the differential threshold for the rate of change in frequency. The target value for shifting speed was then set above the discernable rate of change in frequency.

With regard to the rate of acceleration, it was assumed that visual feedback related to the driver's posture is dominant because of the small gain in the rate of acceleration itself. Based on the results of the panelist evaluation, a dead zone was identified in which a change in the rate of acceleration could not be discerned on basis of visual feedback. The target value was then set above that dead zone.[4] The

次に「加速度」については，加速度自体のゲインは小さいので，視覚による姿勢フィードバックが支配的であると考え，視覚補正による加速度の不感帯をパネラ評価で抽出した．その不感帯以上を目標値として設定した[4]．その値を割り込まないように適合を実施した．

以上の検討，確認結果から，加速持続感の目標値を設定した（Fig. 8）．

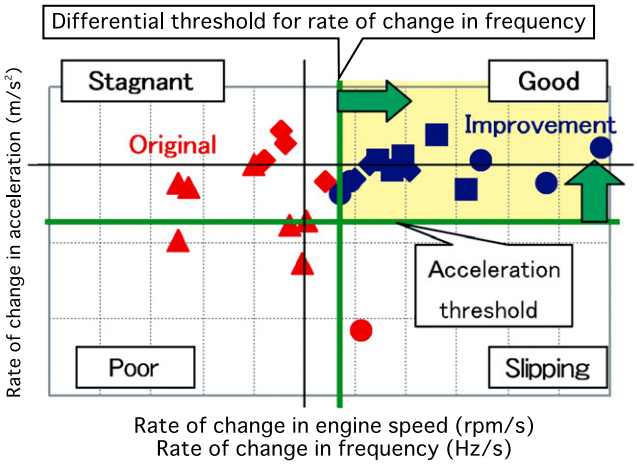

Fig. 8 Before and after improvement of the index under each driving condition

4. 車両への適用と効果

設定した目標値を満足した車両をパネラ評価すると，加速感の持続に対し，ほぼ狙い通りの結果が得られた（Fig. 9）．

検証結果より，目標値の妥当性が確認できたため，市販車両にも採用を開始，お客さまから好評を得ている．

また，開発期間短縮のために，目標値を満足する変速仕様の決定をシミュレーション化した（Fig. 10）．

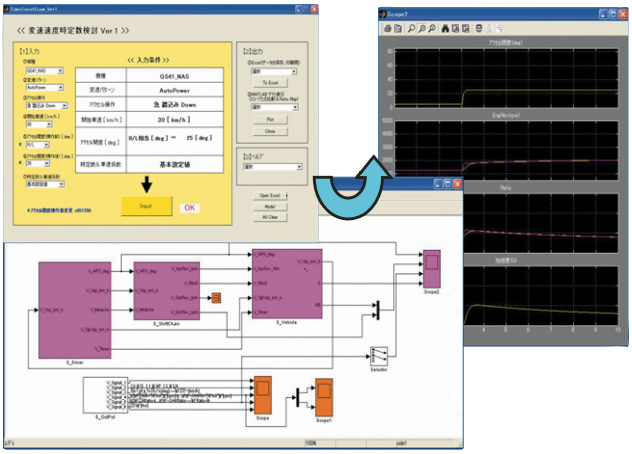

Fig. 10 Confirmation by simulation

transmission control program was tuned so as not to fall below that value.

The target for a feeling of sustained acceleration was defined on the basis of the foregoing investigations and confirmation results (Fig. 8).

4. Vehicle Application and Effects

A panelist evaluation was conducted using a test vehicle that satisfied the set target values. The results indicated that a feeling of sustained acceleration was obtained almost as intended (Fig. 9).

Since the evaluation results verified the suitability of the target values, we have started to apply them to transmissions used on production vehicles. The resultant acceleration performance has been highly praised by customers.

A simulation program has also been created for use in determining transmission specifications that satisfy the target values, in order to shorten development lead times (Fig. 10).

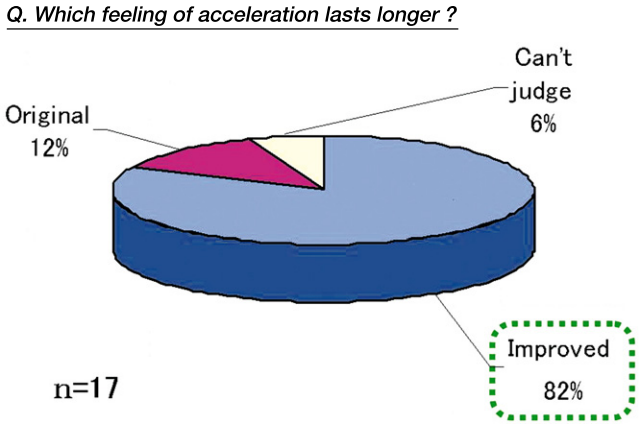

Fig. 9 Confirmation of improvement

5. Conclusions

(1) The results of global market studies have revealed differences in customer demands between mature and emerging markets, indicating the necessity of optimizing vehicle performance to meet the respective demands.

(2) Human engineering perspectives were also included in an analysis of market demands in order to set target values for a feeling of sustained acceleration.

5. まとめ

①グローバル市場調査から，成熟国と新興国で市場要求が異なり，これに応じた車両性能の最適化が必要である．
②市場要求を人間工学の視点にも取り入れ，加速持続感の目標値を設定した．
③加速持続感の目標値は，市販車両にも採用し，お客さまから好評を得ている．
④開発期間短縮のために，目標値を満足する変速仕様決定のシミュレーション化を実施した．

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MAN IN MOTION The Psychology of Travel by James Reason
3）神宮英夫著：印象測定の心理学
4）関邦博他編集：人間の許容限界ハンドブック

(3) The target values for a feeling of sustained acceleration were applied to transmissions used on production vehicles, and the resultant acceleration performance has been evaluated highly by customers.
(4) In order to shorten development lead times, a simulation program has been created for determining transmission specifications that meet the target values.

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(2) James Reason, Man in Motion: The Psychology of Travel, Translated into Japanese by Kiyoshi Isaka, Tokyo: Keigaku Shuppan Co., Ltd., 1981.
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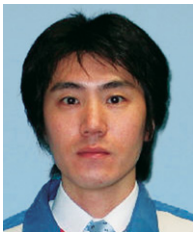
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ジヤトコUSAとジヤトコ株式会社のグローバル化についての考察

JATCO USA Inc. and the Globalization of JATCO Ltd. an American's perspective.

Jim FRIEDLINE*

1. はじめに

本報告は，アメリカの従業員の立場でジヤトコ株式会社とJATCO USA（以下JUS）についてまとめた，一個人の意見であり，未だグローバル企業になっていないトランスミッション会社で働くアメリカ人従業員の意見以外の何物でもない．

ジヤトコ株式会社は1970年に日産・FORD・マツダの合弁会社として誕生した．

ジヤトコ（株）の本社は日本にあり，日本人の日本人による日本人のためのトランスミッションメーカーとして設立された．そして，主に日本の自動車メーカーにトランスミッションを供給した．

このやり方は，ジヤトコと親会社の日産との関係においては，良好なものであった．その当時は，ジヤトコは自ら開発したトランスミッションを搭載したクルマが世界中で売られているという意味でのみグローバルな企業であった．

ジヤトコは，車両が日本以外で製造されたり，販売されたときでさえ，顧客車両に搭載されているトランスミッションのために販売，修理などを通じて良好な品質を提供した．

ジヤトコは，短期間出張や長期派遣で，日本人のマネージャ・日本人エンジニア・および日本人の技術者をサポートとして提供した．この手法により，ジヤトコは，お客様のための非常に良いサポートを提供し，世界中から必要な技術的および商業的なデータを収集することができた．

残念ながら，この方法は，情報を集めるためのコストを膨らませることとなり，多くの日本人従業員を彼らの故郷や家族から引き離し，日本以外の顧客の習慣や技術手法を理解する妨げとなってしまった．

1. Introduction

What follows is an unscientific, unresearched, personal opinion based summary of JATCO Ltd. and JATCO USA from the perspective of an American employee. In no way should these opinions be taken for more than what they are intended, an American employees impressions of working for a foreign based and yet global transmission manufacturing company.

JATCO LTD as it is known today came into existence in 1970 as a joint venture between Nissan, Ford and Mazda.

JATCO is headquartered in Japan. JATCO engineered transmissions in Japan, with Japanese staff for manufacture and assembly in Japan, with Japanese labor. JATCO supplied these transmissions to customers who were primarily Japanese.

This scenario served JATCO and parent company Nissan successfully for many years. JATCO was global only in the sense that the vehicles equipped with their transmission where sold all over the world.

JATCO provided sales, engineering, and quality support to our customers for transmissions integrated into customer vehicles even when the vehicles were manufactured or sold outside Japan.

JATCO provided this support with Japanese managers, Japanese engineers and Japanese technicians using short term business trips and/or longer term temporary assignments (dispatchee). This strategy provided very good support for our customers and allowed JATCO to collect necessary technical and commercial data from around the world. Unfortunately this strategy also exaggerated the cost of collecting this information, displaced many Japanese nationals from their homes and families and restricted JATCO's global understanding of non-Japanese customers' culture and engineering practices.

* JATCO USA, INC.

今後，真に競争力のあるグローバルなジヤトコになるために，世界中のあらゆる場所で確固たる地位を確立する必要がある．従来のように，ジヤトコが，売り上げ･エンジニアリング･品質を確立するためには，機能的な日本人のスタッフを派遣するのではなく，むしろ進出した先のローカルのスタッフをより活用すべきであろう．

本稿は，世界中のパートナーとの関係を改善するか，少なくともよりよく理解する目的で，ジヤトコのGlobalizationについて，一アメリカ人の印象を詳述する．

なお，グローバルパートナーとは，ジヤトコ本社･ジヤトコ関連会社･ジヤトコの多くの顧客を含む．

2. グローバル化の始まり ジヤトコUSAの誕生

1998年，米国での販売･技術および品質の要求を満たすための拠点として，JUSは設立された．JUSの最初の従業員は，日本人（出張と単身赴任）と現地のスタッフであった．正規雇用の現地スタッフを社員に迎えたことでジヤトコの真実のグローバリゼーションが始まった．

今や，日本のビジネス方法は日々アメリカのビジネスと比較され，また，日本のエンジニアリング文化は米国エンジニアリング文化と比較されている．

JUSは，その立ち位置を本社のための重要な情報資源として確立した．JUSは，良質な調査，営業･マーケティングとデータ収集でジヤトコの北アメリカ市場顧客を支えた． 我々JUSのセールスは，クライスラーでJF011Eビジネスをまかされ，日本国内以外では過去最も大きな契約をものにした．このプログラムは，ジヤトコのグローバル化を飛躍的に高める役割を果たした．

JUSの現在の活動は，新しい車両への適用開発，既存の生産プログラムに対する継続的な技術的改善業務の支援と新しいユニット開発に対する技術支援である．

ジヤトコは，急速にグローバル化が図られている．しかしJUSは本社のクローンではない．本社の方針を引き継ぎながら，現地スタッフの才能や経験を組み合わせより一層の発展を継続している．

In order to become cost competitive and truly, global JATCO needed to establish a permanent presence in many locations around the world. JATCO needed to establish sales, engineering and quality support capabilities around the world that provided the functional capabilities of the Japanese staff but utilized local staff rather than dispatchees.

This article will detail an American's impression of the Globalization of JATCO with a view to improving or at least better understanding the relationships of all global partners.

The global partners include JATCO Headquarters, JATCO affiliates and JATCO's many customers.

2. Globalization begins: JATCO USA Inc is born

In 1998 JATCO USA was created to satisfy the need for a permanent Sales, Engineering and Quality presence in the United States. Initial staffing of JATCO USA (JUS) was both Japanese (business trip and dispatchee) and local staff. The inclusion of permanent local staff began the true globalization of JATCO.

Now Japanese business practices would be exposed to American business practices on a daily basis. Japanese engineering culture would be balanced against US engineering culture.

JUS had established itself as a significant resource for JHQ achieving all of the objectives set during JUS creation. JUS has supported JATCO's North American market customers with quality investigation, sales and marketing and data acquisition. JUS sales landed one of the largest unit sales contracts to a non-Japanese customer when we were awarded the JF011E business at Chrysler. This program alone was responsible for dramatically advancing the globalization of JATCO.

JUS activities currently involve total support for new vehicle applications, continued support for existing production programs and engineering support for new unit development.

JATCO achieves these functions as a global extension of JATCO's policies and directives. JUS is not a clone of JHQ activities it is a homologation of JATCO's policies and standards combined with local human resource talent and experience.

3. グローバル化の課題：＃1言語

1つ目の課題は当然のことながら言語である．

我々はごく幼い頃から，自国の言語を学ぶ．そして，友人・親類・同僚と何の問題もなくコミュニケーションをとり，情報交換をする．そしてテレビ，ラジオ，娯楽，などからたくさんの新しい言葉を見聞きし，そこから自然に言葉を受け止めている．

ところが突然第二言語を習得しようとすると「お手洗いは何処ですか」という単調な会話でさえそれを表現するのにどれほど難しいかに気づく．

ジヤトコは日本語が優位な言語とはならない場所に拠点を拡大していったので，コミュニケーションは大きな課題となった．ジヤトコの顧客は，米国，英国，ドイツ，フランス，メキシコ，中国，韓国と，世界中あらゆるところにおり，ジヤトコは，従来使われてきた日本語を使用しない同僚と顧客に接するようになっている．それはさらに広がりを見せており，今後そのような状況に対応できる優秀な人材をみつけることが会社にとっての最大の課題である．

その解決策は，または解決策への最も良い試みは，皆が共有できる第二言語を見つけることである．

ジヤトコに関していえば，それは英語である．

それは幸いにも，われわれのように英語を母国語をするものにとって第二言語を学ぶ必要がないことを意味する．

残念ながら，母国語が英語以外の人にとっては，グローバルコミュニケーションは負担となって降りかかることとなる．彼らは，学ぶ必要を感じていなかった第二言語を習得しなければならない．学校で教えられるような「私は，フライドポテトが欲しい」というようなレベルを超え，技術的な言葉使いを理解できるようにならなければいけない．その大変さを英語圏のわれわれは軽く考えてはならない．

われわれは自分たちが理解できているからといって，相手もすべてが理解できていると思ってはならない．

われわれは，英語圏の人間にとっては何気なく使ってしまう，口語的表現やスラングを避けるように注意しなければならない．英語を話さない人々に誤解されるか，無視されるのが確実な表現だからである．

速度超過による事故死！スピードについての事件は主に車とオートバイに関連するものだが，それはコ

3. Challenges of Globalization: #1 Language

Language is something we all take for granted.

We learn our national language at such an early age that it often appears to be effortless. We communicate with friends, relatives, colleagues with absolutely no difficulty. We are exposed to numerous forms of information and entertainment through radio, tv, and print and take all of these for granted, until we are exposed to a language completely new to us.

Suddenly even simple conversations become difficult, "where is the bathroom?" can be the most important piece of information you are interested in when a second language is added to the challenge.

As JATCO expanded operations to locations where Japanese was not the dominant language communications became a major challenge. JATCO was now faced with interactions with customers, and colleagues who did not speak the traditional language of JATCO. JATCO customers now came from all areas of the world, US, England, Germany, France, Mexico, China, Korea. The list continues to grow. The ease with which communications happened was now problematic. How can a company find qualified engineers, marketing, quality, and finance people who could interact with their counterparts around the world? It is hard enough to find qualified people much less qualified people who are multi lingual.

The solution, or best attempt at a solution, is to find a language that everyone can share, a second language that allows everyone to have at least one common communication option with everyone else. For JATCO that second language is English. Fortunately for those of us who have English as our native language this means we do not have to learn a 2nd language. Unfortunately for those who have native languages other than English, the burden of global communications falls on them. They must achieve a proficiency in their 2nd language that they probably never considered while they were learning it. They must achieve a technical language capability well beyond the normal level of "I'd like fries with that", that is taught in school. The burden of achieving a technical level of English as a second language should not be taken lightly by those of us whose primary language is English. We must not take for granted that everything we say is

ミュニケーションにもあてはまると言えよう．

ネイティブの人間は自分たちがどのくらい速く話しているかに，気づいていない．われわれは自分の話した内容が正しく理解されていて当然だと思っている．おまけに，英語を母国語としない人の“ 翻訳プロセス ”を考慮していない．彼らは頭の中で英語の字句を理解してから，頭の中で自分の母国語に翻訳している．情報が入り続けている間中この作業は繰り返されなければならないうえ，かなり大変なことなので，会話についていくのも大変であるし，入って来る情報が処理能力を超えてしまうと，情報の幾つかは消えてしまう．英語の世界的な共通言語化は英語を話す人々にとってボーナスであり，私たちは，この利点を認めて，英語を話さない同僚のために適応しなければならない．

4. グローバル化の課題：＃2タイムゾーン

ほとんどの人の日常生活はルーチン化している．

いくつかのバリエーションは存在するとはいえ，基本的にわれわれは①仕事をしている時間．②通勤時間．③リラックスするための自分だけの時間．そして，④睡眠のための時間．このように日常の生活は完全にルーチン化している．今，私たちは国際的な業界に属し，多くの顧客がいる．

日本で働く人は米国で働く人が寝りにつく頃出勤し，米国で働く人が仕事のための準備をしているときに日本で働く人は眠りにつく．グローバリゼーションは，しばしば非常に遠いビジネスパートナーとの間の通信や情報を共有する必要があるのだが，日本と米国の間では，重なり合う通常の労働時間がない．距離を隔てた拠点間の通信は，最終的に誰かの，またはみんなの日常生活を破壊することになる．通信を効率化することと，われわれの通常業務が混乱に陥ることと，どちらに分があるのか，きちんと比較して考える必要がある．

拠点間の通信や情報を共有するには，電子メール，電話会議（音声またはビデオ），および対面式といういくつかの方法で行うことができる．電子メールと電子通信は，まさに現在の生活様式にぴったりの方法である．電子メールは，多分最も簡単で我々の通常のルーチンに与える影響は最も少ないといえ

comprehended just because it makes sense to us.

We must take care to avoid colloquial and slang terms that are almost meaningless to many English speaking people and are certain to be misunderstood or ignored by non-English speaking people.

Speed kills! is a statement often associated with cars and motorcycles, but it also applies to communications.

Native English speaking people are often unaware of how fast we talk. We take for granted that the words we use are heard correctly, and understood. We do not consider the "translation" process that must take place for people who have English as a second language. Words and phrases in English must be understood, translated to native language then rearranged to the native sentence structure; all of this must happen while still more information continues to come in. It can be overwhelming and often frustrating for people trying to keep up with a conversation. When incoming information exceeds the processing capability some information is going to be lost. Global communications in English are a bonus for English speaking people, we must recognize this advantage and be willing to adjust for our non-English speaking colleagues.

4. Challenges of Globalization: #2 Time Zone

Most individuals slip into a routine which guides their daily lives.

Some variations exist but fundamentally we all have jobs that require a certain portion of our time. We usually require commuting time to get us from our homes to work and back to our homes again. We have personal time, for family, friends, hobbies, or nothing at all, relaxing. We have time to sleep, usually but not always at night. A routine is by definition, predictable.

Now we have international business associations, affiliates as well as customers. Someone working in Japan is coming to work when someone in US is going to bed. Japan is going to bed when someone in US is getting ready for work. Globalization often requires communications and information sharing between very distant business partners. Between Japan and US there are no overlapping normal work hours. Communications between remote sites will

よう．自分の生活のペースで対応を調整することが出来るし，迅速な行動を求められるわけでもない．しかし，不適切に使用される場合は，メールにも大きなリスクをもたらすこととなる．

"私は電子メールを送った"ということは，"私が問題を解決するために必要なことをすべて行った．"というわけではない．電子メールを送ることは，行動または関係の不足を正当化するスケープゴートとして，しばしば使われてしまうが，誰が答えに対して責任があるか指定することなく，20人の受取人に電子メールを送ることは，電子メールを送らないことと全く同じである．個人を指名して応答を要求しないのであれば，納得できる結果が得られなくても仕方がない．

英語で書かれたメールはまた，非英語圏の人々にとって課題である．英語で書かれるロングメールは毎日の大きな課題となっている．多くの場合，文書は受け手にとって非日常的な言語であるので，翻訳・理解・応答を忍耐強くこなす必要がある．

英語圏の人間は電子メールを作成するときに，珍しい単語やフレーズを使用してはならない．さもなければ受け取り手の非英語圏の人は何度も何度も辞書を繰り返し参照するため，そのうちに全員がメッセージを無視するようになるかもしれない．

テレビ会議は今日のグローバルな労働環境においては当たり前のものである．

しかし，米国と日本の間の会議は参加者の日常生活において困難を伴う．米国での早朝は日本の夜，日本の早朝は米国の夜となる．通常であれば会議は参加者のスケジュールを考慮して設定されるが，残念ながら現状はそうなっておらず，参加者は通常の業務をこなしながらこれらの時折の会議をサポートしなければならない．

会議開催とは･･･全員が同じ国または地域にある場合は問題ない．しかし複数の国が関与している場合は大いに問題がある．会議を要請するときは，個人の日常生活に混乱をきたさないよう，考慮される必要がある．

個人の日常生活に支障をきたすような会議は，その会議を開くことのメリットが文書などで充分裏づけられていなければならない．

ultimately result in a disruption of someone's or everyone's daily routine. The efficiency of the communications must be weighed against the disruption of our normal work routines. When disruption of the routine becomes the norm, there is no routine.

Communications and information sharing between remote sites can be done in several ways, email, conference call (voice or video), and face to face. Email and electronic communication is a way of life now. Email is probably the easiest and least disruptive to our normal routines. It does not require immediate action by the receiving person so they can coordinate the response into their normal daily routine. However; email can also bring great risks if used improperly.

"I sent an email" is not sufficient evidence that I have done everything I should to resolve an issue. Sending an email is often used as a scapegoat to justify lack of action or involvement. Sending an email to 20 recipients without specifying who is responsible for the answer is basically the same as not sending the email at all. No individual is requested to respond; therefore no response must be an acceptable outcome.

Emails written in English are also a possible communications challenge for people who have English as a second language. Long emails written in English can present a huge daily challenge to a non-English speaking person. Often the document must be translated, understood, and replied to in a language which is not normal for the receiver.

English speaking people must take this into consideration when composing their emails, again they must not use words and phrases that are unusual and will force the receiver to repeatedly reference the dictionary or worse, ignore the message all together.

Audio and Video conference calls have become a common practice in today's global work environment.

However a conference call between USA and Japan is by nature disruptive to everyone's routine. Early morning in USA requires Japan to stay late into the evening. Early morning in Japan requires USA to stay late into the evening. If these meetings were normal the routines of the participants could be adjusted to accommodate the meetings, unfortunately the participants must also support more normal work activities as well as these occasional meetings.

直接顔を見あわせながら会議をする．というのがすべてのコミュニケーション方法の中でもっとも生産的で素晴らしいものである．

お互いが環境や背景を理解し，感情をぶつけ合い，そしてその結果理解と協力を得ることが出来る．

最も適切な人々がその会議に参加している場合，おそらく数日または何週間にも及ぶメールのやり取りは数時間で解決することが出来るはずである．

顔を合わせてはいるのに，残念ながら，コミュニケーションの方法としては出張というものは最悪である．

会議の出席者の少なくとも一方が自分のホームベースを離れなければならず，快適な日常の空間から全く異なる環境（時差・ホテル・ことば・食べ物・・基本的にすべての事柄）のなかに身をおかなければならない．

顔を見合わせての会議も利点ばかりとは言えず，充分注意する必要がある．この会議方法は，大きな可能性を提供してくるが，それは同時に多額の費用の発生と通常業務の大混乱を招くもととなるからだ．

5. グローバリゼーションへの挑戦　＃3技術と開発

言語が第一の難関であれば，技術開発が第二の難関である．

従来の資本系列内で仕事をしている間はまだ良いが，たとえばクライスラーなど系列外の企業に売り込むと，各社は独自の技術基準，評価基準を持っているので，困難が生じる．ジヤトコの基準で作ったユニットをそのまま受け入れてくれれば楽だがそうは行かない．

相手の基準に会うようにユニットを作り直せばコストも上がるし，リスクも増え，派生機種も増えてしまう．

相手企業は，彼らの成功体験を元に彼らの基準を押し付けようとし，さらにユーザーは，系列外からユニットを買い付けることに慣れていない．新しい買い手とサプライヤの間に欠けているのは「信頼」．ジヤトコはJUSやコアな顧客群とは信頼関係を作ってきた．この信頼関係があれば技術開発についても顧客との間にシナジーを生むことができる．歴史がそういうものを育む．新しい顧客とは，この信頼関係がないので関係に多くの困難が生じる．

ジヤトコはこれまで，圏外の顧客と新しいプログラ

Let's have a meeting is no problem when everyone is in the same country or region. Let's have a meeting becomes more problematic when multiple countries are involved. Minimizing the disruption to individual life routines should be considered when requesting a meeting. When meetings are requested and the disruption to everyone's daily routine is accepted, the meeting should be well documented in advance to make the most efficient use of the available time.

Face to Face can be the most productive of all communications methods. Seeing associates face to face, understanding their work environment and being directly exposed to the culture of distant customers and colleagues results in an understanding and cooperation that can not be achieved via phone, email, and video conference. Issues that could possibly take several days or weeks of badminton emails can often be resolved in hours if the appropriate people are meeting in real time, and willing and able to take quick action.

Unfortunately travel is also the most disruptive of all communications methods. At least one of the meeting parties must travel away from their home base. Removing them from their comfort zone and exposing them to the disruptive affects of travel, time zones, hotels, language, food, basically everything.

As with other information sharing methods, face to face meetings must be utilized with care. They offer the possibility of great benefits, but carry the burden of maximum cost and disruption to the normal work routine.

5. Challenges of Globalization: #3 Engineering and Development practices

If communication is the number one challenge for globalization, engineering and development practices has to be number two.

JATCO globalization implies that we will be supplying transmissions to many companies outside our normal cadre of customers. JATCO's economic growth potential is dramatically improved as we extend our customer base to include a greater number of vehicle manufacturers. Unfortunately each vehicle manufacturer has their own engineering and development standards and JATCO must be willing to adapt our traditional methods to satisfy these new customer standards.

ムを成功裏に達成してきた．

しかし信頼関係においては，まだ，真のグローバル化を果たしたというレベルにはない．ジヤトコは，真にグローバル企業と呼ばれるためには，市場に適合する努力を継続する必要がある

そのためには，コア顧客だけでなく，新しい顧客に対しても熱意を持って，技術課題に挑戦していかなければならない．

6. 終わりに

本報告の初めに述べたとおり，これは，一個人の観察および見解に基づいたジヤトコのグローバル化の分析である．

このような意見は意見として受け入れられるべきであろう．

今日の多くの企業によるグローバリゼーションに向けた取り組みには，強い・オープンな心が必要だった．

成功したグローバル企業は，1つの文化だけのDNAを持っているのではなく，多くの文化のDNAを上手く融合している．数多のかずほどの新しい取り組みの中から最適な方法を選び出している．

ジヤトコはより優れた成功に向けて取り組んでいる最中であり，進化の最中であることを忘れてはならない．（多分今は真中あたりだろう．）

私は，ジヤトコの未来とグローバリゼーションへの一端を担うことが出来ることを大変うれしく思っている．

This is often difficult to reconcile as JATCO's traditional methods have proven very successful from a design and manufacturing perspective. From JATCO's point of view the most cost efficient means of adapting our transmissions to customer vehicles is to ask them to accept what we have already designed. Change is to be resisted as much as possible as a means of reducing development costs and risks. There is fundamentally nothing wrong with this logic. However; as much as we would like our customers to accept our standards and development methods, they desire to avoid deviations from their own. Our new customers have developed their own engineering and development standards, often, over a considerable amount of time; hopefully these standards have provided success for them. Many of these customers are relatively new to the concept of buying transmissions from outside sources or sources outside their normal cadre of suppliers.

The key missing element in this supplier customer relationship is trust. JATCO has established trust between us and our core group of customers. This trust allows some synergy between our engineering and development standards and our customers. They trust that we know what we are doing, and that we will deliver quality engineering and support because they have a history with us. Our new customers have no history (or very short history) with us. They do not trust that we will deliver on our promises and therefore they must that our performance measures up to their expectations by applying the only measurement standard they have, their own.

JATCO has been reasonably successful at achieving new programs with customers outside of our core group. But new programs alone cannot create the trust level needed to be truly global. JATCO must strive to achieve multiple successful programs with new customers, to prove that we are good long term partners and not just niche market solution suppliers. JATCO must be willing to accept new customers as true long term partners and be willing to work with them on the high volume high profit programs as well as the low volume low profit programs. If JATCO wants to achieve true global status we must be willing to engineer solutions for our new customers with the enthusiasm we apply to solutions for our core customers.

6. Conclusion

As was stated at the beginning of this document, this is an analysis of JATCO's globalization based on the writer's personal observations and opinions.

It should be accepted as such.

Globalization of any company presents several challenges which must be met with a strong and open mind.

Successful Global companies do not have the DNA of only one culture; they have the merged DNA of many cultures. Take the best from each and create a newer stronger whole from the many pieces. JATCO is progressing on this challenging path with good success, but we should keep reminding ourselves that we are not at the end of the path (maybe the middle). JATCO has room for improvement.

I look forward to being part of JATCO's future and sharing in the challenges of globalization.

■ Author ■

Jim FRIEDLINE

フランスというクルマ社会

Automobiles in French Society

竹本　幸一*
Kohichi TAKEMOTO

抄　録　本稿では，昨今の欧州市場，特にフランスにおける自動車をとりまく状況と，ATの位置づけについて解説する．

Summary　This article describes the recent environment surrounding automobiles and the position of automatic transmissions in the European market, focusing especially on France.

1. ジヤトコ・フランスの生い立ち

欧州におけるジヤトコの歴史は，1991年ドイツのミュンヘンに設立されたジヤトコ・ヨーロッパ（JATCO Europe GmbH, 以下JEG）に始まる．JEGはFF/FR ATをVolkswagen，BMW等の欧州各自動車メーカへ供給していた．その後の状況の変化により，2003年にジヤトコ・フランス（JATCO France SAS, 以下JF）を設立．2004年欧州での活動の中心をドイツからフランスへ移し，JFがJEGを吸収する形で新しいJFとして再出発することとなった．現在では，欧州顧客への当社製品搭載車両の開発支援と，生産・市場品質への対応をJFの主な活動としている．また欧州における業界各社の最新動向を探るために，主要なモーターショー，技術会議を中心に新技術，新製品の調査活動も行なっている．

2. 自動車市場としての欧州

ヨーロッパ全体（EU27カ国＋EFTA4カ国）での2009年1年間の乗用車新車登録台数は14,481,545台*1であった．これは北米市場と肩を並べる規模である．国別では，主な車両メーカが位置する4国，ドイツ（約381万台），フランス（約227万台），イタリア（約216万台），イギリス（約199万台）が上位を占め，この4国で全体のおよそ7割を占めている．

*1 ACEA（欧州自動車工業会）による

1. Background of JATCO France

The history of JATCO's operations in Europe began with the establishment of JATCO Europe GmbH (JEG) in Munich, Germany in 1991. JEG supplied ATs for front-drive and rear-drive cars to various European automakers, including Volkswagen, BMW and others. As a result of subsequent changes in circumstances, JATCO France SAS (JF) was established in 2003. The center of JATCO's activities in Europe was then transferred from Germany to France in 2004, and JF was relaunched in a new form in which it absorbed JEG. Currently, JF's principal activities are to support JATCO's European customers in their development of vehicles fitted with JATCO transmissions and to coordinate production and handle field quality matters. JF also undertakes surveys of new technologies and products presented at major auto shows and technical conferences in order to scout out the latest trends among European companies in the automotive industry.

2. European Vehicle Market

The number of new passenger vehicles registered throughout Europe (27 EU nations + 4 EFTA nations) in 2009 totaled 14,481,545 units, according to the European Automobile Manufacturers' Association (ACEA). The European vehicle market ranks on a par with the North American market in terms of size. A breakdown of the volume by country shows that Germany (approx. 3.81 million units), France (approx.

* JATCO France SAS

3. フランスの状況

フランスの2009年1年間の乗用車新車登録台数は2,268,671台*1であった．この数字は日本の乗用車新車登録台数（軽自動車を除く）2,640,312台*2をやや下回るレベルである．一方，フランスの人口は約6500万人で，日本の人口約1億3000万人のおよそ半分である．この人口の差を考慮すると，フランスは日本以上に自動車が溢れた社会であると言うことができる．

*2 社団法人 日本自動車販売協会連合会による

4. クルマに依存する社会

フランスの首都であるパリ市内には，メトロ（地下鉄），バス，トラム（路面電車）が網の目のように張り巡らされている．路線の多さも，混迷の具合も東京都心の鉄道路線図のようである．最近では近距離の移動用にレンタル自転車も整備され，パリ市内だけで生活する分には自家用車が無くてもほとんど困らない．にもかかわらずパリ市内が常に路上駐車で溢れているのには理由がある．

パリは世界の中でも夜間人口＝実際に居住している人口が多いことで知られている．パリは世界的な観光地であることは言うまでもないが，観光スポットの隙間を埋めるかのようにたくさんの居住用アパートが建っている．このたくさんのアパートのうち，比較的最近建築されたものには地下に駐車場が整備されている．一方で18世紀頃からの姿をとどめたような古いアパートも多く，このようなアパートには地下駐車場が無い．周辺の路上駐車に頼らざるをえない状況にある．中世の頃から続く複雑怪奇な街づくりの一部である狭い道に，さらに路上駐車枠を設置するため，パリ市内はいたるところが1車線の一方通行路になっている．

パリは，呼吸するかのように朝に夕に大量の人を吸いこみ，吐き出す．パリは欧州有数のオフィス地域でもあり，多くの人が毎日市外から働きに来る場でもある．パリ市内の公共交通網が整備されている一方で，パリと郊外をつなぐ鉄道の路線数は少なく，中長距離の路線バスを含めても絶対的な輸送量が足りない．乱暴に言うと，私鉄路線がまったく無い

2.27 million units), Italy (approx. 2.16 million units) and the U.K. (approx. 1.99 million units) are the top vehicle producers. These four countries, in which the major automakers are located, account for approximately 70% of the total vehicle volume.

3. Situation in France

New passenger vehicle registrations in France in 2009 totaled 2,268,671 units, according to the ACEA. That figure was somewhat lower than the 2,640,312 new passenger vehicles (excluding minivehicles) registered in Japan that year, according to the Japan Automobile Dealers Association. On the other hand, France's population of some 65 million people is only about half Japan's population of approximately 130 million people. Taking the population difference into account, France is apparently a country with a greater abundance of vehicles than Japan.

4. Vehicle-dependent Society

France's capital city Paris is crisscrossed with subway (Metro), bus and tram networks. The number of public transportation lines and their degree of complexity resemble a map of the train lines in the central part of Tokyo. Rental bicycles have also been provided lately as a means of short-distance mobility. In everyday life just within the city of Paris, people without a personal vehicle are hardly inconvenienced at all. Nonetheless, there is a reason why the streets of Paris are always filled with parked vehicles.

Paris is well-known worldwide for having a large nighttime population of people who actually reside in the city. While it need not be mentioned here that Paris is a global tourist destination, there are plenty of residential apartment buildings that seem to fill in the spaces between tourist spots. Apartment buildings that have been built relatively recently usually have an underground car park. On the other hand, there are many old apartment buildings retaining the look of around the 18th century that do not have any underground parking facility. Consequently, vehicle owners have no choice but to park on nearby streets. The labyrinth of narrow streets is one facet of the city that has remained since medieval times. The added provision of on-street parking spaces has resulted in a

東京のようなものである．ここを補っているのが多量の乗用車である．

鉄道よりも乗用車が主流という交通形態は，郊外の生活でも同じである．パリから30kmも郊外に出ると，そこは田園地帯となる．フランスは穀物自給率が100%を大きく上回る農業国でもある．郊外の風景は北海道の富良野，美瑛かと見紛うほどである．広大な農地の中に点在する村々の多くには，中世以降の集村の構造が今もはっきりと残っている．中心には教会，広場があり，周辺を1車線の狭い道が囲んでいる．大きく成長した町には商店街が形成されることもあるが，小さな村にはよろず屋が一軒だけのこともある．住宅地としての集落は，古くからある中心部の外側に新しい街並みを追加することで成長したが，商業地域は集落の外で別の方向に進化を遂げることになる．

1970年代以降，郊外の主要な幹線道路の脇にショッピングモールが形成されるようになる．大型のスーパーマーケットを中心に，専門店，飲食店が集まり，広大な駐車場が用意され，自家用車でのアクセスが前提になっている．駐車場では，自家用車のハッチバックを開けて，1週間分の大量の食材を手押しカートから移す家族連れの姿が日常の光景になっている．このように書くとアメリカの商業モールと同じかと思われるかもしれないが，決定的な違いが一つある．駐車場の1台当たりのスペースの広さは日本とほとんど同じである．サイドミラーはたたんだほうが安全である．さもないと，周りの車のように粘着テープでサイドミラーを支えることになる．

situation where many streets throughout Paris have just a single lane of one-way traffic.

Paris takes in hordes of people in the morning and disgorges them in the evening as if the city were inhaling and exhaling. The city is one of Europe's leading office locations, where swarms of people come to work every day from the suburbs. While the center of Paris is well provided with public transportation networks, the number of train lines connecting the city with the surrounding suburbs is limited. Even including regular medium- and long-distance bus routes, the absolute transport capacity is insufficient. A rough analogy would be Tokyo without any private train lines at all. The large number of private passenger vehicles is what compensates for that lack.

This situation where vehicles are the principal mode of transportation instead of trains is also true for life in the suburbs. If you go to the suburbs 30 km from Paris, you are in the countryside. France is an agricultural country with a self-sufficiency rate for cereals that greatly exceeds 100%. The scenery in the suburbs could easily be mistaken for that of Furano or Biei in Hokkaido. Many of the villages scattered throughout the vast farm land still retain their structure as settlements from the Middle Ages. In the center of the village is a square with a church and encircling the village is a narrow one-lane road. Towns that grew significantly sometimes developed a business district, but small villages may have only a single general store. Some settlements grew as residential areas by adding new streets on the outside of the old town center. However, business districts tended to evolve in different directions on the outside of the settlement.

Since the 1970s, shopping malls have been built along the main arterial roads in the suburbs. Malls generally have a collection of specialty stores and restaurants centered around a mammoth supermarket with a huge parking lot, premised on the assumption of access by private vehicles. Families loading a week's supply of groceries from a shopping cart into the open rear hatch of their vehicle is an everyday scene in the parking lot. This description may sound like a shopping mall in the U.S., but there is one definite difference. The size of a parking space for one vehicle in the parking lot is virtually the same as

5. 2009年フランスで売れたクルマ

フランスではどんな車が売れているのだろうか？フランスのArgus*3という会社が，「その年に売れた車の典型的な仕様」を毎年発表している．これは，フランスで最も売れたクルマ上位130台のスペックを平均した統計値である．

価格：19,153ユーロ
全長：4.10m
全幅：1.74m
馬力：96hp
CO_2排出量：131g/km

このスペックは小型のハッチバックやファミリーカーに相当する．実際の車名によるランキングでも

Peugoet 207（1位）
Renault Clio（3位）
Citroen C3（5位）

という車が上位に並んでいて，フランス人の好みをよく表している．

ちなみに，クルマの色は白，黒，銀，紺といった地味な色が主流である．パステルカラーや原色系の派手な色の車はほとんど見かけない．

*3 www.argusauto.com

6. CO_2排出量によるボーナス/ペナルティ制度

フランスでは，新車購入時にその車のCO_2排出量に応じたボーナス/ペナルティの制度が存在する．CO_2排出量がある値よりも少なければボーナス（支援金）が支給され，多ければペナルティ（追徴金）が課せられる．このCO_2排出量の基準とそれに応じたボーナス/ペナルティの金額は適時見直され，販売される新車のCO_2排出量が年々少なくなる方向へ誘導されている．2010年と2011年のボーナス/ペナルティの基準を表.1に示す．

in Japan. When parking, it is safer to fold in the outside mirrors, otherwise it may be necessary to support them later with masking tape like the ones on nearby vehicles.

5. Best-selling Vehicles in France in 2009

What kinds of vehicles sell well in France? Every year a French company called Argus*3 publishes the typical specifications of vehicles that sold well during the year. The data below are the average specifications of 130 vehicles that were the top-sellers in France.

Price: 19,153 euros
Overall length: 4.10 m
Overall width: 1.74 m
Horsepower: 96 hp
CO_2 emissions: 131 g/km

These specifications correspond to those of a small hatchback or family sedan. In the actual ranking of vehicle models, the Peugoet 207 (1st), Renault Clio (3rd) and Citroen C3 (5th) were among the top best-selling cars. These models clearly reflect the preferences of French customers.

Incidentally, subdued colors like white, black, silver and deep blue are the mainstream vehicle body colors. One almost never sees vehicles with pastel body colors or vivid primary colors.

*3www.agrusauto.com

6. Bonus/Penalty System for CO_2 Emissions

There is a system of bonuses/penalties for CO_2 emissions that is applied to new vehicle purchases in France. A buyer is paid a bonus (subsidy) if a vehicle's CO_2 emissions are below a certain level and pays a penalty (surcharge) if the emissions are above it. The CO_2 emission standards and corresponding bonus/penalty monetary amounts are reviewed periodically so as to encourage automakers to reduce the CO_2 emissions of the new cars they put on the market every year. The bonus and penalty standards for 2010 and 2011 are shown in Table 1.

Let us look at how the changes in Table 1 affect vehicles equipped with a JATCO transmission. The Renault Megane fitted with the JF011E and a 2.0L inline 4-cylinder gasoline engine (CO_2 emission level:

Table 1 CO_2 Bonus/Penalty System

	2010		2011	
BONUS	~60g/km	5000€	~60g/km	5,000€
	GPL, GNV, HEV ~135g/km	2000€	HEV ~110g/km	2000€
	61~95g/km	1000€	61~90g/km	800€
	96~115g/km	500€	91~110g/km	400€
	116~125g/km	100€	111~120g/km	0€
	126~155g/km	0€	121~150g/km	0€
	156~160g/km	200€	151~155g/km	200€
PENALTY	161~195g/km	750€	156~190g/km	750€
	196~245g/km	1,600€	191~240g/km	1,600€
	245g/km~	2,600€	240g/km~	2,600€

この変更により，ジヤトコ製品を搭載した車がどのような影響を受けるかを見てみる．JF011Eを搭載したルノー・メガーヌ 直4 2.0Lガソリン仕様（CO_2排出量：175g/km）は2010年，2011年共に750ユーロのペナルティで変わらない．一方，JF613Eを搭載したラグーナV6 3.0Lディーゼル仕様（CO_2排出量：192g/km）では，2010年は750ユーロだったペナルティが2011年には1600ユーロに上がることになる．ちなみに，2010年よりルノーが導入したEDC（6速DCT）搭載のメガーヌ 1.5Lディーゼル仕様（CO_2排出量114g/km）では，2010年は500ユーロのボーナスを得ていたが，2011年からはこのボーナスは無くなる．このように，年々同じCO_2排出量の車のボーナスが減り，ペナルティが増える方向へ改定されるため，市場では切り替え間近になるといわゆる駆け込み需要が発生することになる．また同時に市場からのCO_2排出量低減への期待は年々高くなる．この期待に応えるために，各カーメーカーにとっては継続的なCO_2排出量削減＝燃費改善が極めて大きな課題になっている．

7. なかなか普及しないAT

欧州で売れている乗用車のうち，AT車はおよそ2割程度と言われている．一律に2割というわけではなく，小型，廉価車ではより低く，大型，高級車ではより高い比率になる傾向にある．ATが日本やアメリカのように普及しない理由が知りたくて，JFのフランス人社員にATの普及が進むモデル（仮説）を話したことがある．

最近の日本の状況を想定して私が話したモデルは，

175 g/km) is assessed the same penalty of 750 euros in both 2010 and 2011. Meanwhile, the penalty on the Renault Laguna equipped with the JF613E and a 3.0L V6 diesel engine (CO_2 emission level: 192 g/km) goes up from 750 euros in 2010 to 1,600 euros in 2011. In 2010, Renault rolled out a Megane model fitted with its EDC 6-speed double clutch transmission (DCT) and a 1.5L diesel engine (CO_2 emission level: 114 g/km) that earned a 500 euro bonus that year, but the bonus disappeared in 2011. As indicated here, the standards are revised every year such that the bonuses paid for vehicles emitting the same CO_2 levels decrease and the penalties increase. This can give rise to last-minute vehicle demand just before the standards change. At the same time, there are rising expectations that CO_2 emissions will be reduced in real-world driving as a result of these revisions. In order to respond to such expectations, continuous efforts to reduce CO_2 emissions by improving vehicle fuel economy represent a crucial issue for every automakers.

7. Difficulty in Popularizing AT-equipped Vehicles

It is reported that AT-equipped vehicles account for only about 20% of all passenger vehicles sold in Europe. This figure of 20% is not uniform across all model lines. The percentage tends to be lower for small cars and low-priced vehicles and higher for large luxury models. Because I wanted to know the reasons why AT-equipped vehicles have not diffused in Europe like they have in Japan and the U.S., I discussed a hypothetical model for popularizing AT-equipped vehicles with a French employee at JF.

The following model that I explained was based on recent conditions in Japan.

(1) More women have been entering the workforce in recent years.
(2) Women need to drive in everyday life.
(3) Driving operations can be difficult for women drivers.
(4) A type of driver's license limited to AT-equipped vehicles has become popular in recent years.
(5) The number of AT-equipped vehicles has been increasing.

In response to my explanation, the French employee proposed the following model.

1）近年の女性の社会進出.
2）女性による運転の必要性.
3）運転操作が苦手な女性ドライバー.
4）AT限定運転免許証の普及.
5）AT車の増加.

これに対して，フランス人社員が提示したモデルは.
1）そもそも社会の役割に男女差は無い.
2）以前から，女性も普通に運転している.
3）運転技術に男女差は無い．市バスの女性運転手も特別ではない.
4）MT操作は運転技術に含まれる.
5）女性であることはAT車を選ぶ理由にはならない.

この話をした相手は女性だったが，話している途中から彼女が不愉快になっていくのがわかった．彼女にとって私の提示したモデルは，一方的な先入観に基づいた偏見に過ぎなかったということである.

8. AT車の位置づけ

欧州でのAT車，特に大衆車のAT仕様に対する一般的な認識は，MT車と比べて1）新車価格が高く，2）燃費が悪く，3）修理にお金がかかり，4）中古車としてのリセールバリューは低いというものである．欧州にも渋滞はあるし，一度その中を運転すればAT車の便利さは誰もが認める．それでも，MT操作を当たり前のことと思い，苦に思っていないユーザにとっては，ATの快適性はそれほど大きな魅力には映らないようである．むしろ自動車を生活の道具として使い，故障したらその都度直し，10年，15年という時間，15万km，20万kmという距離を走ることも珍しくない欧州という市場では，先に挙げたようなATのデメリットのほうがが際立つことになる．それでも2ペダルの快適性を選ぶユーザというのはやはり少数派で，現時点では2割程度にとどまっており，その2割のユーザに対する高級オプションとしてカーメーカーはAT仕様を設定している.

一方で，高級セダンのように，その存在そのものがもはや単なる移動のための手段ではなく，快適性を含めた高い付加価値を伴っていることが前提になっている場合には，自ずとより高い比率でATが選ばれることになる.

(1) The roles of men and women in society are not inherently different.
(2) Women have also been driving on a regular basis for many years.
(3) There are no gender differences with regard to driving techniques. Women city bus drivers are not exceptional.
(4) Shifting a MT is included in driving techniques.
(5) Just because of their gender, women customers will not choose AT-equipped vehicles.

The JF employee I was talking with was a woman. During our conversation, I could tell that she was becoming annoyed. To her, the model I presented was nothing more than a biased view based on a one-sided preconception.

8. Positioning of AT-equipped Vehicles

In Europe, the general perceptions of AT-equipped vehicles, especially ordinary family cars, in comparison with their MT-equipped counterparts can be summed up as follows. (1) New car prices are higher. (2) Fuel economy is worse. (3) Repairs are more expensive. (4) The resale value as a used car is lower. Traffic congestion is also common in Europe, so anyone who has driven an AT-equipped vehicle in a traffic jam knows the convenience of an AT. Yet, to drivers who take shifting an MT for granted and think nothing of it, the comfort of an AT apparently does not appear to be so attractive. Europeans use vehicles as tools of everyday life, fixing them whenever they break down and driving them over a period of 10-15 years with an accumulated mileage of 150,000 to 200,000 km. Such usage is not unusual in the European market. To Europeans, the disadvantages of AT-equipped vehicles mentioned above stand out more than convenience. Drivers who prefer the comfort of a two-pedal vehicle are still in the minority and remain at around the 20% level at present. To this 20% of the driving population, automakers offer an AT specification as a high-end option.

On the other hand, a higher percentage of customers of luxury sedans select an AT. Such vehicles do not exist merely as a means of transportation, and it is naturally assumed that they come with high levels of added value, including comfort and convenience features.

9. AT普及のためのアプローチ

大衆車の高級オプションとしてのAT車の需要は，今後も緩やかな増加しか期待できないだろう．欧州の多くのカーメーカーは，この少量バリエーションとしてのAT搭載仕様を，効率良く，短時間，低コストで実現する方法を模索している．ATユニットをカーメーカー自身では開発せず，サプライヤーから調達し，搭載のための適用開発をアウトソースすることもある．つまり少量前提であることが，かえってATサプライヤーにビジネスの機会を与えている．またATサプライヤーの側では，一つ一つのカーメーカーでは少量であるものを．複数のカーメーカーをまとめることで多量化し効率化することが行なわれている．

欧州市場ではATはこれからも，このような限定的なポジションに甘んじていることになるのだろうか？

近年，ここに変化があらわれている．それは，燃費改善アイテムとしてのATである．年々強くなる社会的な環境志向は，エンジンのダウンサイズ化，アイドルストップ等の燃費改善に貢献するあらゆる種類の技術の導入を後押ししている．フランスのCO_2排出量に応じたボーナス/ペナルティ制度もそのような追い風の一つである．また同時にユーザの側にも，多少コストが高くなっても，あるいは運転性等に伝統的なMT搭載車とは異なる部分があっても，燃費が良くなるものであれば受け入れるという素地ができつつある．この動きはまさに価値観の変化であり．大衆車の主たる仕様そのものを大きく変革する可能性をもっている．

DCTは既にこの流れに乗っている．Volkswagenは当初ウェット・クラッチ式のDSG{Direct Shift Gearbox (DCT)}をスポーティ車両専用として導入した．しかし現在では，多段化とドライクラッチ化を進め，環境アイテムの一つとして多くの車種に採用している．

CVTはどうだろうか．日産キャシュカイ(日本名:デュアリス)のJF011E搭載仕様では，欧州燃費サイクルのCO_2排出量で6速MT仕様よりも優れた結果を出している．しかし燃費改善アイテムとしてのCVTは，欧州市場ではまだまだ認知されているとは言えない．プレゼンスの向上のためには，更なる改善と市場へのアピールが必要である．

9. Approach to Popularizing ATs

Can we expect to see only a gradual increase in demand for ATs as a high-end option on ordinary family cars in the coming years as well? Many automakers in Europe are searching for some way to develop AT specification vehicles efficiently, quickly and at low cost as a low-volume variation. In some cases, automakers procure an AT from a supplier without developing it themselves and outsource the application engineering work needed for fitting the unit to the vehicle. In other words, the assumption of low production volumes can actually work to create business opportunities for AT suppliers. For AT suppliers themselves, the volume delivered to individual automakers may be small, but the combined volume supplied to multiple automakers results in larger production volumes and higher efficiency.

Will we have to be content with this limited position for ATs in the European market in the years ahead?

In this regard, certain changes have begun to appear in recent years. For example, ATs are coming to be seen as a means for improving vehicle fuel economy. Societal preferences for eco-friendly products have been growing stronger every year and are driving the introduction of various techniques that contribute to improving vehicle fuel economy. Examples include the downsizing of engines and the use of idling stop systems. France's bonus/penalty system for CO_2 emissions is also another positive force here. At the same time, drivers are also gradually forming a mindset for accepting things so long as they improve fuel economy even if they cost slightly more or if the driving characteristics differ in certain respects from the feeling of a traditional MT-equipped vehicle. This trend is nothing less than a change in value, and it has the potential to radically alter one of the major specifications of ordinary family cars.

DCTs are already taking advantage of this trend. Volkswagen initially introduced its wet-clutch direct shift gearbox (DSG) as a DCT for use on sporty vehicles. However, as a result of the moves to add more speed ranges to ATs and advances in dry-clutch technology, the DSG is now being adopted on many

10. おわりに

欧州は依然MT車が多く走り，一見極めて保守的な市場に見える．伝統的なMT＝実用性 vs AT＝快適性という2元論が未だに続いているのも事実である．一方で，欧州は最先端のパワートレインが次々と産まれ出る場所でもある．環境志向という新しい価値観が旧来の2元論に加わる第3の価値となり，結果として市場全体の価値観が大きく揺さぶられつつある．ジヤトコとしても，市場の期待を上回るような更に素晴らしい製品を投入することで，この大きな時代の変革の主役に加わることが，今の私の，そしてJFの希望である．

models as an eco-friendly technology.

What about the prospects for CVTs? The Nissan Qashqai (Dualis in Japan) fitted with the JF011E achieved a CO_2 emission level superior to that of 6-speed MT-equipped vehicles under the EU fuel economy test cycle. However, CVTs are still not recognized very much in the European market as a technology for enhancing fuel economy. In order to heighten their presence in the market, it will be necessary to make further technical improvements and to publicize CVTs more in the marketplace.

10. Concluding Remarks

Europe still has many MT-equipped vehicles on the road and would appear to be a very conservative market at a glance. The duality debate between the practicality of traditional MTs versus the comfort of ATs is still going on today. On the other hand, Europe is also a market that has given birth to one cuttingedge powertrain system after another. A preference for eco-friendliness has been added as a new value to this traditional dualism to form a third value, with the result that the values of the entire market are being substantially shaken. It is my hope and also that of JF that JATCO will roll out even more impressive products that exceed the expectations of customers and thereby be a major force in advancing this epochal change in the market.

■ Author ■

Kohichi TAKEMOTO

ジヤトコ 韓国エンジニアリング株式会社のグローバル化への取り組み

Globalization Activities at JATCO Korea Engineering Corporation

申　明信*　Myungshin SHIN
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1. 概 要

所在地：大韓民国ソウル特別市衿川区加山洞550−1
Lotte IT Castle 4階
創　立：1998年5月8日
資本金：45億ウォン（約45千万円）
従業員：186名（在韓者のみ‘ 10年11月現在）
事業内容：自動車変速機の車両適用開発，調達支援
ホームページ：www.jatco.co.kr

今年で創立12周年を迎えたジヤトコ韓国エンジニアリング株式会社（以下JKE）は，設立以来開発・調達機能におけるジヤトコとのグローバル分業を拡充しながら成長を遂げ，グローバルジヤトコの主要な海外拠点としてその位置づけを高めてきた．

現在JKEの組織は商品・開発（設計・実験），技術研究所，データセンター，調達，管理部門で構成されており，その業務はJKEに設置されたDPCE（Deputy Product Chief Engineer）を中心とした韓国向けプロジェクト業務と日本やその他の地域向けの構造部品，機能部品，制御，解析，調達などのジヤトコの機能軸と連携した機能軸業務である（Photo 1）．

機能軸業務はジヤトコの主管を核とした一体化

1. Overview of JKE

Location :	4th Fl, Lotte IT Castle Bldg., 550-1 Gasan-dong, Geumcheon-gu, Seoul, Korea
Establishment :	May 8, 1998
Capitalization :	4.5 billion won (approx. 45 million yen)
Workforce :	186 employees (Korea-based personnel only as of November 2010)
Business activities :	Vehicle application engineering for automotive transmissions and procurement support
Website :	www.jatco.co.kr

In the 12 years since the company was established, JATCO Korea Engineering Corporation (JKE) has continued to grow and elevate its position as a principal engineering center in JATCO's global organization. JKE has been expanding and strengthening its global division of work activities with JATCO in the areas of product development and procurement.

Currently, JKE's organization consists of the product development department that is engaged in design and testing work, technical R&D center, data center, procurement department and administration department (Photo 1). One area of our activities

Photo 1 Launch ceremony for Korean market project in fiscal 2009

* ジヤトコ韓国エンジニアリング社 実験チーム
JATCO Korea Engineering Corp. Experiment Team

組織の中で運営されているが，韓国向けプロジェクトの顧客の中にはその親会社が欧米にある企業もあることや，韓国以外の新興国でのサプライヤー開拓業務も行っていることなど，その活動領域は韓国と日本との関係のみならずグローバルに広がっている．

JKEがこの様にグローバルに活動領域を広げることができたのは，主に人財面での特徴を活かして来たことと日本を含めたJATCOの海外拠点との人財交流を積極的に進めてきたからである．

以下に，その内容について詳しく述べていく．

2. グローバルマインド＆スキルがあふれる人財と世界第5位の自動車生産国

韓国にある外国企業として研究･開発に携わる社員だけで200名の規模の企業は珍しいケースであるが，その規模もさることながら，JKEの長所といえば，なによりも人財にある．

韓国はグローバルな金融危機からいち早く立ち直り，自動車や家電といった主力工業製品のシェアを拡大するなど，世界経済においてプレゼンスを急速に高めているが，GDPの約40%を輸出が占めている様に国内市場だけでなく，当初から世界市場を舞台に戦っていく必要がある国である為，グローバルなマインドとスキルを身につけている人財が大変多い．

JKEの例で言えば，社内公用語は日本語を基本とし一定水準になるまで日本語講座受講を義務化していること，TOEIC平均点数は700点を超しており英語も堪能な社員が多いことなどが挙げられ，ジヤトコがある日本以外にもアメリカ･フランスとの仕事が並行して行われていることが多いこともあり，社内では毎日，日本語･英語･韓国語の3ヶ国語が飛び交っている．そして，毎月の全員集会での社長メッセージも資料は英語，スピーチは日本語もしくは英語で行われたり，最近は中国語の勉強を始める社員も増えてきたりしていること（Photo 2）や海外在留（留学や就業及び日本駐在など）経験がある社員も約60%も占めていることなど，グローバルマインドとスキルがあふれる社員が多いことがJKEの強みである．

また，韓国は世界第5位の自動車生産国である．現代一起亜自動車，GM大宇，ルノー三星の3大

concerns projects for the Korean market that are mainly overseen by a Deputy Product Chief Engineer (DPCE) at JKE. Another area involves function-oriented activities linked to JATCO's corporate functions and concerned with the Japanese and other markets. The latter activities are largely related to structural and functional components, control systems, simulations and procurement.

Function-oriented activities are carried out within an integrated organization structured around JATCO's general managers, but the projects for the Korean market extend over a global scope of activities that are not limited to our relationship with JATCO in Japan. One reason for this is that some of the customers of these projects have American or European parent companies. Another reason is that the projects include efforts to develop supplier companies in emerging markets apart from Korea.

JKE has been able to expand its business activities globally in this way mainly by taking advantage of the distinct features of the company's human resources and by vigorously promoting personnel exchanges with JATCO's organization in Japan and with its other overseas operations.

The following sections describe JKE's activities in more detail.

2. Human Resources Abounding in a Global Mindset and Skills; Located in the World's 5th Largest Vehicle-producing Country

JKE is a rare entity in Korea as a foreign-capital company with a workforce of approximately 200 employees who are engaged in R&D activities. Even more noteworthy than the company's scale is its outstanding workforce that is JKE's most valuable asset.

Korea was among the first countries to recover from the recent global financial crisis and has rapidly elevated its presence in the global economy. This includes expansion of Korea's market share for leading industrial products such as automobiles and consumer electronics. Korea is a country where products must compete from the outset not only in the domestic market but also on the stage of the global market, as evinced by the fact that exports account for approximately 40% of Korea's GDP. For that reason, there are many workers who have acquired a global

国内メーカーが世界各国の市場に製品を輸出しており，海外生産まで含めればその規模は500万台を超える．また，自動車関連の部品サプライヤーも韓国国内に数多く存在しているなど，各カーメーカやサプライヤーを通じて日本ではつかみきれない世界の動きをつかむこともできることも強みである．

Photo 2 Chinese and Japanese language classes

3. ジヤトコ本社との人財交流

韓国で商品開発や調達業務を行う事ができる様にする為には，必要な技術や仕事のやり方をまず日本から学ぶことから始める必要があった．当初は短

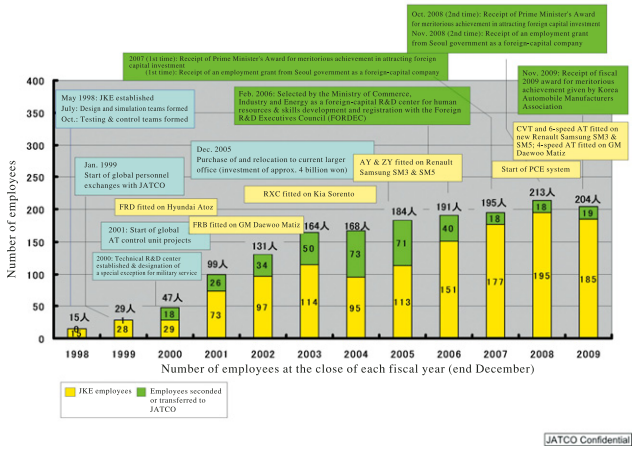

Fig. 1 History of JKE's growth (1998-2009)

mindset and skills.

Taking JKE as an example, the official language within the company is Japanese, and employees are obligated to take Japanese language classes until they reach a certain level of proficiency. Many employees are also fluent in English, as the average TOEIC score is over 700 points. There are numerous instances where projects are being carried out in parallel with American or French companies, in addition to JATCO in Japan. Our workplaces are abuzz every day with the three languages of Japanese, English and Korean. At the monthly meeting of all the employees, the president speaks to us in either Japanese or English and the handouts are in English. The number of employees who have started studying Chinese has also been increasing recently (Photo 2). Over 60% of JKE's employees have experience living abroad, either as students or while working or on assignments in Japan or other countries. As these examples illustrate, one of JKE's strengths is that many employees abound in a global mindset and skills.

Another factor is that Korea is the world's fifth largest producer of automobiles. Korea's big three automakers—Hyundai-Kia, GM Daewoo and Renault Samsung—export their products to other markets worldwide. Their combined production volume, including offshore production, exceeds five million vehicles annually. There are also many automotive parts suppliers located throughout Korea. Still another JKE strength is that through these automakers and suppliers we can pick up global trends that cannot be discerned in Japan alone.

3. Personnel Exchanges with JATCO's Head Office

In order to undertake product development projects and procurement activities in Korea, JKE first had to learn the necessary techniques and work procedures from JATCO in Japan. Initially, we acquired the work processes through repeated short-term trips to Japan, but global personnel exchanges with JATCO's Head Office were initiated in 1999, the year after JKE was founded, in a move to increase efficiency (Fig. 1).

Personnel exchanges began with one person in 1999, increased to 18 employees in 2000 and peaked at 73 employees in 2004. Seventeen JKE employees are working at JATCO in Japan this fiscal year (Photo 3).

期の出張を繰り返しながら業務習得を行ってきたが，より効率を上げるために設立翌年の99年からジヤトコ本社とのグローバル人財交流を始めた．

99年に1名から始まった人財交流は2000年には18名，ピークの2004年には73名に及び，今年度は17名の社員が日本で働いている（Photo 3）．

長いときは5年を超える期間日本へ駐在し，現在は駐在している社員の27%，チーム長，グループ長といった上級幹部については76%が日本駐在経験者で占められ，今日のJKEの中核を担っている．

Photo 3 JKE employees residing in Japan and their families (2005)

当初は日本での技術習得を主な目的としていたが，昨今はジヤトコグローバルの海外人員派遣ポリシー（JATCO FSA（Foreign Services Assignment）Principles）のもと，日本への工数応援的な形態から，JKEでは分担してない領域の業務を行い技術力を高めるような育成的形態，JKEへ将来的に移管する領域の技術を習得するための技術移転を目的とした形態，JKEに既に移管された業務領域をJKEで主体的に行う為の主に生産現場との窓口業務の形態，クロスカルチャーな経験や自分の能力へのチャレンジ，グローバルなネットワークの創出などを身につけさせる環境の中で仕事を行い，マネジメント・技術の幅を広げる様な形態など様々な形態の人財交流を行っている．また，日本のみならず，欧州やアメリカ，中国の拠点にも人財を派遣してきており，グローバル人財の輩出の一端も担っている．

また，日本との連携がよりスムーズに行えるよう，社内イントラやメールシステム，各種サーバー環境についても3年前からジヤトコと同様な環境を構築し，時差の無いことや高い日本語能力と相まって，まるで日本で作業をしているかの様な業務環境を実現している．

これらの人財や活動を通じて，韓国カーメーカや

In the longest case, JKE employees have stayed in Japan for over five years. At present, 27% of our employees have experience working in Japan. Among the senior managers such as team leaders and group leaders, 76% have experience working at JATCO in Japan. Employees who have worked in Japan now form the core of our workforce.

The main objective initially was to acquire technical skills at JATCO, but personnel exchanges are now carried out in various forms for a variety of purposes under the JATCO Foreign Services Assignment (FSA) principles. One form is for helping with the workload in Japan, another form is for developing and improving personal technical skills by undertaking work at JATCO that has not yet been assigned to JKE, and still another form is for technology transfer in which techniques are acquired in areas slated to be transferred to JKE in the future. A further form involves liaison mainly with production workplaces in Japan so as to enable us to independently carry out work in areas already transferred to JKE. Another form is for broadening one's management and technical capabilities by working in an environment that involves gaining cross-cultural experience, challenging personal abilities, creating a network of global contacts and acquiring various other skills. Personnel exchanges are carried out with facilities not only in Japan but also in Europe, America and China. This exchange program is one part of the ongoing efforts to develop human resources globally.

In order to facilitate smoother collaboration with JATCO in Japan, we have been building the same environment as JATCO's during the past three years in terms of our internal intranet, email system and the operating environment of various servers. Thanks to the absence of a time difference between Korea and Japan and our high levels of proficiency in Japanese, we have achieved a workplace environment that feels very much like we are working in Japan.

Backed by our excellent human resources and this personnel exchange program, we have made steady progress in establishing an organization for executing development projects and procurement work in Korea. In this process, we have been expanding our vigorous activities in various areas to advance JATCO's "fine monozukuri and human resources

サプライヤーの近くにあるというロケーション面や，先進的な解析技術に秀でているなどのテクニカルな面を活かしながら，V-3Pへの対応，テストコースでの走行実験，新技術分野の解析技術開発，各種学会での論文発表，箱物・軸物や金型などの調達支援など，様々な分野で「世界一の商品」のために活発に活動を広げながら着々と韓国で開発や調達業務が遂行できる体制を整えてきた．

以下に現在のグローバル分業の状況についていくつかのチームの実例を紹介する．

4. 各チームの業務事例紹介

4.1. 商品設計チーム

商品設計チームは，韓国カーメーカへの新規適用開発の着手から量産までの開発進捗管理，仕様管理と判断など全てのQCD活動をマネジメントする責任部署である．そして，韓国カーメーカの近くにあるというロケーション面を活かし客先と緊密に連携しながら，ジヤトコグループ共通の開発プロセスのもと安定した開発品質を確保できるよう設計審査・移行判断・出荷判断を行い，プロジェクト全般の進捗状況をマネジメントしている．

韓国カーメーカは，前述の通り常に世界市場を睨んだ車づくりをするので，私たちも世界各地の市場要求を意識した開発を心がけていると共に，韓国の自動車ユーザの特徴である運転性や音振に対する高い要求を満足し韓国市場でも競争力を確保できるよう適用開発ユニットの更なる性能改善を行っている．

このような状況の中，韓国向けの車両適用開発プロセスを標準化し，QCDや開発進捗事項をきめ細かくマネジメントしながらDPCEを中心にその役割を着実に遂行してきた．

一方，適用車種の増加や開発規模が大きいプロジェクトの着手，開発日程重複などによりこれまで以上に人的・物的資源を効率的に運用することが求められている．今後は，これまでの韓国向け開発の経験を活かしたナレッジ化や標準化により，更に安定した開発品質を確保できるようにすると共に，柔軟な要員配置や実験設備の確保と併せて韓国プロジェクトの競争力向上に貢献していきたい．

development." This includes undertaking V-3P (Value Up Innovation of Product, Process and Program) activities, proving ground driving tests, development of simulation tools in new technical fields, presentation of papers at various conferences, and support for procuring cases/housings, shafts, dies, molds and other parts, among other activities. In carrying out our duties, we make the most of our location advantages of being situated near the Korean automakers and suppliers and our technical strengths, including excellent capabilities in advanced simulation techniques.

The following section describes several examples of the projects carried out by each JKE team under the present global division of work activities.

4. Examples of Projects Done by Each Team

4.1. Product Design Team

The Product Design Team is responsible for managing all QCD activities from the initiation of a new application development project for a Korean automaker to the determination and management of the specifications and the management of the engineering progress until the mass production launch. The team manages the progress of an entire project through close collaboration with the customer, taking advantage of our favorable location in being close to the Korean automakers. This involves design screening, determining the transitions to subsequent phases and deciding when to ship the product. The work is carried out under the common development process of the JATCO Group so as to ensure stable product development quality.

As mentioned earlier, Korean automakers always design and engineer their vehicles with focus on global markets. Accordingly, we must keep the market requirements of different regions of the world in mind in the process of engineering our transmissions. Simultaneously, we must further enhance the performance of the transmissions we are developing for application in our domestic market in order to ensure their competitiveness in Korea, as Korean customers are characterized by their high demands regarding driving performance, noise and vibration.

Given this situation, we have steadily discharged

4.2. システム性能・制御性能開発・実験チーム

システム性能・制御性能開発・実験チームは年々進む法規制も勘案しながら，互いに連携しベースユニットを市場の特徴に合わせるロジック開発や性能改善を行っている．

韓国の運転環境の特徴は，頻繁な渋滞，速度超過を防ぐ多数の監視カメラや凸凹の影響で頻繁な変速や加減速が発生することである（Photo 4）．また，地下駐車場が多く暗騒音が低い場所での走行も多い．その為，ユーザは燃費，低車速でのショックや異音に敏感であり，韓国向けの適用業務では，燃費，車両発進性，静粛性の三つの性能が重要な課題となっている．

Frequent congestion　Many traffic cameras　Many ups and downs

Photo 4 Characteristics of Korea's driving environment

実験チームの業務はKATRI（Korea Automobile Testing & Research Institute）での走行実験とV3P推進の為の台上実験が主であるが，走行実験ではブラジル，メキシコ，ドバイ，中国など世界各地の市場要求への適合実験も現地で行っており，その活動領域はグローバルに広がってきている．

4.3. 構造部品開発チーム

構造部品設計チームの業務は，2000年に箱物・操作系の技術習得をすることから始まった．

2001年度からはベルト&プーリー，4点ギヤ機能を追加，2006年度はデフまで拡大し，更に韓国向け開発が増えていく中で不足機能を補完するために，クラッチ・システム強度・遊星歯車機能を加え，現在までに8機能ブロックを担当し，増えつつある韓国向け開発をJKEで主体的に対応できる体制を構築してきた（Fig. 2）．

当初はジヤトコから技術習得する領域が多かったが，業務拡大と共に新規開発などの難易度の高い開発業務の経験を重ねることで，自分達で自己完結した開発ができる部品も出てきており，2010年度は操作系，2011年度からは箱物を含む他部品まで

our responsibilities under the direction of the DPCE by standardizing the process for developing transmissions for application to Korean cars and by closely managing QCD objectives and the criteria for monitoring the progress of development work.

Meanwhile, it has become necessary for us to utilize our personnel and material resources more efficiently than ever before owing to the increasing number of vehicle model applications, initiation of large-scale development projects and the overlapping of development schedules, among other reasons. In the future, we want to be able to ensure stable development work quality by building a knowledge base and standardizing procedures so as to take advantage of the experience gained so far in development projects for the Korean market. We also want to ensure flexible deployment of personnel and utilization of our testing facilities so as to contribute to enhancing the competitiveness of Korean market projects.

4.2. System Performance / Control Performance Development and Testing Teams

The System Performance/Control Performance Development and Testing Teams work together to develop control logic and improve control performance so as to adapt base transmissions to market characteristics, while also keeping in mind the legal and regulatory requirements that are becoming more stringent every year.

The driving environment in Korea is characterized by frequent congestion, numerous traffic surveillance cameras for preventing speeding, and the occurrence of frequent shifting and acceleration/deceleration owing to the influence of the undulating terrain (Photo 4). Additionally, there are many underground car parks, so people often drive in places where the background noise level is low. For these reasons, drivers are very conscious of fuel economy as well as shift shock and noise during low-speed driving. Three key performance issues in application development work for the Korean market are fuel economy, vehicle acceleration performance and quietness.

The main work of the Testing Team is to conduct driving tests at the Korea Automobile Testing & Research Institute (KATRI) and bench tests for promoting V-3P. Driving test activities have now become global in scope, as tests are also carried out

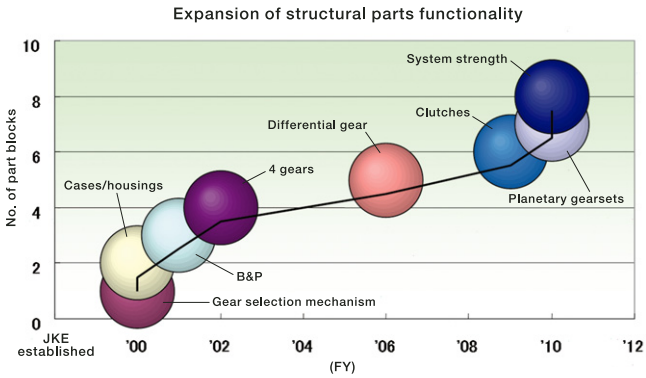

Fig. 2 History of project expansion by the Structural Parts Design Team

自己完結業務（以下，シングルサイン活動）を拡大する方向で取り組んでいる．様々な課題を如何に早く正確に設計者にフィードバックできるかが鍵である．そこで，ジヤトコに駐在するJKEエンジニアが生産現場からのフィードバックをタイムリーに受け，その内容を判断して韓国にいる設計者にタイムリーに提供しすばやく設計に反映できるようにしている（Fig.3）．

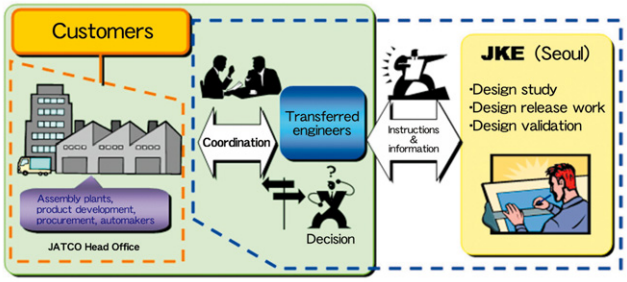

Fig. 3 Outline of activities by JKE engineers residing in Japan

今後は，開発･生産の両面でジヤトコとの連携をより密接にすると共に，レイアウトや音振性能業務などについてJKE内での横連携も強化し，グローバル分業の効果を最大化する．

4.4. 技術研究所（解析）

技術研究所（解析）は，ジヤトコ商品･開発部門のCAE業務をより効率的に遂行する為に，ジヤトコと共通の依頼業務管理システム（CAE Teknoss）のもとで一体となった運営体制を執り，設計から生産までのプロセスに必要な解析手法や解析ソフトを開発している．

技術研究所の業務は現在の課題を解決する解析手法開発業務と将来のニーズに対応する新技術開発業務であり，高度な解析手法の構築に優れて

locally in Brazil, Mexico, Dubai, China and other locations worldwide in order to verify conformity with local market requirements.

4.3. Structural Parts Development Team

The work of the Structural Parts Development Team began in 2000 with the acquisition of technical skills related to cases/housings and the gear selection mechanism.

The CVT belt and pulley assembly and the functions of four gears—final gear, reduction gear, idler gear and output gear—were added in fiscal 2001, and the scope was expanded to include the differential gear in 2006. Subsequently, as the number of projects for the Korean market increased, clutches, system strength and planetary gearset functionality were added to complement the functional capabilities that were lacking. At present, JKE is now responsible for eight functional blocks, and we have put in place an organization for handling the increasing number of Korean market projects independently (Fig. 2).

Initially, there were many areas in which we had to acquire technical skills from JATCO, but we are now able to complete the development work for some components by ourselves. This is the result of the steady expansion of our work activities and the experience gained from repeatedly undertaking relatively difficult development projects, including the development of entirely new components. We have been working vigorously to expand the scope of the development work we can complete by ourselves, from the gear selection mechanism in fiscal 2010 to other parts, including cases/housings, starting from fiscal 2011. This effort is referred to as the "single sign-off activity." A key factor in overcoming JKE's distance from the production workplaces is how quickly and accurately various issues that occur in production processes can be fed back to our designers. To accomplish that, JKE engineers working at JATCO receive timely feedback from the production workplaces. They assess the details of an issue and feed the results back to the designers in Korea in a timely manner so that the information can be immediately reflected in the design (Fig. 3).

In the future, we intend to form even closer ties with JATCO in both the product development and manufacturing areas. We also want to strengthen our

いるところが特徴である．

当初は機構解析技術が優れていた点を活かし，ADMASを用いた解析手法を数多く開発した．この成果は2003年のJATCO技術発表会「ADAMS解析導入によるレバー操作トルクシミュレーション精度向上」として報告され，以降の操作系業務の開発力の向上と韓国での業務推進に大きく貢献した．

更に，技術研究所で開発された解析技術を積極的に活用してラチェット挙動，操作力，乗り上げ検討などの解析が自動的にできるソフトウェア（JAPSS）を開発し，より効率的に操作系設計をできるようにした．

※JAPSS（JAtco Parking System Simulatorの略字）とは，運動解析関連の知識が少ない設計者であっても，初期設計段階から新規ユニットのデータベースを活用して簡単にパーキングギヤ及びマニュアルプレートの形状を定義し，各特性係数を入力すると以前に開発された設計検討項目中，解析から得られる結果を設計者が直接実行しながら確認できるソフトウェアである．

また，一つひとつの解析手法や一人ひとりの解析スキルを効果的に組み合わせ，多様な技術力と発想，連携プレイで，単一の解析手法では難しい課題を解いていくことが得意なこともJKEの強みである．

この様な取り組みにより，スピーディな問題解決と毎年の新技術開発件数アップを実現している．

更に，韓国はIT技術に強みがある国であり，ソフト開発会社との業務連携を通じた新技術情報の迅速な入手，韓国の大学及び研究所との産学活動を通じての基礎技術力の向上，そしてIT技術に優れた人財の採用など，ジヤトコグループの解析技術向上に大きく貢献している（Fig. 4）．

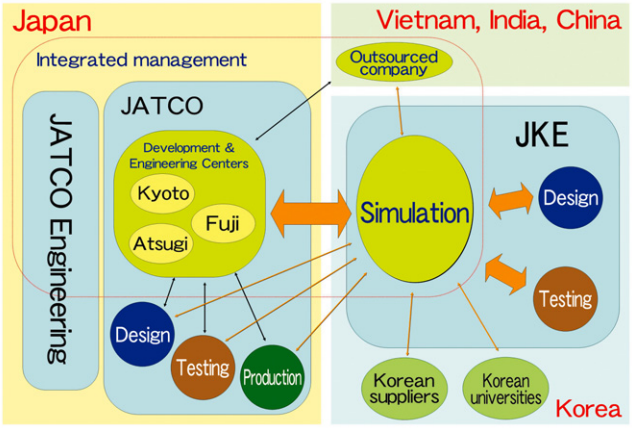

Fig. 4 Concept of integrated management of simulation work

horizontal collaboration within JKE, including handling matters related to the transmission layout and noise/vibration performance, so that we can maximize the benefits of the global division of work responsibilities.

4.4. Technical R&D Center (Simulation)

The Technical R&D Center (Simulation) has implemented an integrated work management system under the work request management framework (CAE Teknoss) shared in common with JATCO. This enables more efficient execution of the CAE activities of JATCO's Product Engineering and R&D Divisions. The Center develops the simulation tools and software that are needed throughout the process from design to production.

The work of the Technical R&D Center includes the development of simulation methods for resolving current issues and the development of new techniques for addressing future needs. One of the Center's features is its excellence in creating advanced simulation methods.

Initially, the Technical R&D Center made effective use of its outstanding mechanical system analysis techniques to develop many simulation methods based on the use of ADAMS. The results were reported in a presentation entitled "Improvement of selector lever torque simulation accuracy through the use of ADAMS analysis software" given at JATCO's Technical Presentation Forum in 2003. Those methods have since contributed greatly to the improvement of our development capabilities for selector lever-related projects and the promotion of our activities in Korea.

Moreover, the simulation techniques developed by the Center were actively used to develop the JAPSS* software for conducting automatic simulations of ratchet behavior, shift effort, parking pawl catching in the parking gear and other phenomena. This software has made it possible to design parking system mechanisms more efficiently.

*JAPSS stands for JAtco Parking System Simulator. With this simulation software, even designers with little knowledge of motion analysis can easily define the parking gear and manual plate shapes at the initial design stage by using the database of a new AT. By inputting the various coefficients of performance characteristics, a designer can confirm the simulation results directly in the process of executing the study items of a previously developed design.

4.5. 調達支援チーム

韓国部品は良い技術力・良い品質でありながらコストも良いと評価されている．JKEは世界的に評価されている韓国サプライヤーの近くにあるというロケーション面を生かしながらJATCOグローバル拠点と連携を取り，様々な調達支援の活動をしている．

設計・調達チームは，ジヤトコと韓国サプライヤーの間で，文化の差違や言語の壁による要求事項の誤解及び違和感を無くしながら仕様決心から図面作成・日程調整・工程レビュー監査・仕様確定・量産前承認・量産までフォローし，QCD達成に貢献してきている．

また，韓国国内のみならず，インド，中国などに進出している韓国サプライヤーの調査・採用提案を行い採用に結びつけることや，現地の新規サプライヤーの調査・発掘活動も行うなど，活動領域も広がってきている（Fig. 5）．

今後は，韓国サプライヤーと密接に連携した品質向上活動なども行いながら，グルーバル調達拡大に対する貢献度を高めていきたい．

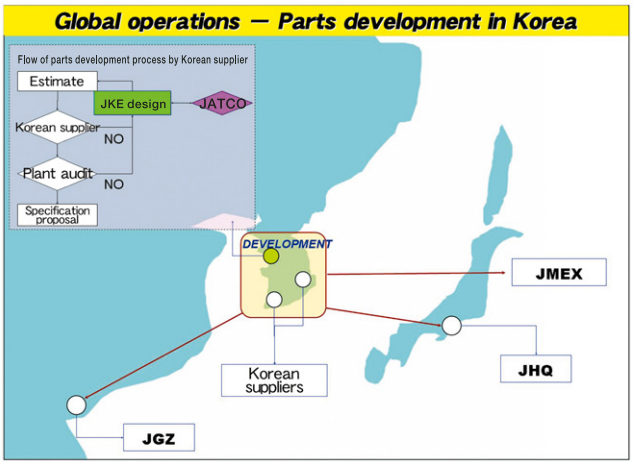

Fig. 5 Concept of global procurement support by JKE in Korea

5. 社外からの評価

この様にグローバルな分業体制を拡充し，ジヤトコのものづくりに貢献してきたが，その活動は韓国政府からも高く評価され，2006年度には産業資源部傘下韓国貿易振興協会（KOTRA）から「外国R&D人力養成企業」の認定，2007年度，2008年度には外国人投資誘致有功国務総理勲章受賞を2年連続で受賞する（Photo 5）など，韓国内での位置づけも着々と高めてきている．

At JKE, we effectively combine separate simulation methods and the simulation skills of individual employees to obtain manifold technical capabilities and concepts in collaborative efforts to resolve issues that would be difficult to solve with just one simulation approach alone. This particular capability is another example of JKE's strong points.

Such efforts facilitate speedy problem-solving and enable us to increase the number of new techniques JKE develops every year.

Thanks to Korea's strengths in information technology (IT), JKE can contribute substantially to improving the JATCO Group's simulation capabilities. For example, JKE quickly obtains new technical information through collaborative work with Korean software engineering companies, improves fundamental technical skills through industry-academia collaboration with Korean universities and research institutes, and employs people who have outstanding IT abilities (Fig. 4).

4.5. Procurement Support Team

Korean-made components have a good reputation for being very well-engineered and high in quality, yet reasonably priced. JKE is engaged in a wide range of procurement support activities, working closely with JATCO's global operations and taking advantage of our close proximity to Korean suppliers.

JKE's Design and Procurement Teams contribute to the attainment of QCD targets from the time the specifications are decided by undertaking the creation of drawings, coordinating schedules, conducting process reviews and audits, performing specification checks and carrying out pre-mass production verification and follow-up until the mass production launch. JKE serves to eliminate misunderstandings and confusion about items requested by JATCO that arise due to cultural differences and language barriers between JATCO and Korean suppliers.

JKE also surveys Korean suppliers operating in India, China and other markets in addition to the Korean domestic market and makes proposals about adopting their products, which can lead to their use by JATCO. We are also involved in researching and discovering new local suppliers. In these and other ways, we are expanding the scope of our procurement support activities (Fig. 5).

Photo 5 Korean Prime Minister's Award for meritorious achievement in attracting foreign capital investment

6. おわりに

これまで述べたようにJKEは人財の強みや積極的な人財交流，ロケーションのメリットを活かしながらグローバルな分業体制を築き，ジヤトコのモノづくりを支える主要な海外拠点として大きく成長してきた．

現在急成長しているアジア市場では品質・コストはもちろんのことスピードがより求められる．今後は，韓国の特徴である「パリパリ（早く早く）」の文化を活かし，韓国カーメーカやサプライヤーと連携しながらCO_2低減や自動車を運転する楽しさ，快適性に関する性能向上に取り組みアジア市場の拡大に更に貢献度を高めていきたい．

In the future, we want to increase our contribution to the expansion of JATCO's global procurement by working closely with Korean suppliers in conducting quality improvement activities.

5. Evaluation by Others

As described above, JKE has contributed to JATCO's monozukuri operations by expanding its global division of responsibilities. JKE's activities have also been highly praised by the Korean government. In fiscal 2006, JKE was recognized by the Korea Trade Investment Promotion Agency (KOTRA), under the Ministry of Commerce, Industry and Energy, as a foreign company that fosters the development of human resources. JKE also received an award from the Korean Prime Minister two years in a row in fiscal 2007 and 2008 for the company's meritorious achievement in attracting foreign capital investment (Photo 5). These and other awards testify to the steady elevation of JKE's standing in Korea.

6. Concluding Remarks

Over the years, JKE has grown substantially into a key overseas engineering center that supports JATCO's monozukuri operations. This has been accomplished through the establishment of a global division of labor by making the most of JKE's strengths in human resources, active personnel exchanges and location advantages.

In today's rapidly growing Asian market, speed is increasingly required in addition to high quality and low cost. In the future, we want to capitalize on the speed that characterizes the Korean culture and further increase our contribution to the expansion of the Asian market. Through close collaboration with the Korean automakers and suppliers, we will strive to reduce CO_2 emissions and improve performance attributes related to driving pleasure, comfort and convenience.

■ Authors ■


Myungshin SHIN


Jongrim SEO

中国自動車市場の変化と上海サービス事務所の取り組み

The changes in China automobile market and the approach of Shanghai office

曹　松青*
Syousei SOU

抄　録　本稿では，世界最大マーケットに急成長した中国自動車市場の現状とそこで起きている変化を捉えつつ，上海サービス事務所の取り組みを紹介する．

Summary　This article summarizes the current situation of China's booming automobile market, now the world's largest, and the changes taking place, as well as the recent activities of the Shanghai Office.

1. はじめに

改革開放以来の中国のGDP成長率は年平均9.8%（1979年～2008年）に達した．Fig. 1のように，今後10年も8%前後の高い成長率が予測され，2010年には日本を超え世界第2の経済大国，2030年にはアメリカを抜いてトップに上り出ると言われている．また，実質的な購買力を表す「購買力平価（PPP）ベース」では2012年にも米国を追い抜くとの予測があり（2010年11月10日付，米調査会社カンファレンス・ボード），世界経済における影響力が増す一方である．とりわけ，2008年10月のリーマン・ショック以来，停滞していた世界経済を牽引してきたのは中国をはじめとする新興国であると言っても過言ではなかろう．

とはいえ，一人当たりGDPでは3,735US$（2009年）と世界の平均にも遠く及ばず，大都会・沿岸部を中心に6,000US$を超えている地域がある一方，内陸部を中心に3,000US$を下回っている地域も少

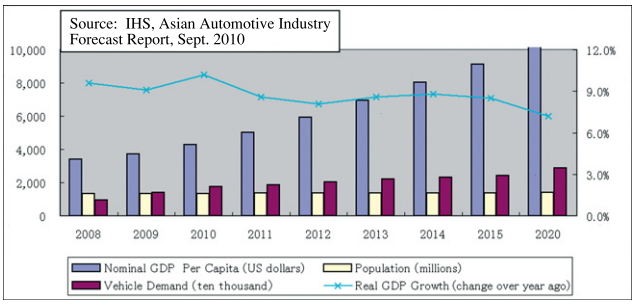

Fig. 1 Predicted growth rates of China's GDP, nominal GDP, population, and vehicle demand

1. Introduction

From the beginning of economic reforms and opening-up in 1979 to 2008, China's GDP grew at an annual average rate of 9.8%. As shown in Fig. 1, the economy is projected to continue growing at a high rate of around 8% annually during the next ten years. In 2010, China surpassed Japan in GDP to become the world's second largest economic power and is said to be on track to eclipse the U.S. in 2030, thus becoming the world's biggest economy. In terms of purchasing power parity (PPP), an index of actual purchasing power, The Conference Board, a business research association located in the U.S., predicted in a report dated November 10, 2010 that China may have a larger GDP than the U.S. as early as 2012. China's impact on the global economy continues to increase unabated. Since the collapse of Lehman Brothers in October 2008 in particular, it would be safe to say that China and other emerging markets have led the stagnant global economy.

Having said that, China's GDP per capita in 2009 stood at US$3,735, still a long way from the world average. While the figure exceeds US$6,000 in big cities and the coastal region, there are many areas especially in the interior where it falls below US$3,000. Moreover, there are large disparities in income between economic sectors, companies, blue and white collar workers and so on. In trying to analyze China's automobile market, it is essential to ascertain the changes taking place in the surrounding environment.

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なくない．また，業界によって，会社によって，ブルーカラーとホワイトカラー等によって収入格差が大きく，中国自動車市場を分析する際，環境の変化を捉えることが肝要であろう．

2. 中国自動車マーケットを取り巻く環境の変化

2009年の中国における新車販売台数は1364万台（前年比46.2%増）に達した．これは同年の米国1042万台を上回って初めて世界一となり，日本460万台の約3倍に匹敵するレベルである．また，2010年に入ってからもその勢いが衰えず，1月−10月の新車販売台数は1468万台（中国汽車工業協会発表，前年比34.8%増），通年では1700万台に達する見通しである．図1のように，2020年には2881万台と予測されている．

ここでは，中国自動車マーケットを取り巻く環境の変化に着目したい．

2.1. 自動車の購入に影響を与える周辺環境

2.1.1. 都市化

建国当初の1949年の城鎮人口比率がわずか10.64%で，改革開放初年度の1979年になっても18.96%に過ぎなかったが，Fig. 2のように，1988年以降，都市化が急速に進み，2009年には城鎮総人口が6.2億人で，全人口に占める比率が46.59%に達した．

今後も，都市部への人口移転が更に進み，中国国務院発展研究センターの予測では，2020年に城鎮人口比率が60%〜65%に上がるとなっている．都市部の自動車保有率が農村部を遥かに超えている現状から，都市化の進展に伴い，自動車の潜在的

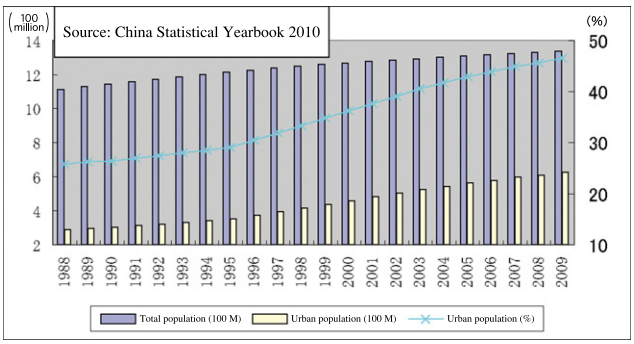

Fig. 2 Ratio of urban population in China's total population

2. Changes in the Environment Surrounding China's Automobile Market

New car sales in China in 2009 reached 13.64 million vehicles, up 46.2% over the year before. That sales volume made China the world's largest vehicle market in 2009, surpassing the U.S. figure of 10.42 million vehicles and being approximately three times larger than Japan's new car sales of 4.6 million units. China's new car sales showed no sign of slowing down in 2010, as 14.68 million new vehicles were sold in the first ten months from January to October, an increase of 34.8% over the same period of 2009, according to the statistics announced by the China Association of Automobile Manufacturers (CAAM). It is estimated that annual vehicles sales will total 17 million units. As indicated in Fig. 1, the sales volume in 2020 is projected to reach 28.81 million vehicles.

Here, let us focus on some changes taking place in the environment surrounding China's automobile market.

2.1. Surrounding environment influencing car purchases

2.1.1. Urbanization

The percentage of China's urban population in 1949 when the People's Republic was founded was only 10.64%, and even in the first year of the economic reforms in 1979, it was no more than 18.96%. However, as Fig. 2 shows, as a result of the rapid pace of urbanization since 1979, urban dwellers reached 620 million people in 2009, accounting for 46.9% of the total population.

Population migration to urban areas is expected to continue in the coming years, with the urban population reaching 60-65% of the total by 2020, according to a prediction by the Development Research Center of the State Council. Since the rate of vehicle ownership in urban areas vastly exceeds that in rural areas at present, further urbanization is expected to expand the strata of potential vehicle buyers.

However, owing to China's vast land size, there are large gaps between the coastal and interior regions and between urban and rural areas. Following the government's implementation of a strategy to promote the development of the country's western and interior regions, all the automakers have begun rapidly to

な購入層の更なる拡大が見込まれる．

ただし，国土が広いゆえに，沿岸部と内陸部，都市と農村の差が大きく，中国政府による西部地域・内陸部の発展戦略の実施に伴い，自動車メーカー各社とも，遅れている地域への梃入れを急ピッチで図り始めている．

2.1.2. 道路整備

中国において，初めての高速道路（上海ー嘉定，延べ18.2km）を開通したのは，なんと1988年10月になってからであった．しかし，経済発展の為にインフラ建設を先行させる重要性を認識した中国政府の動きが実に早かった．2004年12月17日に「国家高速道路網計画」が認可され，20年～30年に掛けて人口20万以上の都市を結ぶ「7918構想」（北京から放射状に伸びる7路線，全国を南北に縦断する9路線，東西に横断する18路線から構成され，延べ8.5万km）が打ち出され，2010年末には総延長7.3万km，早くも米国の10万km程度を射程圏内に置いている．

因みに，高速道路を含めた道路の総延長はFig. 3のように，1988年の100万kmに対し，2009年には386万kmに達し，大幅な伸びを示している．

このように，道路の急速な整備は高度経済成長をもたらす一方，人々の生活様式にも深く影響を与えている．

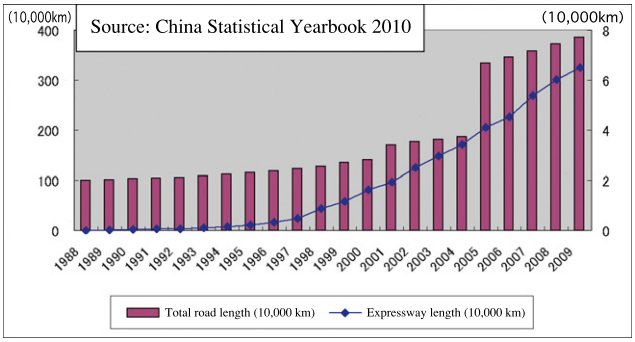

Fig. 3 Road length statistics

2.1.3. 自動車免許と1000人あたりの乗用車保有台数

ここ数年，中国における自動車免許の保有者数が年に1000万～2000万レベルで増えてきており，Fig. 4のように，2009年末の保有者数が1.44億に達した．

ただし，Fig. 5のように，1000人当たりの乗用車保有台数に目を向けると，先進国のそれと桁違いに

strengthen their business activities in the less developed areas.

2.1.2. Road construction

Incredible as it may seem, China's first expressway, covering a distance of 18.2 km from Shanghai to Jiading, did not open to traffic until October 1988. However, having realized the importance of putting priority on the construction of infrastructure for supporting economic development, the Chinese government began to move quickly. A plan to build a national trunk highway system was authorized on December 17, 2004, and the "7918 Network" initiative was announced, aimed at linking all cities with a population of over 200,000 during the next 20-30 years. This road network will consist of 7 highways radiating outward from Beijing, 9 longitudinal highways connecting north and south and 18 latitudinal highways connecting east and west, for an overall length of 85,000 km that will span the entire country. The aim is to complete 73,000 km of the network by the end of 2010, so as to bring China within the range of the 100,000-km interstate highway system in the U.S. as early as possible.

For reference, whereas China's total road length, including expressways, was one million km in 1988, the figure increased dramatically to 3.86 million km in 2009, as shown in Fig. 3.

This rapid construction of a national highway network has helped to facilitate high economic growth, while having a profound impact on peoples' lifestyles at the same time.

2.1.3. Number of driver's license holders and vehicle ownership per 1000 population

The number of driver's license holders in China has been increasing at an annual pace of 10-20 million these last several years. As indicated in Fig. 4, driver's license holders totaled 144 million at the end of 2009.

A look at vehicle ownership per 1000 population in Fig. 5, however, reveals that there is an order of magnitude difference between China and the developed countries. This suggests there is ample room for vehicle ownership to increase with the sustained development of China's economy.

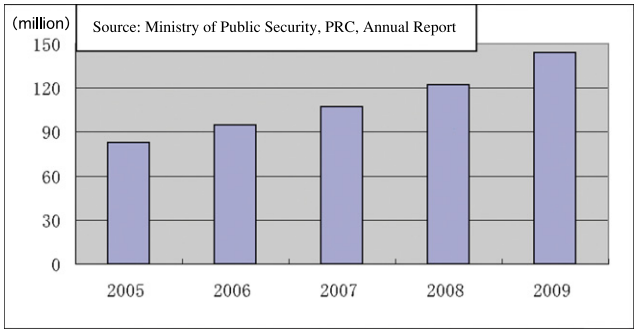

Fig. 4 Number of driver's license holders in China

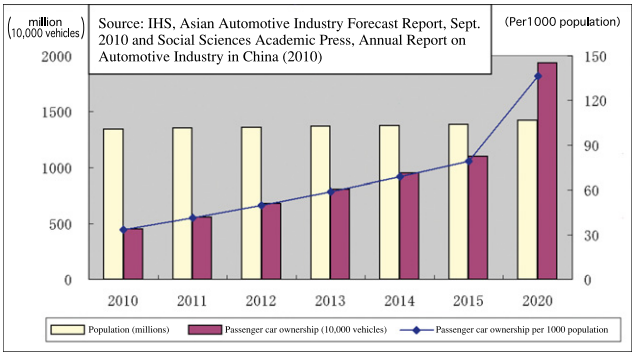

Fig. 5 Passenger car ownership in China

あることがわかる．中国経済の持続発展に伴い，逆に上昇する余地の大きさを伺える．

2.2.自動車産業振興策と民族系ブランドの台頭

リーマンショックの影響を受け，自動車産業の持続的な発展･内需拡大･構造改革を目的に，2009年3月20日，中国政府が「自動車産業調整振興計画」（3ヵ年計画）を発表した．8つの計画目標からなる同振興計画の中に，自主ブランドシェアの40%超実現が謳われている．

自主ブランドのシェアを上げるべく，政策面においては，M&Aの促進や1.6L以下排気量への政策的な傾斜，研究開発費用の政府補助が挙げられる．一方，民族系企業においては，研究開発の強化による商品力アップのほか，生産･品質･販売･アフターサービスの全ての分野において絶えず改善を重ねてきている．最近，外資との合弁企業において，中国パートナーのニューブランド戦略を外資側が支援し，民族系メーカーがほぼ独占してきた低価格帯市場へ進出しようとする動きがあり，外資系･民族系･外資系中国パートナーが入り乱れる構図を見せ始めている．

2.2. Automotive Industry Plan and emergence of domestic brands

The Chinese government announced the Automotive Readjustment and Revitalization Plan on March 20, 2009, under the impact of the collapse of Lehman Brothers. This three-year plan is aimed at promoting sustained development of the automotive industry, expansion of domestic vehicle demand and the restructuring of the industry. One of the eight goals called for in the plan is to raise the market share of domestic auto brands to over 40%.

The policy measures for increasing the market share of domestic brands includes encouragement of consolidation by mergers and acquisitions, a policy preference for small cars with an engine displacement of less than 1.6 liters, and government subsidies for R&D expenses. With regard to domestic brands, the plan calls for ceaseless efforts to improve the areas of manufacturing, quality, sales and after-sales service, in addition to enhancing the marketability of their products through stronger R&D activities. In recent years, joint venture companies with foreign capital have adopted strategies in which the Chinese partner promotes new vehicle brands with the backing of their overseas partner and enters the market for low-priced cars. Previously, this market has been virtually monopolized by the domestic brands. The market composition of foreign capital companies, domestic brands and the Chinese partners of foreign capital companies has started to show signs of becoming all jumbled up.

As a result of the foregoing developments, the market share of the domestic brands is projected to increase as shown in Fig. 6, albeit these data are only for passenger vehicles.

2.3. Changing share of two-pedal transmission vehicles

The average share of two-pedal transmission vehicles in China is projected to increase gradually from 31% in 2009 to 40% around 2015.

However, the comparison of major domestic automakers and foreign capital manufacturers in Fig. 7 reveals that a large gap still exists between them in this respect. There are multiple reasons for the low share of two-pedal transmission vehicles among the domestic manufacturers. Two factors that can be cited in this regard are their product strategy centered on

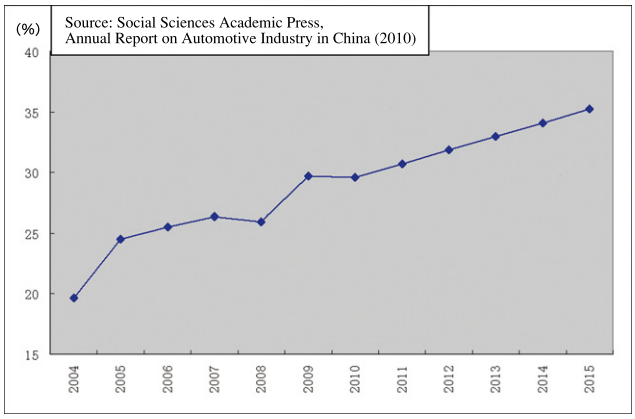

Fig. 6 Share of domestic brands in passenger car sales in China

上記の結果として，Fig. 6のように，乗用車だけのデータとなるが，自主ブランドシェアの伸びが予測される．

2.3. 2Pedal搭載車比率の変化

中国における2Pedal平均搭載比率は2009年の31%から徐々に上がり，2015年頃には40%に達する見込みである．

しかし，民族系主要メーカーを外資系主要メーカーと比較した場合，Fig. 7のように，歴然とした開きが存在していることがわかる．民族系車両メーカーの低い搭載率には複合的な要因があるが，低価格車中心の商品戦略と自前の2Pedalトランスミッション又は技術を持ち合わせていないことが挙げられる．

その現状を打開すべく，民族系車両メーカーにおいて，外資系の牙城である中価格帯以上へのブラ

low-priced vehicles and a lack of their own two-pedal transmissions or associated technologies.

In order to overcome this situation, one domestic automaker after another has unveiled a brand strategy for medium-priced vehicles or higher, which so far have been the province of foreign capital car makers. The domestic automakers are moving ahead with efforts to develop two-pedal transmissions independently or through joint development projects for dual clutch transmissions (DCTs). They have also announced intentions to buy existing transmission manufacturers or their technologies or production lines.

Nonetheless, the domestic automakers will probably have to continue to rely primarily on procuring two-pedal transmissions from foreign capital transmission producers in the foreseeable future.

2.4. Recall situation and response to market quality issues in this Internet age

In China, Regulations on Defective Automobile Product Recalls came into effect on October 1, 2004. However, neither foreign capital automakers nor domestic manufacturers, except for vehicle makers importing and selling CBUs(Completely Built-Up), took any active steps to conduct recalls until the middle of 2006, as shown in Fig. 8. That can be attributed to cultural unfamiliarity with product recalls and the lightness of the prescribed fines, among other factors. After nearly two years of

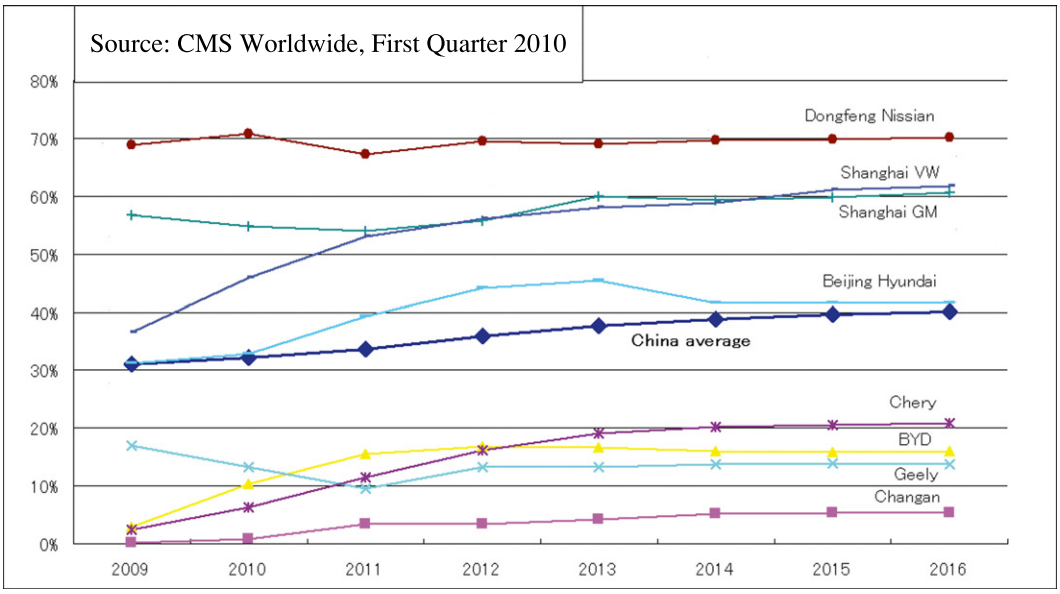

Fig. 7 Forecast for 2-pedal transmission-equipped vehicles in China

ンド戦略を相次いで打出し，2Pedalトランスミッションの独自開発や共同開発（DCT）を進めるとともに，開発スピードを上げる為，既存トランスミッションメーカー又はその技術や生産ラインの買収にも名乗り出ている．

とは言っても，当面の間，民族系車両メーカーを中心に，2Pedalを主に外資系トランスミッションメーカーからの調達に頼らざるを得ない状況は続くであろう．

2.4.リコールの実態とネット時代の市場品質対応

2004年10月1日より「欠陥汽車製品リコール管理規定」が施行されたが，2006年の中頃までは，リコール文化の未定着と罰則規定の軽さ等から，Fig. 8のように，CBU（Completely Built-Up）車を輸入販売している車両メーカーを除き，中国内の外資系と民族系メーカーとも積極的なリコールを実施しようとしなかった．2年近くの運営と国内外比較による世論の反発を受け，当局がようやく重い腰を上げ，強制リコールの適用を含めリコールの強化に乗り出し，また，リコールに対する一般ユーザーの考え方の変化もあり，外資系メーカーを中心にリコールを主体的に実施するようになり，2007年以降の件数急増に繋がっている．

operation of the regulations and a public outcry prompted by a comparison with other countries, the authorities finally overcame their inertia and moved to strengthen the recall regulations, including the adoption of obligatory recalls. There has also been a change in the public's attitude toward recalls, with the result that foreign capital automakers in particular have started to conduct voluntary recalls. This has led to a sharp increase in the number of recalls since 2007.

Meanwhile, recent recall cases have revealed a distinct difference from a recall system that relies on the independent judgment of the automakers. It is clear that claims made by individuals through the Internet and a marked increase in group action by adhoc organizations have been strong forces in moving the automakers and the authorities to respond.

The warranty period in China is usually for two years or 60,000 km. As a result of the rapid increase in vehicle ownership, including used vehicles, there is a risk of being confronted with unprecedented issues that have not been present heretofore.

Under these circumstances, the previous idea that quality levels or service policies different from those in Japan, the U.S. or Europe can be applied in China without any problem is no longer viable. A crucial

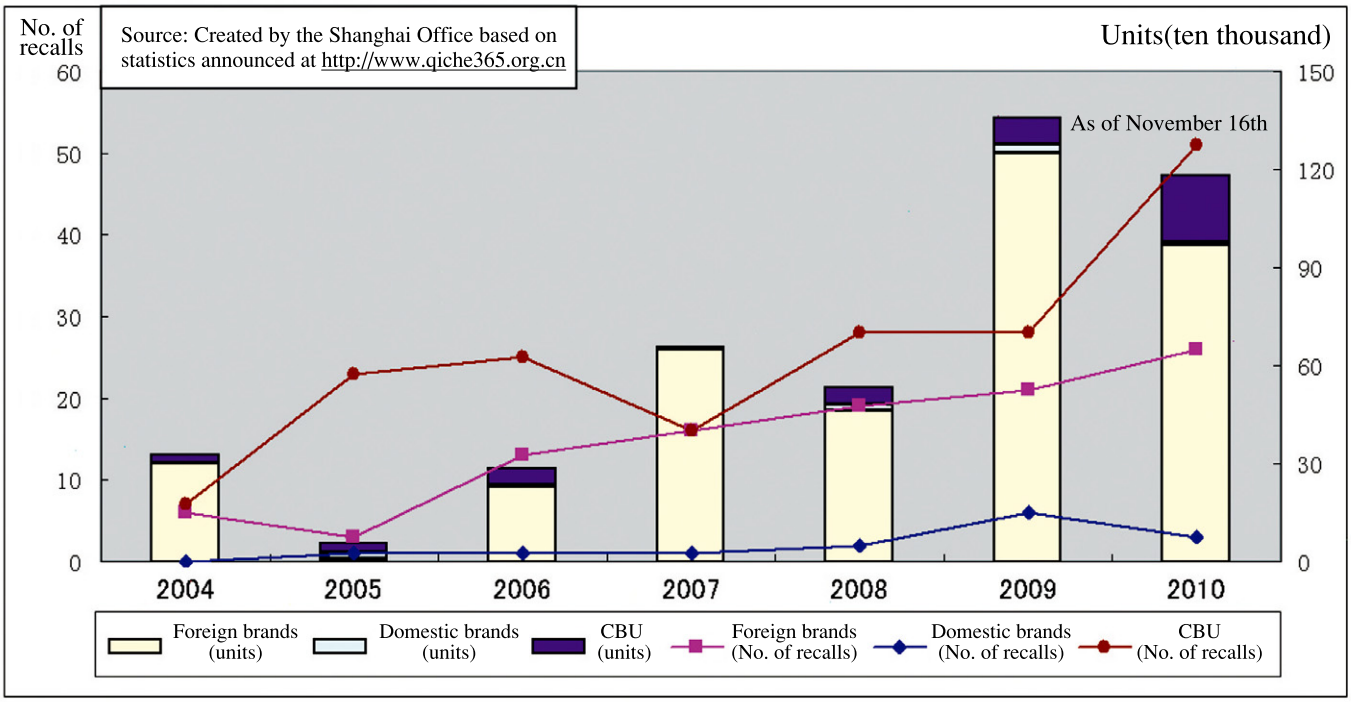

Fig. 8 Trend in vehicle recalls in China

一方，車両メーカーの主体的な判断に頼らざるを得ないリコール制度と違い，ネットワークを利用した個々人の訴求又は緩やかな組織による団体行動が急激に増え，車両メーカーや当局を動かす大きな力となっていることは昨今のリコール事例から明らかになっている．

また，中国での車両保証期間が2年又は6万kmをメインとしており，中古車を含めた保有台数の急増に伴い，いままで顕在化していなかった未曾有の問題に直面するリスクがある．

このような環境の中，中国だから，日米欧と違った品質やサービス方針で臨んでいても問題ないだろうという旧来型の発想では既に通用しなくなり，多様性を持つ広い中国でアフターワランティーを含む市場品質情報を如何にスピーディーに吸い上げ，品質改善とサービス対応に生かし，お客様の要求に応えていくような仕組みを構築していけるかが，この国でビジネスをやっていく上で避けて通れない重要な命題で，また成功することによってユーザーの心を掴めるであろう．

3. 上海サービス事務所の取り組み

2004年8月，中国経済の中心地である上海にジヤトコにとって初めての中国拠点となる上海サービス事務所を立ち上げた．ジヤトコという会社を中国のお客様に広くアピールするとともに，日本の関連部署と連携し，ジヤトコ製オートマチックトランスミッションに関わる市場品質情報の収集と品質改善，中国現地サービス体制の構築と日常管理，現地調達部品の品質管理等を担っている．

3.1. 市場品質情報の収集と品質改善活動

上海サービス事務所設立の2004年8月頃までは中国から市場品質に関わる情報が殆ど入ってこなく，市場で何が起きていて，ジヤトコとして何をなすべきかが分らなかった．

そのような状況を打開すべく，主に以下に取り組んできた．

i）プロセスの構築

不具合発生～対策完了まで，販社や車両メーカー，ジヤトコ関連部署並びに上海サービス事

proposition for doing business in China with its broad diversity is to put in place a system for responding to customers' demands by speedily gathering field quality data, including after-warranty issues, and using that information to improve product quality and customer service. This is absolutely necessary, and its successful implementation will cement customer loyalty.

3. Activities of the Shanghai Office

JATCO opened the Shanghai Office, its first base for business operations in China, in August 2004 in Shanghai, the center of China's economy. Besides publicizing the JATCO company name widely among consumers in China, the office is responsible for gathering field quality data about JATCO automatic transmissions for use in quality improvements, building a local service system in China and handling its daily operation, and overseeing the quality of parts procured locally, among other activities, which are carried out in close collaboration with the related departments at JATCO.

3.1. Gathering of field quality data and quality improvement activities

Until the establishment of the Shanghai Office in August 2004, there was virtually no feedback of field quality information from the Chinese market. Accordingly, JATCO did not know what was happening in the field or what action the company ought to take.

To overcome that situation, the Shanghai Office has mainly been engaged in the following activities.

(1) Process implementation

Clarifying the process from the occurrence of a problem to the implementation of a final solution, including the inputs and outputs of the dealers and automaker concerned, JATCO's departments involved and the Shanghai Office and making clear the related deadlines.

(2) Building a relationship of trust with the automakers by giving them periodic reports and regular technical advice.

(3) Acquiring accurate information through task force activities in the initial sales period after a new car launch and regular activities by Field

務所によるインプットとアウトプット及び納期の明確化.
ii) 車両メーカーへの定期的な報告や日常的な技術助言による信頼関係の構築.
iii) 新車販売初期のタスクフォース活動，日常的なFES活動による的確な情報入手.
iv) ローカルスタッフに対する計画的な教育による仕事の質アップと効率化.

これらに取り組んできた結果，入手する市場品質情報の量・質とも飛躍的に上がり，不具合発生～対策までの期間を大幅に短縮させることができた.

3.2. 中国におけるアフターサービス体制の構築

いままでMT車中心であったこともあり，ATやCVTに関わる販社の判断力又は修理業者のスキルが必ずしも高くなく，トランスミッションにまったく問題ないのに，勘違いしてATやCVTを修理に廻してしまうケースがしばしばあった.

そこで，ユーザー満足度を上げるべく，主に以下に取り組んできた.

i) トラブルシューティング等を用いて，販社や車両メーカー担当の故障診断力のレベルアップ.
ii) 中国の既存修理ショップに対する徹底的な調査を通して，選んだ優良業者への積極的な技術支援.
iii) 車両メーカーや指定修理業者との設計変更を含めた情報の共有.

これらに取り組んできた結果，販社や車両メーカーの誤判断がまだ残るものの，目に見える形で減ってきている．また，指定修理業者の修理品質も日本に匹敵するレベルまで上がってきた.

3.3. 現地調達部品の品質改善に向けた取り組み

ジヤトコの中国現地法人である「加特可（广州）自动变速箱有限会社（2007年4月設立）」の新規立上げ，グローバル最適調達の推進に伴い，中国での調達部品が増え，如何にして品質のよいものを安定的に供給してもらえるかが大きな課題になっている.

そこで，本社の関連部署に協力して，主に以下に取り組んでいる.

i) 共同説明会等によるジヤトコ品質理念，品質管理基準，品質手法の周知と徹底.

Engineering Specialists (FES).
(4) Improving the work quality and efficiency of local employees through planned educational programs.

Both the quality and quantity of the field quality data obtained have been improved dramatically by undertaking the foregoing activities, and the period from the occurrence of a problem to the implementation of an effective countermeasure has been shortened substantially.

3.2. Building an after-sales service system in China

There have often been cases where ATs and CVTs were mistakenly sent to auto repair shops to be fixed even though there was nothing actually wrong with the transmission. Dealers have not been able to judge the condition of ATs or CVTs accurately, and mechanics have not always had sufficient skills, owing in part to the predominance of MT-equipped vehicles to date.

Accordingly, the Shanghai Office has made the following efforts to improve customer satisfaction.

(1) Improvement of the abilities of dealers and automaker personnel to diagnose problems through the use of trouble-shooting procedures.
(2) Active provision of technical support to outstanding auto repair shops selected on the basis of a thoroughgoing investigation of existing shops in China.
(3) Sharing of information, including design changes, with automakers and designated auto repair shops.

As a result of carrying out these activities, cases of mistaken judgment by dealers and automakers have visibly decreased, though they still occur. Additionally, the repair quality of designated auto repair shops has also been improved to a level that compares favorably with Japan.

3.3. Efforts to improve the quality of locally procured parts

The number of parts procured locally in China has increased due to JATCO'S promotion of an optimal global purchasing strategy and the new production launches undertaken at JATCO (Guangzhou) Automatic Transmission Ltd., JATCO's local manufacturing arm that was established in April 2007. The question of how to ensure stable supplies

ii) 工程監査の実施による課題出し及び対策完了までの徹底的なフォロー.
iii)納入品質不具合が起きた際の情報伝達と，暫定&恒久対策フォロー.
iv)設計変更に関わる現地フォロー.

これらに取り組んできた結果,生産に大きな支障を与えず済んではいるが,更なる体制強化が求められている.

3.4. 新たなチャレンジ

いままで，日本の自動車メーカー各社にとって，一般輸出仕様のままでも通用していた中国市場であったが，自動車と関連地域の普及，競争激化とユーザー要求の多様化等で，中国の実情に適した車両を如何にタイムリーに開発していくかが大きな課題になっていることに違いなく，トランスミッションを供給するジヤトコにとっても他人事ではあるまい.

そこで，より良い商品を中国のお客様にお届けする為，ジヤトコ関連部門に協力して，中国ユーザーの走行パターン，中国道路環境の現状と変化を掴み，それらの調査結果を開発や品質改善にフィードバックしていくことが，上海サービス事務所に与えられた新たなチャレンジで，永遠の課題でもある.

4. 終わりに代えて

2010年10月18日に閉幕した中国共産党5中全会において，2011年から始まる第12次5ヵ年計画（2011年～2015年）の経済と社会発展について，5つの目標を掲げている.

i) 経済の安定的で比較的高い成長
ii) 経済構造の戦略的な調整が重大な進展を遂げること
iii) 都市と農村住民収入の普遍的で比較的早い増加
iv)社会インフラ整備の著しい強化
v) 改革開放の更なる深化

第12次5ヵ年計画の数値目標は2011年に予定される全人代で論議されることになるが，更なる経済発展・一般層の収入増・インフラ整備の強化等により,自動車購入層の裾野が更に広がり，自動車メーカー各社にとってチャンスの拡大を意味するとともに，厳しい競争の中でどう勝ち抜いていくか，大きな課題

of high quality parts has become a critical issue.

In this regard, the Shanghai Office has mainly been carrying out the following activities in cooperation with the related departments at JATCO's Head Office.

(1) Thoroughgoing efforts to instill JATCO's quality philosophy, quality control standards and quality procedures through joint briefings to parts suppliers and other activities.
(2) Detection of issues by conducting process audits and undertaking thorough follow-up until corrective measures have been implemented.
(3) Conveyance of information to suppliers when their delivered parts have quality problems and pursuing thorough follow-up on temporary and permanent solutions.
(4) Local follow-up regarding design changes

As a result of these efforts, problems have been resolved without seriously affecting production operations, but the system needs to be strengthened further.

3.4. New challenge

Japanese automakers have so far been able to apply general export specifications to their vehicles sold in China, but the situation is clearly changing due to the spread of vehicles into other regions of the country, intensifying competition, diversification of customer needs and other factors. The timely development of vehicles that meet today's conditions is now a critical issue that also concerns JATCO as a supplier of transmissions.

Accordingly, a new challenge for the Shanghai Office is to research the driving patterns of Chinese customers, ascertain the present status of and changes occurring in China's road and traffic environment, and feed that information back to JATCO for use in product development and quality improvements. We intend to address this eternal task in cooperation with the related departments at JATCO in order to deliver products of excellent quality to customers in China.

4. Concluding Remarks

The fifth plenum of the 17th Central Committee of the Communist Party of China ended on October 18, 2010, following discussions of the 12th 5-year plan that runs from 2011 to 2015. The following five goals

となるであろう.

そこで，資源節約型･環境配慮型社会に合致し，中国の道路環境とお客様の好みに合った低燃費･低コストの良い商品を如何に開発&生産し提供して行けるか，グローバル化に取り組んでいるジヤトコにとって，上海という地で頑張っている上海サービス事務所の諸君にとって，大きな試練を迎えていると言えよう.

were set for China's economic and social development.

(1) Stable and relatively rapid economic development
(2) Attainment of significant progress in strategic economic restructuring
(3) A universal and relatively rapid increase in the incomes of people in urban and rural areas
(4) Noticeable strengthening of social infrastructure implementation
(5) Further deepening of the reform and opening-up process

The numerical targets of the 12th 5-year plan will be discussed at the National People's Congress scheduled to be convened in 2011. Continued economic development, increasing the income of the general populace, strengthening of infrastructure implementation and other measures will further broaden the base of the vehicle-buying strata. That will mean greater opportunities for the automakers to expand sales, and it will also pose a major question of how to succeed in the face of intensifying competition.

The crucial issue is to develop, produce and supply high-quality products that are fuel efficient, low in cost, fit China's road environment, match Chinese customers' preferences and are consist with societal demands for resource conservation and environmental friendliness. Addressing this issue will be a major test for JATCO, which is proceeding with the globalization of its operations, and for all Shanghai Office employees who are trying to do their best in Shanghai's business environment.

■ Author ■

Syousei SOU

燃費と走りの良さを実現した副変速機付きCVT

New CVT with an Auxiliary Gearbox Designed for Eco-friendliness and High Performance

野々村　良輔* Ryosuke NONOMURA　臼杵　克俊* Katsutoshi USUKI　道岡　浩文** Hirofumi MICHIOKA

抄　録　地球環境問題に燃費向上で貢献するために，軽から小型自動車をカバーする新小型CVTを開発した．このCVTの最重要ポイントである燃費と動力性能の両立，小型･軽量化を達成するために世界で初めて採用した副変速機構造と，従来CVT同等のスムーズなシフトフィーリングを実現するために開発した制御技術の中で，プーリーと副変速機の協調制御，難易度の高いクラッチ掛け替えを可能にしたクラッチ圧制御の学習制御を紹介する．

Summary　This article describes JATCO's new small CVT developed for use on both minivehicles and small cars and intended to contribute to the resolution of global environmental issues by improving vehicle fuel economy. One of the key features of this CVT is an auxiliary gearbox, a world-first technology for reconciling power performance with low fuel consumption and for achieving a smaller, lighter design. Other key features include cooperative control between the belt-pulley assembly and the auxiliary gearbox and adaptive learning control techniques for controlling the clutch pressure to facilitate gearshifts involving highly complex switching between clutches. These and other control features have been developed to deliver a smooth, seamless shift feel equal to that of conventional CVTs.

1. はじめに

当社は，2009年7月に新小型CVTの生産を開始した．このCVTは従来の軽自動車用CVTと小型自動車用CVTを統合した幅広い適用領域をカバーすると同時に，副変速機構を有することにより大幅な低燃費を実現した新小型CVTである．

近年，法規制を含めて地球環境問題への関心がますます高まる中で，自動車業界では燃費向上が環境維持の貢献へと捉えている．いろいろな燃費向上技術が実施されるなかで，CVTはその中でも有力な技術の一つであり，この数年の間に各メーカーでそのシェアを広げてきた．当社は早くからCVTに着目し，他社に先駆けてフルラインナップ化の取り組みをおこなってきた．1997年に当時世界初となる2.0LクラスFFベルトCVTを発表して以来，軽FF車用から3.5Lクラス大型FF車用まで幅広い車両に対応したCVTを実用化し，好評を得ている．

1. Introduction

JATCO began producing the new small CVT described here in July 2009. This next-generation small CVT is capable of a broad range of application, combining the coverage of existing CVTs for both minivehicles and small cars. It also features an auxiliary gearbox to achieve a dramatic improvement in fuel economy.

The automotive industry today sees improvement of fuel economy as a way of helping to sustain the environment, amid the heightened concern about global environmental issues in recent years, including stricter laws and regulations. Among the various approaches being taken to improve vehicle fuel economy, CVTs are one of the most effective technologies available. These past few years all of the automakers have been increasing the proportion of their vehicles fitted with a CVT. JATCO was among the first to focus on CVTs and has led other

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今回，新規に開発したCVTは，軽自動車から小型自動車まで幅広く搭載できる商品である（Fig. 1）．本稿ではこの新小型CVTの燃費向上に向けた主要技術と副変速制御，グローバル対応の取組みについて紹介する．

Fig. 1 New CVT

companies in developing a full lineup of CVTs that have been highly popular with customers. In 1997, JATCO announced the world's first steel-belt CVT for use on front-wheel-drive (FWD) cars. Subsequently, we developed a wide range of CVT models, from units for FWD minivehicles to a CVT for application to large FWD vehicles powered by a 3.5-liter class engine.

The newly developed CVT is a product that can be applied to a wide range of vehicles from minivehicles to small cars (Fig. 1). This article describes the principal technologies incorporated in this new small CVT to improve fuel economy, the auxiliary gearbox shift control techniques and the efforts made to facilitate global application.

2. 商品・新技術

2.1. 商品コンセプト

新小型CVTは以下のコンセプトで開発をおこなった．

1）ワイドレシオ化による低燃費，動力性能の両立
2）フリクション低減による低燃費化
3）小型・軽量化による軽～小型自動車までの共通化

環境，経済性の両面で世界的な燃費向上要求はますます高まっている．法規的にも日本国内のグリーン税制（優遇税制含む），北米，欧州，中国という自動車メインマーケットでの燃費規制の強化もますます厳しくなっている．

燃費向上の対応として，電気自動車やハイブリッド車など環境対応に関して各社の検討が加速している．しかしながら，グローバルに台数影響を考慮すると最量販であるレシプロエンジンとの組合せで使われるトランスミッションの燃費向上はCO_2排出の面積効果を出す上で，非常に重要になる．

新小型CVTではワイドレシオ化により，低燃費と動力性能の両立，さらに小型・軽量化を達成する

2. Product Concept and New Technologies

2.1. Product concept

This new small CVT was developed around the following product concept.

(1) To reconcile power performance with lower fuel consumption through wider ratio coverage
(2) To improve fuel economy by reducing friction
(3) To achieve a CVT applicable to both minivehicles and small cars by downsizing and lightening the unit

There are growing demands worldwide for improving fuel economy from the standpoint of both environmental and economic aspects. Fuel economy regulations are becoming increasingly tighter in the main vehicle markets of North America, Europe and China. The same regulatory trend can be seen in Japan's Green Tax system that gives preferential tax breaks to eco-friendly vehicles.

Manufacturers are accelerating their efforts to improve vehicle fuel economy and address environmental issues, including the introduction of electric vehicles and hybrid vehicles. However, considering the potential effect in terms of global sales volumes, it is essential to improve the fuel economy of transmissions used with volume-selling reciprocal engines in order to reduce CO_2 emissions over the widest possible area.

The new small CVT features wider ratio coverage to reconcile power performance with lower fuel consumption. It is also the world's first CVT to adopt

ために世界初となる副変速付CVTの構造を採用した（Fig. 2）.

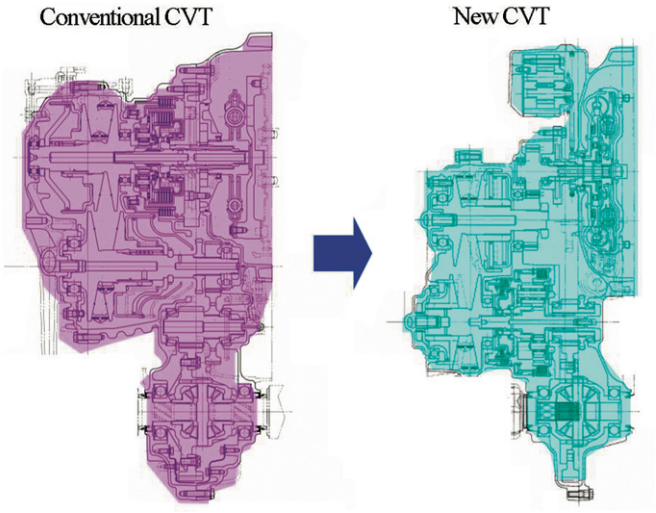


Fig. 2 Structural comparison

2.2. CVTラインナップと新小型CVTの位置付け

当社は軽自動車用から排気量3.5Lクラスまでの CVTフルラインナップを実現しており，機種構成は軽FF車用・小型FF車用・中型FF車用・大型FF車用の4機種構成を採ってきた.

新小型CVTは副変速機の追加により，小型・軽量化を達成し，軽自動車にも搭載可能とした．新小型CVTの採用により軽自動車・小型自動車用を1機種でカバーすることができた．これにより台数規模が拡大しコスト低減に貢献した（Fig. 3）.

今回開発した新小型CVTの諸元を示す．（Table 1）

Table 1 Major specifications

Item			New CVT	Conventional CVT
Torque Capacity			150 Nm	150 Nm
Gear Ratio	Ratio Coverage		7.3	6.0
	Pulley Ratio		2.200～0.550	2.561～0.427
	Final Gear Ratio		3.753 (0.967×3.882)	5.473 (1.486×3.684)
	Planetary Gear Ratio (Auxiliary Gearbox)	1st	1.821	None
		2nd	1.000	None
		Rev	1.714	1.023
Through Low Ratio			15.035	14.016
Weight (kg)			67.5	77.4
Overall Length (mm)			323.3	354.7
Distance between Pulley Shafts			147	156
Distance between 1st and 4th Shafts			183	186

2.3. 燃費向上に向けた主要技術

1）世界トップレベルの変速比幅拡大

通常のCVTに副変速機を追加することで，既存CVT，ステップA/Tの中で世界トップレベルのレシオ

an auxiliary gearbox for achieving further size and weight reductions (Fig. 2).

2.2. CVT Lineup and position of new small CVT

JATCO has a full lineup of CVTs, ranging from units for minivehicles to a CVT for use with large engines of the 3.5-liter displacement class. The CVT model mix consists of four types designed respectively for application to FWD minivehicles, FWD small cars, FWD midsized cars and FWD large cars.

The addition of an auxiliary gearbox to the new small CVT has achieved both size and weight reductions, enabling its use on minivehicles. This single new CVT can cover both minivehicle and small car applications, thereby achieving larger production volumes for reducing costs (Fig. 3).

The specifications of the newly developed CVT are given in Table 1.

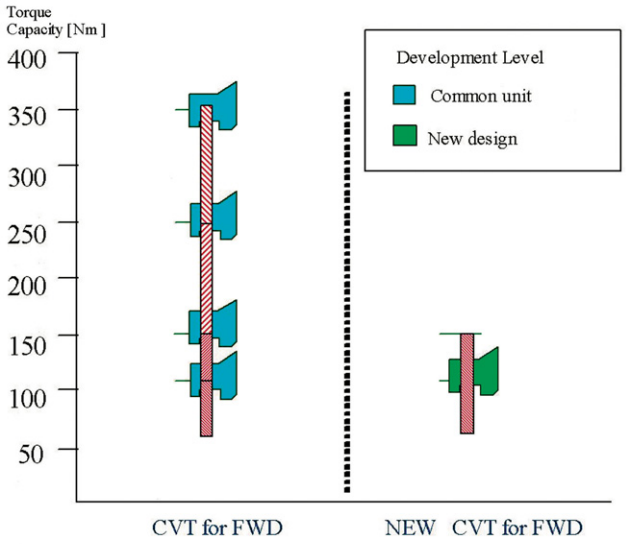


Fig. 3 Torque range

2.3. Major technologies for improving fuel economy

1) One of the world's widest ratio coverages

The addition of the auxiliary gearbox to an ordinary CVT belt-pulley assembly achieves one of the world's widest ratio coverages among existing CVTs and stepped ATs. This contributes to achieving both improved fuel economy and power performance (Fig. 4).

2) Downsizing of pulleys

The parallel use of the planetary auxiliary gearbox with the conventional belt-pulley system for ratio

カバレッジを実現し，低燃費・動力性能の両立へ貢献している（Fig. 4）.

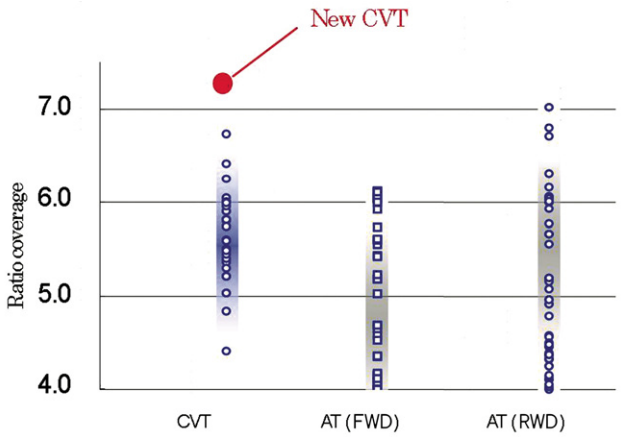


Fig. 4 Ratio coverage

2）プーリの小型化

新小型CVTはベルト&プーリーによる変速と遊星ギア式の副変速を併用することでベルト&プーリーのレシオカバレッジを4.0とした．レシオカバレッジを4.0とすることによりプーリーの外径＆ストローク長さを小さくして，軽・小型車のエンジンルームへの搭載を可能とした．さらにCVTの中で大型部品であるプーリーの重量を従来比約30%低減し軽量化にも貢献した.

3）フリクション低減技術

新小型CVTは1-2軸間をカウンタギア，2-3軸間をベルト&プーリー，3-4軸間をリダクションギアの配置とした.

通常第1軸にあるプーリー入力軸のプライマリプーリーは従来CVTに対しユニット上方配置とした（Fig. 5）.

これによりプライマリプーリーがオイル油面と接触しない回転運動が可能となり，オイル攪拌によるフリクションロスを低減させることができた.

また，CVTは定常走行状態において，プーリー比1.0付近がベルトフリクションの観点で最も効率がよい.

新小型CVTは，副変速機の1速を用いることで発進性能に有効な総減速比を確保できるので，従来CVTよりも終減速比を小さくすることができる.

これにより，2速で走行する領域において，同一車速では従来CVTよりもベルト&プーリーの効率がよいプーリー比1.0付近を多用でき，CVTのフリクションが低減できた（Fig. 6）.

changes made it possible to set the ratio coverage of the belt-pulley assembly of the new small CVT at 4.0. Setting the ratio coverage at 4.0 allowed the outer diameter of the pulleys and the stroke length to be reduced, enabling the new CVT to be mounted in the engine compartment of both minivehicles and small cars. Additionally, the smaller pulley size helped to reduce the pulley weight by approximately 30% compared with existing pulleys. That is significant because pulleys represent large components of a CVT.

3) Friction reduction techniques

The new small CVT is laid out with a counter gear between the first and second shafts, the belt-pulley assembly between the second and third shafts and the reduction gear between the third and fourth shafts.

The primary pulley on the pulley input shaft, i.e., the first shaft of an ordinary CVT, is now positioned higher in the unit (Fig. 5).

This enables the primary pulley to rotate without touching the CVT fluid surface, thereby reducing fluid churning for a reduction of friction loss.

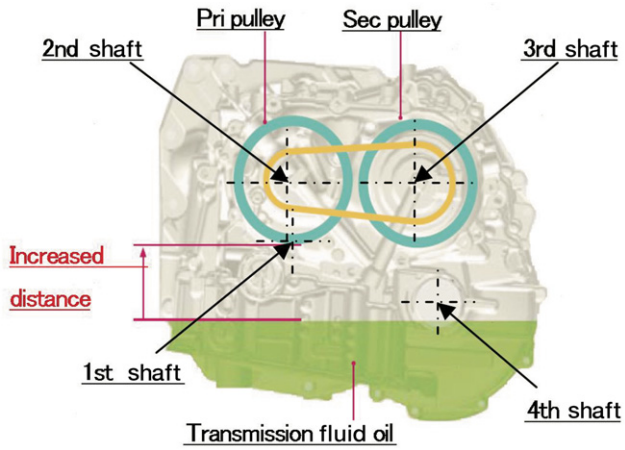


Fig. 5 Shaft layout

A steel-belt CVT usually attains its maximum efficiency with respect to belt friction at a pulley ratio near 1:1 during steady-speed driving.

The new small CVT uses the first gear of the auxiliary gearbox to secure an overall reduction ratio effective for good start-off acceleration.

This made it possible to set the final reduction ratio smaller than that of existing CVTs.

As a result, compared with existing CVTs when traveling in the second-gear range at the same vehicle

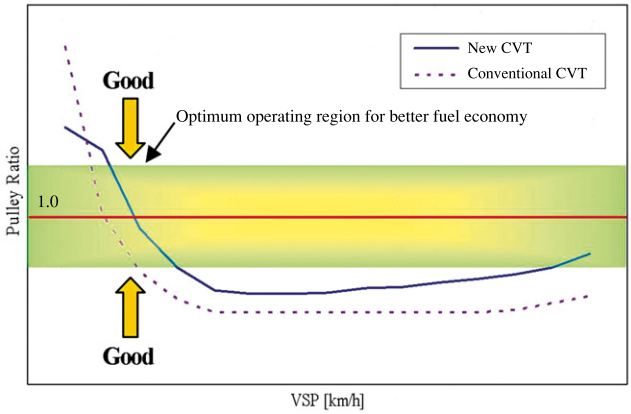


Fig. 6 Pulley ratio chart

尚，ワイドレシオを活かすことでエンジンとのマッチングを考慮した自由度の高い変速線設計が可能になった．

3. 副変速機の変速制御

3.1. 構成概要

前後進の切り替え機構しか持たない従来CVTの遊星歯車とは異なり，新小型CVTはベルト変速機構の後流に前進2段，後進1段の変速が可能な副変速機を有す（Fig. 7）．副変速機の構造は，全長短縮のためラビニヨ遊星を採用し，コンパクトに収めた．また，前進側の1速ではLow Brakeを締結し，2速ではHigh Clutchを締結する．この副変速機はワンウェイクラッチを持たない構造で，1→2・2→1の切替えは全てクラッチの掛け替え変速となる．

3.2. シフトパターン

副変速機のシフトパターンには，大きく分けて3種類ある．まず，副変速ギア比を1速から2速へ変速させる2種類のアップシフトである．1つは，プーリー比Highで変速するオートアップパターンで，一般的な加速の際に選択される．これは，後述する副変速時のクラッチ架け替え変速による変速ショックを，可能な限り低減させるため，副変速機への過渡入力トルクを最小限にして変速させる意図を持つ（Fig. 8）．

speed, the new CVT can operate more often near a pulley ratio of 1:1 where the efficiency of the belt-pulley assembly is higher. This makes it possible to reduce CVT friction (Fig. 6).

It is noteworthy that the wide ratio coverage was used effectively in designing shift lines with a large degree of freedom so as to match the engine speed better.

3. Shift Control Techniques for Auxiliary Gearbox

3.1. Structural overview

A conventional planetary CVT has only a changeover mechanism for switching between forward and reverse. In contrast, the auxiliary gearbox positioned downstream of the belt-pulley shifting mechanism in the new small CVT can shift between two forward speeds and one reverse speed (Fig. 7). The auxiliary gearbox is built with a Ravigneaux planetary gear set for compactness that reduces the overall length of the CVT. A low brake is engaged in the first forward speed and a high clutch is engaged in the second forward speed. Since the auxiliary gearbox does not have a one-way clutch, 1st→2nd and 2nd→1st shifts are all executed by switching between clutches.

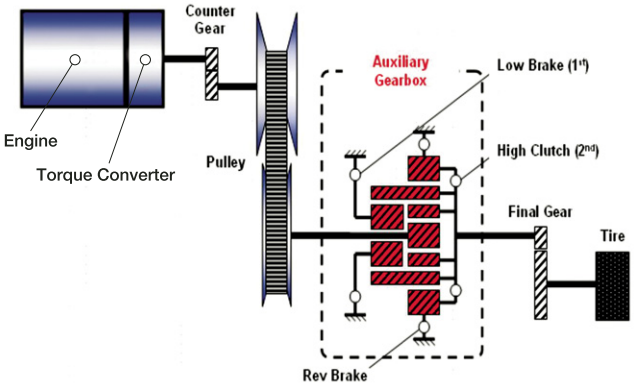


Fig.7 Auxiliary gearbox

3.2. Shift patterns

The shift patterns of the auxiliary gearbox can be broadly divided into three types. There are two types of upshift patterns for changing the auxiliary gear ratio from 1st to 2nd gear. One is an automatic upshift pattern for shifting under a high pulley ratio (Fig. 8). This pattern is selected for ordinary vehicle acceleration and is designed to minimize the transient

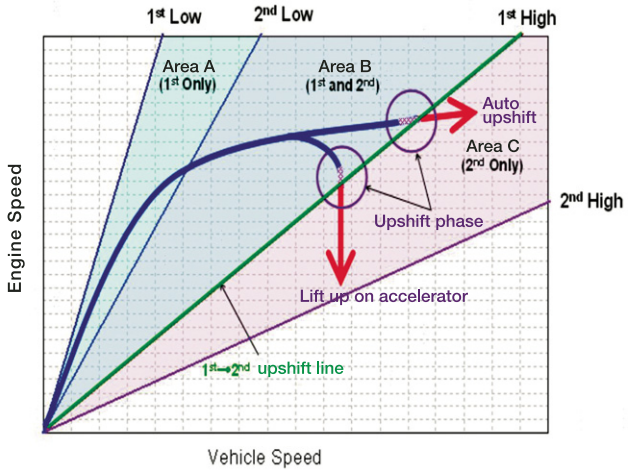


Fig. 8 Upshift patterns

もう1つは，市街路などの低速走行のシーンでは燃費向上を狙い，積極的に2速へ変速してトランスミッション動力伝達効率の良い，プーリー比を使用する（Fig. 9）.

残るシフトパターンは，2速から1速へのダウンシフトである．基本的にはプーリー比Lowで変速を行う．これには，主に副変速頻度を最小限に抑える意図を持つ．併せて，アクセル開度，アクセル開速度の条件を持ち，ドライバーの加速意図を判断してダウンシフトさせることで，その頻度とシフトクオリティを最適化させている（Fig. 10）.

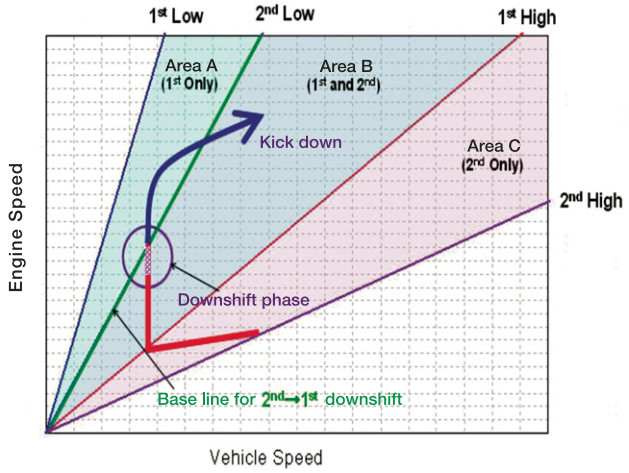


Fig. 10 Downshift patterns

3.3. 協調制御

例として，代表的なオートアップ1→2変速時の副変速制御について説明する．副変速には4つのフェーズがあり，基本的に，各フェーズにおけるクラッチ圧制御方法とその目的は，従来のステップATと同様である．今回の新小型CVT固有の制御を行っているのは，イナーシャフェーズにおける，プーリーとの協

input torque to the auxiliary gearbox when an upshift is executed. As will be explained later, this serves to reduce as much as possible the shift shock induced by switching clutches when the auxiliary transmission shifts.

The other is an upshift pattern designed to improve fuel economy in low-speed driving situations such as when traveling on city streets. The auxiliary gearbox is intentionally shifted to 2nd gear so as to use a pulley ratio that facilitates more efficient transfer of power by the transmission (Fig. 9).

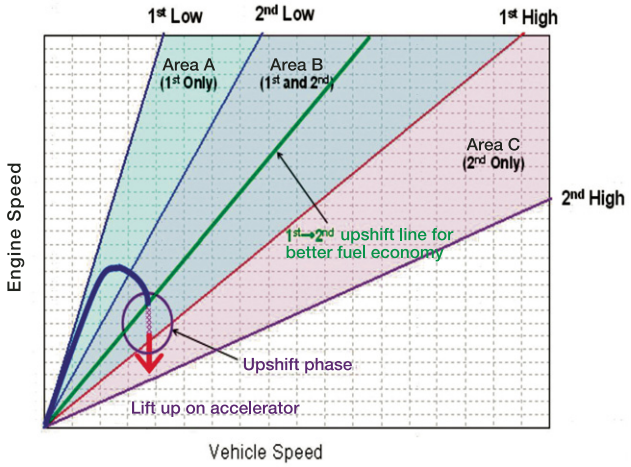


Fig. 9 Upshift patterns for better fuel economy

The remaining shift pattern is for a 2nd→1st downshift. Basically, a downshift is executed under a low pulley ratio. The intention here is to minimize as much as possible the shift frequency of the auxiliary gearbox. In addition, downshifts are executed by judging the driver's intention to accelerate based on the accelerator pedal position and accelerator depression speed. Taking these conditions into account works to optimize the shift frequency and shift quality of the auxiliary gearbox (Fig. 10).

3.3. Cooperative control

Shift control of the auxiliary gearbox is explained here using a typical automatic 1st→2nd upshift as an example. The auxiliary gearbox has four phases. The method of controlling the clutch pressure in each phase and related purpose are basically the same as for a conventional stepped AT. The only control procedure unique to the new small CVT is cooperative control with the belt-pulley assembly in the inertia phase, in which the input rotational speed

調制御である．

実際に副変速機入力回転変化があるイナーシャフェーズでは，エンジン回転を一定に保つ為に，目標トータルギア比と目標副変速ギア比から目標プーリー比を算出し，実副変速ギア比と実プーリー比との協調制御を行っている（Fig. 11）．

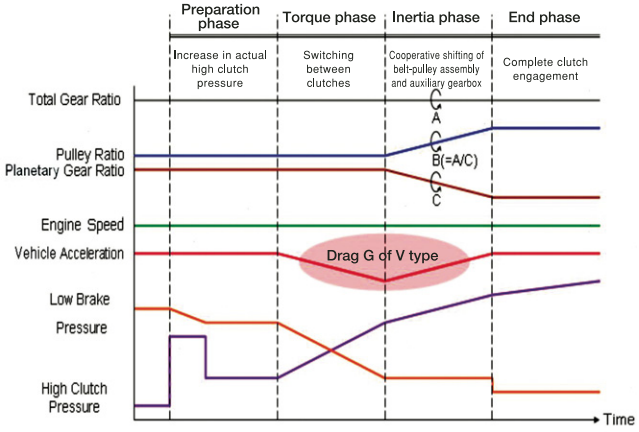


Fig. 11 Automatic upshift control

また，この副変速制御の重要なポイントは，トルクフェーズにおけるクラッチ掛け替えの時に発生する副変速機出力トルク変化による車両加速度の変化，すなわち変速ショックの低減である．

従来CVTと同等のスムーズな変速性能を実現するために，さまざまな手法で，変速ショック低減に取り組んでいる．

3.4. 学習制御

前述したショック低減のため，さまざまな学習制御を持つ．学習制御には大きく分けて2種類あり，1つ目はクラッチミートポイント学習制御である．クラッチミートポイントとは，クラッチがトルクを伝達し始める油圧である．これは，変速ショックを目標とするレベルに安定させるために，目標とするクラッチトルク容量と実際のクラッチトルク容量との偏差を小さくする制御である．初期品は，油圧やハード仕様のバラツキのために，上記の偏差が非常に大きいため，この制御が非常に重要となる．制御内容は，変速準備フェーズにて開放側のクラッチを僅かに滑らせ，締結側のクラッチ圧を初期推定クラッチミートポイント圧まで上げ，締結側クラッチがトルクを伝達し始めた時の副変速機入力回転数の挙動によって，初期推定クラッチミートポイント補正量を決め，それを記憶し制御に反映している（Fig. 12）．

of the auxiliary gearbox actually changes.

In order to maintain a constant engine speed in the inertia phase, a target pulley ratio is calculated based on the target total gear ratio and the target gear ratio of the auxiliary gearbox, and the actual gear ratio of the auxiliary gearbox and the actual pulley ratio are cooperatively controlled on that basis (Fig. 11).

The key point of the cooperative control applied to the auxiliary gearbox is to reduce shift shock, i.e., the change in vehicle acceleration induced by a change in the torque output of the auxiliary gearbox that occurs when it switches between clutches in the torque phase. We have been working on various methods for reducing this shift shock in order to achieve smooth shift performance equal to that of conventional CVTs.

3.4. Adaptive learning control

Various adaptive learning control features have been built into the control program to reduce the above-mentioned shift shock. Adaptive learning control can be broadly divided into two types. One type is adaptive learning control of the clutch engagement point. The clutch engagement point refers to the hydraulic pressure at which a clutch begins to transmit torque. This control feature works to reduce the difference between the actual clutch torque capacity and the target capacity so as stabilize the pressure at a level for mitigating shift shock. In the initial period of use, this difference is noticeably large owing to variability in the hydraulic pressure and the hardware specifications, which makes this control feature very important. The control procedure is to allow the release-side clutch to slip slightly in the shift preparation phase and to raise the pressure of the engaging-side clutch to the level of the initially estimated clutch engagement point. When the engaging-side clutch begins to transmit torque, an amount of compensation is determined for the initially estimated clutch engagement pressure according to the actual input rotational speed of the auxiliary gearbox. The compensation value is stored in memory and reflected in the control operation (Fig. 12).

The second type is adaptive learning control of the clutch torque capacity which is performed when there are no auxiliary gearbox shifts. The main purpose of this control feature is to compensate for changes in performance characteristics due to the aging of parts,

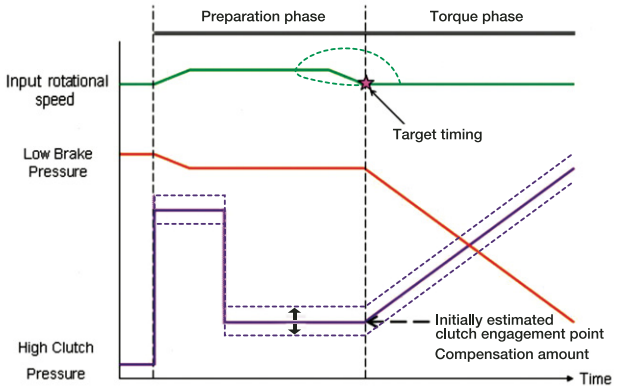


Fig. 12 Adaptive learning control of clutch engagement point

もう1つは，非副変速時に行う，クラッチトルク容量学習制御である．この制御の主な目的は，クラッチ摩擦材の摩擦係数など，部品の経時変化による特性変化を補償することである．制御内容は，トルクや回転の変動の小さい定常状態で，締結側のクラッチ圧を徐々に下げて行き，クラッチが滑り始め，副変速機入力回転数が上がったタイミングにおけるクラッチ圧が，想定値よりも高いか低いかによって，クラッチトルク容量補正量を決め，それを記憶し制御に反映している（Fig. 13）．

オートアップ1→2変速は，クラッチミートポイント学習制御によって，トルクフェーズ開始時のHigh Clutch圧を最適化し，車両加速度の急変を防ぐ．さらに，クラッチトルク容量学習制御によって，トルクフェーズ終了時のHigh Clutch圧を最適化し，車両加速度の変化量を安定させ，また，イナーシャフェーズ中の副変速ギア比変化を理想どおり行うことにより，プーリーとの協調変速が最適化され，変速によるエンジン回転変動を防ぐ（Fig. 14）．

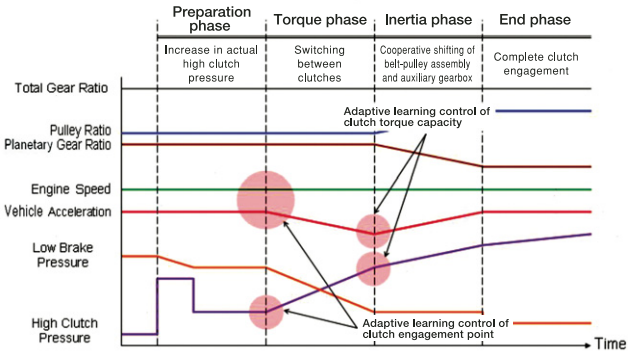


Fig. 14 Adaptive learning control points

including changes in the friction coefficient of clutch friction materials. The control procedure is to lower the engaging-side clutch pressure gradually under a steady-state condition where there is little variation in torque and rotational speed. At the point where the clutch begins to slip and the input rotational speed of the auxiliary gearbox rises, an amount of compensation is determined for the clutch torque capacity depending on whether the clutch pressure is higher or lower than the estimated value. The compensation value is stored in memory and reflected in the control operation (Fig. 13).

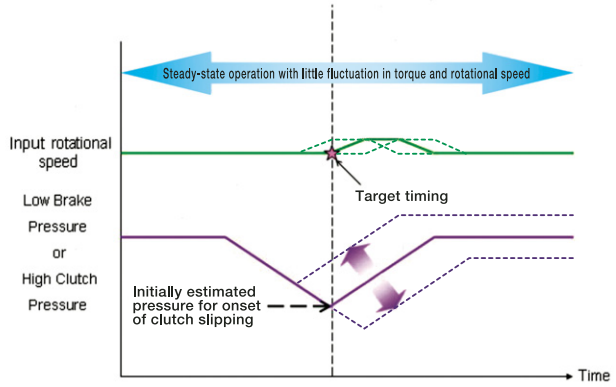


Fig. 13 Adaptive learning control of clutch torque capacity

In an automatic 1st→2nd upshift, the adaptive learning control of the clutch engagement point serves to prevent a sudden change in vehicle acceleration by optimizing the high clutch pressure at the onset of the torque phase. Moreover, the adaptive learning control of the clutch torque capacity works to stabilize the amount of change in vehicle acceleration by optimizing the high clutch pressure at the end of the torque phase. In addition, the change in the gear ratio of the auxiliary gearbox during the inertia phase is ideally controlled to optimize cooperative shifting with the belt-pulley assembly and thereby prevent any fluctuation in engine speed due to shifting (Fig. 14).

4. Conclusion

The development of the new small CVT has brought the following benefits.

(1) Wider ratio coverage for reconciling power performance with low fuel consumption

The adoption of the auxiliary gearbox has achieved one of the world's widest ratio coverages to secure

4. まとめ

新小型CVTの開発により，以下の効果が得られた．

1）ワイドレシオ化による低燃費，動力性能の両立

副変速機の採用により世界トップレベルのワイドレシオを実現し，排気量の小さい軽・小型車用で，発進性能の確保，及び巡航走行時の低回転走行が可能になることによる低燃費化が達成できた．

2）フリクション低減による低燃費化

従来CVTとは異なる軸配置を採用したことにより，伝達効率を向上させることができた．

また，ワイドレシオと制御の組み合わせにより，レシオ1.0付近を使った効率の良い走行とエンジンとの更なる最適マッチングの選択を可能とした．

3）小型・軽量化による軽～小型自動車までの共通化

副変速機を採用したことでプーリーの小型化が実現し，軽自動車から小型車まで搭載が可能なコンパクトなCVTが開発できた．また，軽量化により車両燃費へも貢献できた．

4）シフトクオリティの確保

世界初のプーリーと副変速機の協調制御や，従来のステップATよりもさらに難易度の高いクラッチ掛け替え変速を，学習制御等を用いたクラッチ圧制御により実現したことで，従来CVTと同等のスムーズなシフトフィーリングを実現した．

excellent start-off acceleration together with low fuel consumption by allowing a lower engine speed during highway cruising when this CVT is used on minivehicles and small cars with small displacement engines.

(2) Improvement of fuel economy by reducing friction

The adoption of a shaft layout different from that of conventional CVTs has improved power transmission efficiency.

Additionally, the combination of wider ratio coverage and adaptive learning control allows more frequent operation near a pulley ratio of 1:1 for improved driving efficiency as well as achieving an optimum match with the engine speed.

(3) Shared use on minivehicles and small cars thanks to size and weight reductions

The adoption of the auxiliary gearbox allows the use of smaller pulleys, making it possible to achieve a more compact CVT that can be fitted on a variety of vehicles from minivehicles to small cars. The lighter unit weight also contributes to improving vehicle fuel economy.

(4) Assurance of smooth shift quality

The new small CVT features the world's first cooperative control system between the belt-pulley assembly and the auxiliary gearbox. In addition, the adoption of adaptive learning control and other improvements facilitates precise clutch pressure control for executing gearshifts involving more complex switches between clutches than in a conventional stepped AT. These control features achieve a smooth, seamless shift feel equal to that of conventional CVTs.

5. おわりに

昨今の地球環境問題に対する燃費向上に貢献することが変速機の使命であるが，CVTに副変速機を組み合わせる独自の新構造にチャレンジした結果，極めて競争力の高い変速機を開発することができた．

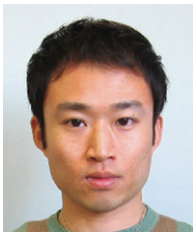
最後に，新小型CVTの開発に多大なご協力を頂いた日産自動車，スズキ自動車並びに社内関連部署の方々に深く感謝の意を表します．

5. Concluding Remarks

In recent years it has become the mission of automotive transmissions to contribute to improving fuel economy as part of efforts to address global environmental concerns. By challenging ourselves to create a unique new structure that combines an auxiliary gearbox with a conventional CVT belt-pulley assembly, we succeeded in developing a new transmission with exceptionally strong competiveness.

Finally, the authors would like to thank everyone concerned at Nissan Motor Co., Ltd., Suzuki Motor Corporation and in our internal departments for their invaluable cooperation in connection with the development of this new small CVT.

■ Authors ■

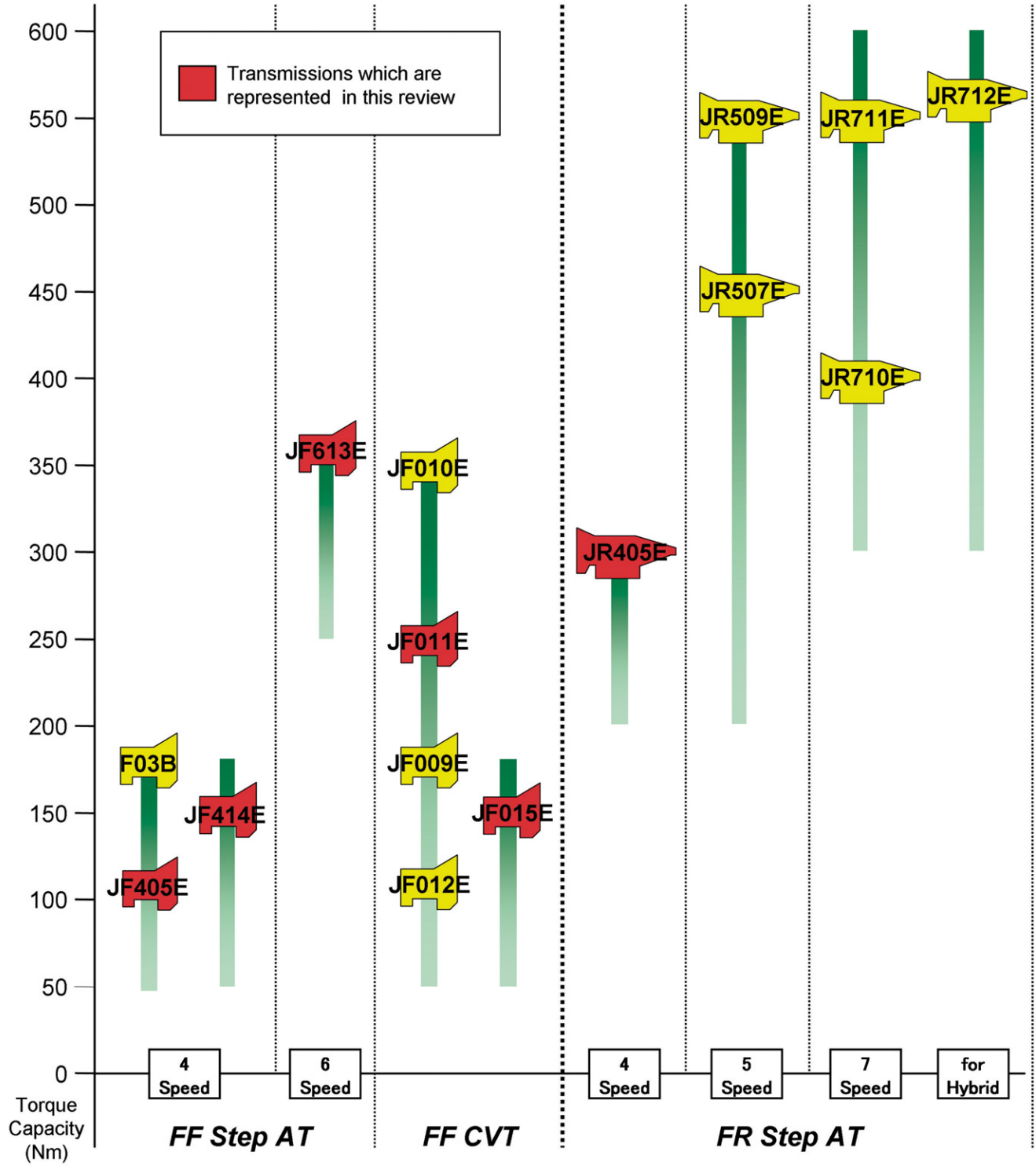

Ryosuke NONOMURA


Katsutoshi USUKI


Hirofumi MICHIOKA

Product Line-up

Jatco



日産自動車向け　FF車用CVT　JF015Eの紹介

Introducing the JF015E Steel-belt CVT for Front-drive Cars

2010年6月販売の日産自動車（株）の小型車（1.5Lクラス）ジュークに搭載されたJF015Eは，従来のベルト式無段変速機＋遊星歯車を用いた副変速機を備えた独自の機構を採用することで世界一の変速比幅を実現し，レスポンスの良い発進，加速性能を確保しつつ，高速走行時の静粛性向上及び低燃費を実現して，お客様に好評を得ています．

続いて2010年7月には新型マーチに搭載されアイドルSTOPの初採用により，クラストップの低燃費26km/l（10.15モード）を達成しお客様の注目を集めています．さらに副変速機構をロックさせて行う車両後退抑制機能の採用により坂道での再発進も安心です．

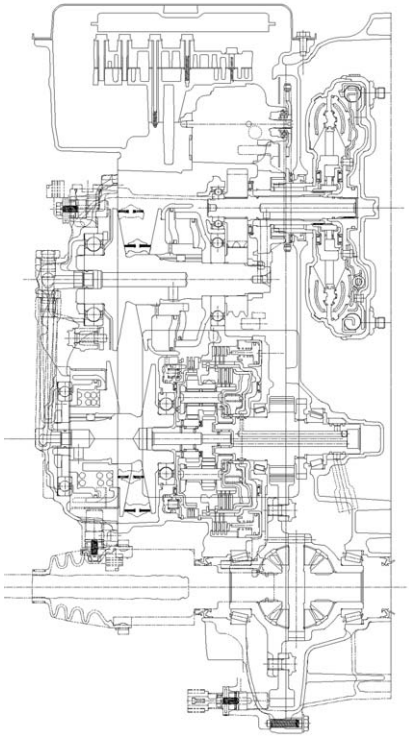


Fig. 1 Main cross-sectional view

The JF015E CVT was adopted on the 1.5-liter class JUKE compact car that Nissan Motor Co., Ltd. released in June 2010. This CVT features a unique structure that combines a planetary auxiliary transmission with a conventional belt-and-pulley assembly. This design achieves the world's widest ratio coverage, enabling the JF015E to improve quietness in high-speed driving and provide better fuel economy, while delivering fast launch response and excellent acceleration performance. All of these attributes are highly acclaimed by customers.

The JF015E was also adopted on the new-generation March released in July 2010. This model features an idling stop system for best-in-class fuel economy of 26 km/l under Japan's 10-15 test mode. As a result, it has attracted widespread customer interest. The idling stop system also incorporates a function for locking the auxiliary transmission to prevent the vehicle from rolling backward on a hill, thereby enabling the driver to start off again with complete peace of mind.

Table 1 Specifications of JF015E

Torque capacity	150 Nm
Control system	Electronic
Torque converter size	205 mm dia.
Counter gear ratio	0.967
Pulley ratio	Low: 2.2　High: 0.55
Ratio coverage	7.3
Auxiliary transmission gear ratios	1st　Fwd: 1.821
	2nd Fwd: 1.000
	Rev: 1.714
Final drive gear ratio	3.882
No. of selector positions	5
Overall length	327.3 mm
Wet weight	67.3 kg (No idling stop system)

■ Typical models fitted with the JF015E CVT ■

JUKE

March

スズキ向けコンパクトカー用　FF車用CVT　JF015Eの紹介

Introducing the JF015E Steel-belt CVT for Front-drive Cars

2009年9月に発売のスズキ株式会社のパレットに搭載されたJF015Eは，従来のベルト式無段変速機＋遊星歯車を用いた副変速機構を備えた独自の機構を採用することで世界一の変速比幅を実現し，レスポンスの良い発進，加速性能を確保しつつ，高速走行時の静粛性向上及び低燃費を実現して，お客様に好評を得ております．

2010年8月には，スズキ株式会社の新型スイフトに搭載されました．スズキ様向けコンパクトカーではJATCO製のCVTは初めての採用となり，全車エコカー減税対象となることに貢献しております．また，グレードによりマニュアルモードを採用しており，運転の楽しさを提供しております．

新型スイフトは'10年12月発表のRJCカーオブザイヤーを受賞し，評論家の高い評価を受けております．

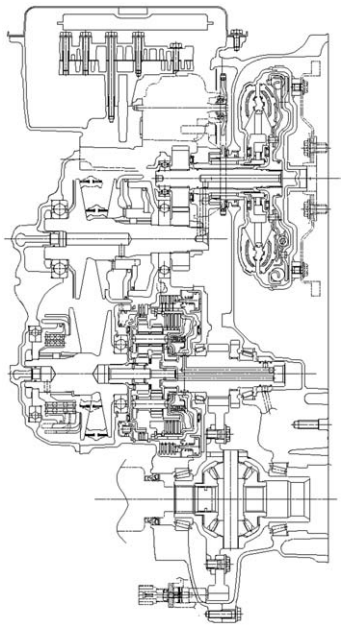


Fig. 1 Main cross-sectional view

■ Typical model fitted with the JF015E CVT ■

New SWIFT

The JF015E steel-belt CVT was adopted on the Palette released by Suzuki Motor Corporation in September 2009. This CVT features a unique structure that combines a planetary auxiliary transmission with a conventional belt-and-pulley assembly to attain the world's widest ratio coverage for improved quietness in high-speed driving and lower fuel consumption, while providing fast start-off response and excellent acceleration performance. All of these qualities are highly popular with customers.

The JF015E was also adopted on the new generation of the Suzuki Swift that was rolled out in August 2010. That marked the first use of a JATCO CVT on a Suzuki compact car, and the JF015E helped all Swift models qualify for a tax reduction on eco-friendly cars. In addition, a manual shift mode is also available on some trim grades for an added measure of driving pleasure.

The new Swift won the 2011 RJC Car of the Year award given by the Automotive Researchers and Journalists' Conference of Japan in December 2010. This honor testifies to the car's high evaluation by auto industry analysts and journalists.

Table 1 Specifications of JF015E

Torque capacity	120 Nm
Control system	Electronic
Torque converter size	205 mm dia.
Counter gear ratio	0.967
Pulley ratio	2.200-0.550
Ratio coverage	7.3
Auxiliary transmission gear ratios	1st Fwd: 1.821
	2nd Fwd: 1.000
	Rev: 1.714
Final drive gear ratio	3.882
No. of selector positions	5
Overall length	346.5 mm
Wet weight	68.5 kg

スズキ向け軽用　FF車用CVT　JF015Eの紹介

Introducing the JF015E Steel-belt CVT for Front-drive Cars

2009年9月に発売のスズキ株式会社のパレットに搭載されたJF015Eは，従来のベルト式無段変速機＋遊星歯車を用いた副変速機構を備えた独自の機構を採用することで世界一の変速比幅を実現し，レスポンスの良い発進，加速性能を確保しつつ，高速走行時の静粛性向上及び低燃費を実現して，お客様に好評を得ております．

2010年8月には，燃費性能の改良を行い，スズキ株式会社のワゴンR，ワゴンRスティングレー及びラパンに搭載され，ターボ付エンジン搭載車も含めて全車エコカー減税対象となることに貢献しております．

さらに，ワゴンRではアイドルSTOP採用により大幅な燃費向上，ワゴンRスティングレーではマニュアルモード採用により運転の楽しさを提供しております．

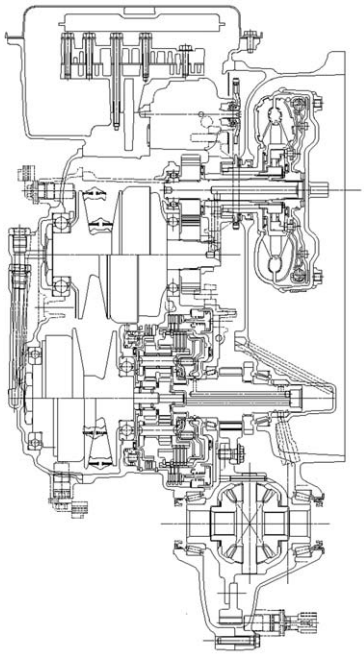


Fig. 1 Main cross-sectional view

Adopted on the Suzuki Palette released in September 2009, the JF015E CVT features a unique structure that combines a planetary auxiliary transmission with a conventional belt-and-pulley assembly. This design achieves the world's widest ratio coverage for improved quietness in high-speed driving and better fuel efficiency while providing fast launch response and excellent acceleration performance. All of these qualities are highly popular with customers.

In August 2010, the JF105E was adopted on Suzuki's Wagon R, Wagon R Stingray and Lapin minicars. Its further improved fuel efficiency helped all models, even those with a turbocharged engine, qualify for a tax reduction on eco-friendly cars.

In addition, the Wagon R model incorporates an idling stop system for a dramatic improvement in fuel economy, and the Wagon R Stingray also has a manual shift mode that provides greater driving pleasure.

Table 1 Specifications of JF015E

Torque capacity	100 Nm
Control system	Electronic
Torque converter size	185 mm dia.
Counter gear ratios	NA: 1.346; TU: 1.178
Pulley ratio	2.200-0.550
Ratio coverage	7.3
Auxiliary transmission gear ratios	1st Fwd: 1.821
	2nd Fwd: 1.000
	Rev: 1.714
Final drive gear ratio	3.882
No. of selector positions	5
Overall length	343 mm
Wet weight	62.5 kg

■ Typical model fitted with the JF015E CVT ■

New Wagon R

日産自動車向け　FF車用CVT　JF011Eの紹介

Introducing the JF011E Steel-belt CVT for Front-drive Cars

JF011Eは日産自動車株式会社の新型エルグランド（2010年10月発売），コンパクトスポーツクロスオーバーの新型ジューク，ティアナに搭載され，CVTならではのスムーズな乗り心地やドライバーの意図に合わせたリニアな変速という定評に加え，ニュートラルアイドル制御やロックアップ領域の拡大，フリクションの低減など，優れた燃費性能を実現しております．

また，重量車への対応やCVT初の直噴ターボエンジンへの適用といった幅広い車種への搭載を可能にし，お客様から好評を得ております．

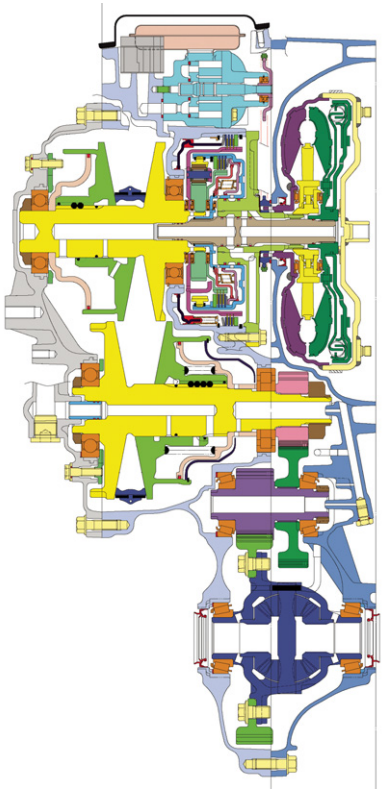


Fig. 1 Main cross-sectional view

The JF011E CVT is used on the new Elgrand (released in October 2010), the new JUKE compact sports crossover and the Teana models of Nissan Motor Co., Ltd. It is highly acclaimed for providing the smooth ride comfort characteristic of a CVT and linear shifting matching the driver's intentions. In addition, this CVT also ensures superior fuel economy thanks to its neutral idle control, expanded range of lock-up operation and reduced friction, among other improvements.

The JF011E can be used on a wide variety of car models, including heavy vehicles, and it is also the first CVT to be mated to a direct injection turbocharged engine. It has been highly popular with customers.

Table 1 Specifications of JF011E CVT

Torque capacity	240 Nm
Control system	Electronic
Torque converter size	236 mm dia.
Pulley ratios	Low: 2.349　High: 0.394
Ratio coverage	6.0
Final drive gear ratio	5.407-6.466
No. of selector positions	6
Overall length	354.7 mm
Wet weight	89.2 kg

■ Typical model fitted with the JF011E CVT ■

Elgrand

日産自動車向け　FF車用CVT　JF011Eの紹介

Introducing the JF011E Steel-belt CVT for Front-drive Cars

'10年11月発売の日産自動車(株)の新型セレナに搭載されたJF011Eは，電動オイルポンプを採用することでアイドリングストップに対応し，オイルウォーマーの採用，フリクション低減，ロックアップ領域拡大，エンジンとの協調制御などにより，燃費性能を徹底的に磨き上げた結果，クラスNo.1低燃費の達成に大いに貢献いたしました．

またアイドリングストップ対応にあたり，他機種との部品共用化を推進したことにより，適用を拡大出来るようにしています．

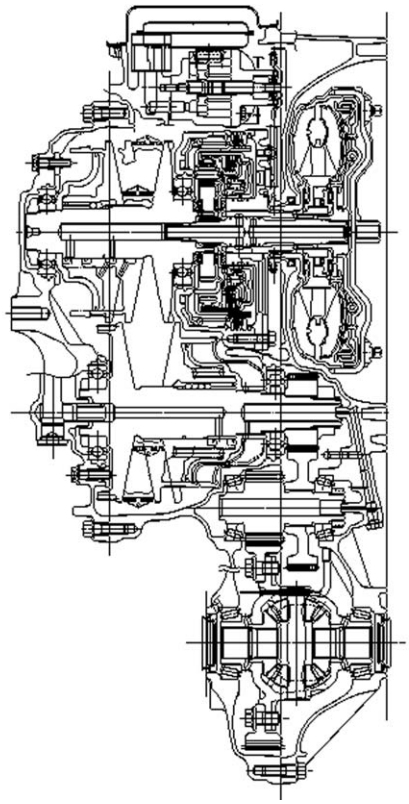


Fig. 1 Main cross-sectional view

The JF011E CVT was adopted on the new generation of the Serena released by Nissan Motor Co., Ltd. in November 2010. This CVT uses an electric-driven oil pump for compatibility with the idling stop system. It also features an ATF warmer, reduced friction, an expanded range of lock-up operation, cooperative control of the transmission and engine, and other improvements for thoroughgoing enhancement of fuel economy. As a result, it contributes significantly to the Serena's attainment of best-in-class fuel economy.

Additionally, in order to achieve compatibility with the idling stop system, greater use was made of parts shared with other models, thereby expanding the JF011E's range of application.

Table 1 Specifications of JF011E CVT

Torque capacity	210 Nm
Control system	Electronic
Torque converter size	236 mm dia.
Pulley ratios	Low: 2.349　High: 0.394
Ratio coverage	6.0
Final drive gear ratio	5.407
No. of selector positions	5
Overall length	354.7 mm
Wet weight	90.9 kg

■ Typical model fitted with the JF011E CVT ■

Serena

三菱自動車工業向け　FF車用CVT　JF011Eの紹介

Introducing the JF011E Steel-belt CVT for Front-drive Cars

JF011E型CVTは，'05年10月に三菱自動車工業（株）のアウトランダーに初めて搭載され，軽量･コンパクトな設計，優れた燃費性能，変速レスポンスの早さで好評を得ています．

'07年1月にデリカD:5，同年8月にギャランフォルティス，そして'10年2月に新型RVRに拡大採用されています．

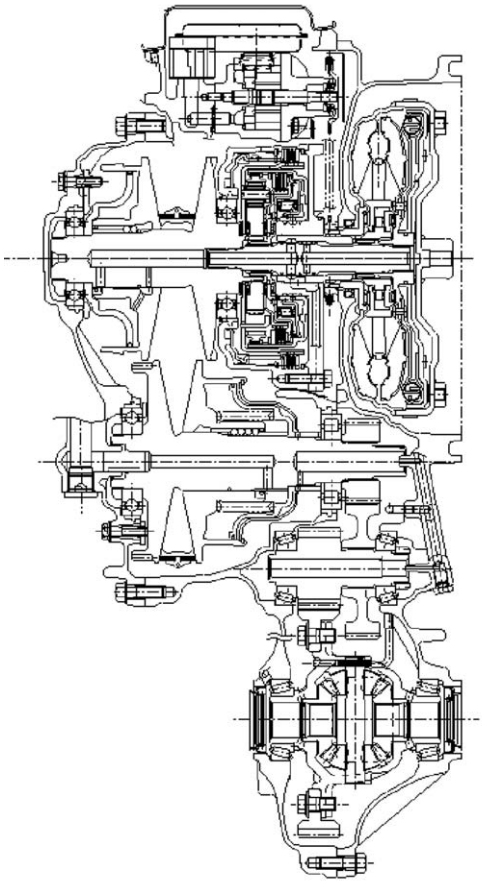


Fig. 1 Main cross-sectional view

The JF011E steel-belt CVT was first adopted on the Outlander model of Mitsubishi Motors Corporation in October 2005. It has been highly acclaimed for its lightweight and compact design, outstanding fuel economy and quick shift response.

Its application was expanded to Mitsubishi's Delica D:5 in January 2007, to the Galant Fortis in August of that year and to the new-generation RVR in February 2010.

Table 1 Specifications of JF011E

Engine		For 1.8L engines	
2WD/4WD		2WD	4WD
Max. input torque		172 Nm	←
Vehicle weight		1360 kg	1430 kg
Control system		Electronic	←
Torque converter		236 mm dia.	←
Ratios	Fwd	2.349～0.394	←
	Rev	1.750	←
Final gear ratio		6.120	←
No. of selecter positions		4（P, R, N, D）With 6-speed sport mode	←
Wet weight		90.9 kg	92.1 kg

■ Typical model fitted with the JF011E CVT ■

New RVR

日産自動車向け　FF車用6速AT　JF613Eの紹介

Introducing the JF613E 6-speed AT for Front-drive Cars

2010年7月に発売された日産自動車（株）のX-TRAIL（Clean Diesel車）に搭載されたJF613Eは，ONE WAY CLUTCH（O.W.C）の廃止，ATF攪拌抵抗の低減等によるフリクション低減，ロックアップ領域の拡大，クリアNアイドル制御の採用により，燃費の向上及びアイドル振動の低減を計り，非常に高い評価を得ています．

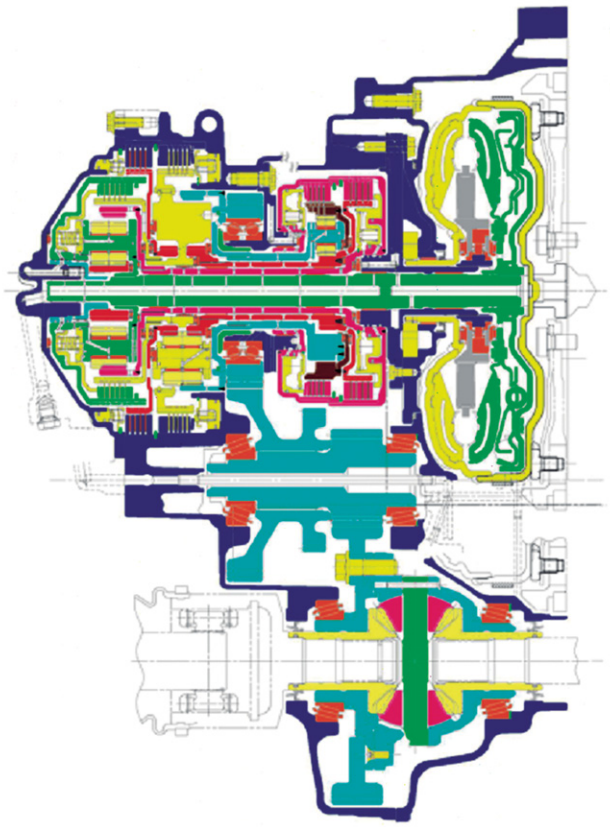


Fig. 1 Main cross-sectional view

The JF613E was adopted on the revised X-TRAIL (Clean Diesel G20 model) that Nissan Motor Co., Ltd. released in July 2010. This AT discontinues the one-way clutch (OWC) to reduce friction by lowering the churning resistance of the ATF, expands the region of lock-up operation and adopts neutral idle control. These features work to improve fuel economy and reduce idling vibration, resulting in an AT that is very popular with customers.

Table 1 Specifications of JF613E

Max. input torque		360 Nm
Max. input speed		5,200 rpm
Max. vehicle weight（GVW）		2,098 kg
Control system		Electronic with linear solenoids
Torque converter		250 mm dia.
Gear ratios	1st	4.199
	2nd	2.405
	3rd	1.583
	4th	1.161
	5th	0.856
	6th	0.685
	Rev.	3.457
Final drive gear ratio		3.571
No. of selector positions		4（P, R, N, D）
Overall length		385 mm
Center distance between engine and differential		197 mm
Weight（wet）		106 kg

■ Typical model fitted with the JF613E AT ■

X-TRAIL

ルノー三星自動車向け　FF車用6速AT　JF613Eの紹介

Introducing the JF613E 6-speed AT for Front-drive Cars

2010年5月に，JF613Eは韓国ルノー三星自動車株式会社の中型乗用車NEW SM5に搭載されました．2010年12月から2.5Lガソリンの国内販売が開始され，現在は【RENAULTブランド】と【RSMブランド】でワールドワイドに展開中です．ASC（アダプティブシフトコントロール）機能により，走行環境や路面状況に応じた最適な変速を実現し，低燃費と優れた運転性により，お客様に大変好評を得ております．

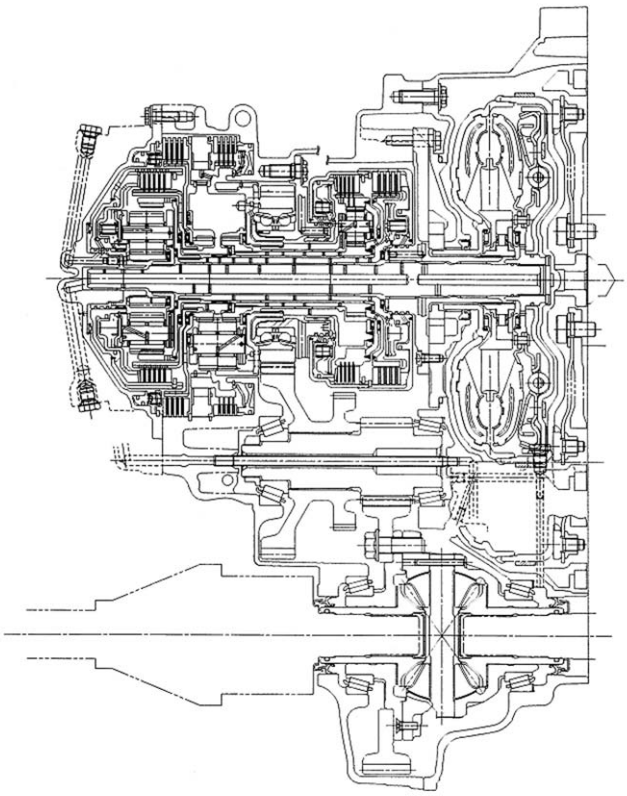


Fig. 1 Main cross-sectional view

The JF613E 6-speed AT was fitted on the new SM5 midsized passenger car released by Renault Samsung Motors (RSM) in the South Korean market in May 2010. It was also adopted on a 2.5-liter gasoline engine model that went on sale in South Korea in December 2010. Currently, the application of this AT is being extended to Renault brand models and RSM brand models worldwide.The JF613E features Adaptive Shift Control (ASC) that automatically selects the optimum gear matching the driving environment and road surface conditions for improved fuel economy and superior driveability. Such performance has made this AT highly popular with customers everywhere.

Table 1 Specifications of JF613E

Torque capacity	230/330/360/450 Nm
Control system	Electronic
Torque converter size	250/260 mm dia.
Gear ratios	1st 4.199
	2nd 2.405
	3rd 1.583
	4th 1.161
	5th 0.856
	6th 0.686
	Rev 3.457
Final drive gear ratios	3.804/3.36/3.36/2.991
No. of selector positions	4 (P, R, N, D) + Manual shift mode
Overall length	385 mm
Center distance between engine and differential	197 mm
Wet weight	98 kg

■ Typical model fitted with the JF613E AT ■

SM5

日産自動車向け　FF車用4速AT　JF414Eの紹介

Introducing the JF414E 4-speed AT for Front-drive Cars

新型FF 4速AT（JF414E）は，2010年8月に日産自動車（株）の中国向け新型マーチにはじめて搭載され新興国向けに拡大採用されていきます．

本ユニットは，信頼性の高い現行ユニット（累計1100万台）の要素部品を流用をしながら，細部の設計見直しを行い，高いロバスト性を実現しました．

また，3方リニアソレノイドを用いた直動制御の採用により，変速性能向上を行いながら軽量・コンパクト化にも貢献し，お客様の要求性能を満足させる事が出来ました．

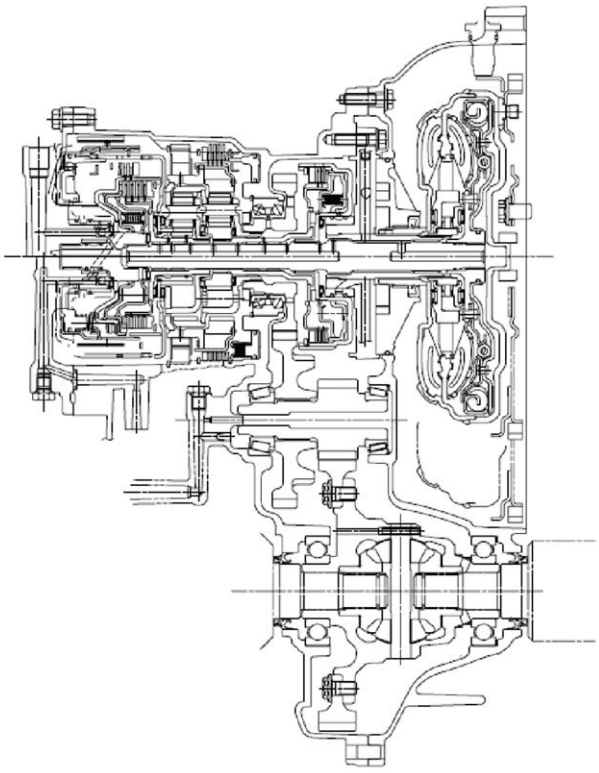


Fig. 1 Main cross-sectional view

The new JF414E 4-speed AT designed for front-drive cars was first adopted on the new March model that Nissan Motor Co., Ltd. rolled out for the Chinese market in August 2010. Its application has since been further expanded to other models sold in emerging markets.

This new AT shares key components of the previous unit noted for its high reliability and a cumulative production volume of 11 million units. Many design details were also improved to attain higher robustness.

The adoption of direct-acting control using three-way linear solenoid valves improved shift performance and also contributed to a lighter, more compact design that satisfies the performance demanded by customers.

Table 1 Specifications of JF414E

Torque capacity	150 Nm
Control system	Electronic
Torque converter size	205 mm dia.
Gear ratios	1st 2.861
	2nd 1.562
	3rd 1.000
	4th 0.697
	Rev 2.310
Ratio coverage	4.1
Final drive gear ratio	4.081-4.351
No. of selector positions	6 (P, R, N, D, 2, 1)
Overall length	344.2 mm
Center distance between engine and differential	183 mm
Wet weight	58 kg

■ Typical model fitted with the JF414E AT ■

March

GM大宇Auto&Technology社向け FF車用4速AT JF405E-Gの紹介

Introducing the JF405E-G 4-speed AT for Front-drive Cars

FF4速自動変速機JF405E-Gは，'02年7月にGM大宇オート&テクノロジ社のMatizに初めて搭載されました．

このユニットは2009年8月にフルモデルチェンジした1000CC軽自動車Matiz creativeにも適用され，コーストスリップロックアップ採用による燃費性能の向上とトルク制御による変速性能の向上及びK-OBD（Korea-On Board Diagnostics）に対応したATとして韓国市場だけではなく，全世界に輸出されています．

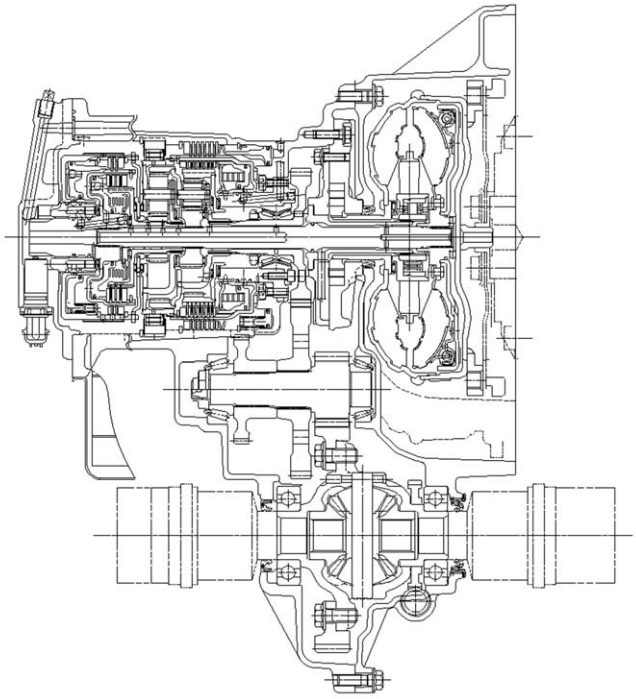


Fig. 1 Main cross-sectional view

The JF405E-G 4-speed AT for front-drive cars was first adopted on the Matiz, built by GM Daewoo & Technology Company, in July 2002.

This AT was also adopted on the 1.0-liter Matiz Creative minicar that underwent a full model change in August 2009. It incorporates coasting slip lockup control for improved fuel economy, torque control for enhanced shift performance and an upgraded control system complying with Korea Onboard Diagnostics (K-OBD) requirements. Besides being marketed in South Korea, the JF405E-G is also exported to markets around the world.

Table 1 Specifications of JF405E-G

Max. input torque		92.3 Nm
Max. input speed		6,500 rpm
Max. vehicle weight（GVW）		1235 kg
Control system		Electronic
Torque converter		200PCD
Gear ratios	1st	2.914
	2nd	1.525
	3rd	1.000
	4th	0.725
	Rev.	2.642
Final drive gear ratio		4.709
No. of selector positions		6（P, R, N, D, 2, L）
Overall Length		359.9 mm
Center distance between engine and differential		172 mm
Wet weight		50.4 kg

■ Typical model fitted with the JF405E-G AT ■

Matiz

マツダ向け　FR車用4速AT　JR405Eの紹介

Introducing the JR405E 4-speed AT for Rear-drive Cars

2010年8月にマイナーチェンジされたマツダ（株）のボンゴに搭載されたJR405E型自動変速機は，クラッチ圧の直接電子制御を特徴とするFR4速自動変速機である．

1999年6月にマツダ（株）のボンゴに初めて採用され，以降マツダ（株）経由のOEMで日産自動車（株）のバネット及び三菱自動車工業（株）のデリカと多くの商用車に採用されており，優れた運転性で高い評価を得ております．

The JR405E 4-speed AT is designed for application to rear-drive cars and features direct electronic control of the clutch pressure. This AT was adopted on the Mazda Bongo that underwent a minor model change in August 2010.

Since it was first featured on the Mazda Bongo in June 1999, the JR405E has been used on many commercial vehicles. Applications include the Nissan Vanette, which Mazda supplies to Nissan under an OEM agreement, and the Mitsubishi Delica. It has been highly acclaimed for providing outstanding driveability.

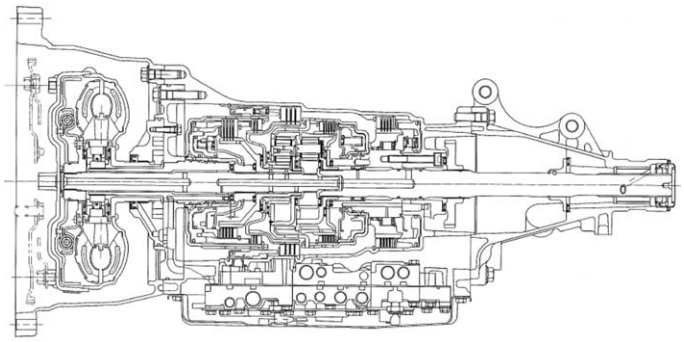


Fig. 1 Main cross-sectional view

Table 1 Specifications of JR405E

Max. input torque		147 Nm
Max. input speed		5,300 rpm
Max. vehicle weight（GVW）		2,749 kg（2WD）
Control system		Electronic
Torque converter		236 mm dia.
Gear ratios	1st	2.785
	2nd	1.545
	3rd	1.000
	4th	0.694
	Rev.	2.272
No. of selector positions		6（P, R, N, D,S,L）
Weight（Dry）		62 kg

■ Typical model fitted with the JR405E AT ■

Mazda Bongo

ジヤトコ 一年間のトピックス

Highlights of the Past Year

1. 日本のトランスミッション技術者が一同に集まる

2009年7月21日(火), パシフィコ横浜で横浜国立大学と自動車技術会協賛の「トランスミッションフォーラム2009」が開催された.

フォーラムでは日本のトランスミッション開発者が一同に集まる技術講演会があり, およそ300名を超える参加があった.

ジヤトコは「AT/CVTの小型軽量化と燃費向上技術」の講演を行い, ドイツの産学連携に習い日本の産学連携のさらなる推進の必要性を力説した. 富士重工からは新開発のチェーンCVTの開発の紹介があった. また, トヨタからの新型プリウスのトランスミッション技術講演では時間をオーバーする質疑応答となり, 技術者の関心の高さが伺える活発なフォーラムとなった. 質問の中には“ プリウスとインサイトの燃費の差はどこにあるのか ”といった核心を突くものもあった.

今回のフォーラムでは, 当社は技術広報視点から横浜国立大学・自動車技術会と連携し, フォーラムを全面的にサポートする事務局として活動した.

2. 富士第一地区でJF015E(CVT)出荷式開催

2009年8月20日(木), 富士第一地区第2工場において, 小型軽量化とフリクションの低減を実現した次世代無段変速機の出荷式が行われた.

7月に発表した, 日産自動車株式会社との共同開

1. Forum for Japanese transmission engineers

The Transmission Forum 2009, co-sponsored by Yokohama National University and the Society of Automotive Engineers of Japan (JSAE), was held at Pacifico Yokohama on Tuesday, July 21, 2009. Organized around a program of technical presentations, this forum brought together over 300 people involved in the development of automotive transmissions.

A JATCO employee gave a presentation concerning techniques for improving vehicle fuel economy by reducing the size and weight of ATs/CVTs. He strongly emphasized the need to promote further industry-academia collaboration in Japan, following examples of such collaboration in Germany. A speaker from Fuji Heavy Industries talked about the development of a new chain-driven CVT. A presentation by a Toyota employee on the technologies incorporated in the transmission of the new Prius ran over the allotted time for the Q&A session. This showed the strong interest of the attending engineers and was indicative of the overall lively nature of the forum. One of the questioners got straight to the point by asking what accounted for the difference in fuel economy between the Prius and the Honda Insight.

JATCO served as the secretariat of the forum this year, working closely with Yokohama National University and JSAE to provide all-out support for the forum from the standpoint of promoting technical public relations.

2. Ceremony in Fuji Area No. 1 to celebrate 1st shipment of JF015E CVT

A ceremony was held at the No. 2 plant in Fuji Area No. 1 on Thursday, August 20, 2009 to celebrate the first shipment of the next-generation JF015E CVT that features notable reductions in size, weight and friction. Unveiled in July 2009, this next-generation CVT was developed jointly with Nissan Motor Co.,

発の次世代の無段変速機となる．日産とジヤトコは，中期環境行動計画「ニッサン・グリーンプログラム 2010」に基づき，これまでにCVTのグローバル年間販売台数100万台の達成や7速ATの開発・市場投入を実施してきた．我々は今後も持続可能なモビリティ社会の発展に貢献するため，実効性のある技術や商品を開発し，市場に投入していく．

次世代CVT

この次世代CVTは従来のベルトによる無段変速機に加え，副変速機を備える独自の構造を採用することにより，変速比を大幅に拡大するとともに小型軽量化，高効率を実現した．主な特長は以下の通り．

●世界一の変速比幅／発進・加速性能の向上

独自構造により，変速比幅7.3と，従来の同クラスのCVTと比較して20%以上変速比幅を拡大した．これは有段ATと比較すると大排気量車等に搭載されている7速ATを超え，世界最大の変速比幅となる．これにより，レスポンスのよい発進加速と，高速走行時の静粛性の向上を実現した．

●小型軽量

世界初となる，ベルトによる無段変速機と副変速機の組み合わせという，画期的な独自構造を採用することにより，従来の同クラスのCVTに比べ10%全長を短縮し，13%の軽量化を実現した．

●フリクションの低減

上記による変速比幅の拡大，プーリーの小型軽量化，オイル攪拌抵抗の低減等により，従来の同クラスのCVTに比べてフリクションを30%低減し単体の効率を向上．

次世代CVTは，加減速，登坂・降坂など運転状況に応じて最適なギアを選択する制御技術である「アダプティブシフトコントロール」（ASC）を採用し，発進・加速性能などの運転性のさらなる向上も図っている．

Ltd. Under Nissan's medium-term environmental action plan called the Nissan Green Program 2010, the two companies have so far achieved annual global sales of one million CVT-equipped vehicles as well as the development and sales launch of a new 7-speed AT. JATCO intends to continue to develop and introduce technologies and products that effectively contribute to the advancement of a sustainable mobility society.

Next-generation CVT

The next-generation CVT has a unique structure that adds an auxiliary transmission to a conventional belt-driven CVT, thereby expanding the ratio coverage dramatically as well achieving a smaller, lighter unit with enhanced efficiency. Its major features are outlined below.

● World's widest ratio coverage for improved vehicle launch response and acceleration performance

The unique structure provides substantially wider ratio coverage of 7.3, a large 20% improvement over that of existing CVTs in the same class. This figure represents the world's widest ratio coverage, even exceeding that of stepped 7-speed ATs used on vehicles with a large displacement engine. As a result, the new CVT provides quicker, more responsive start-off acceleration and improved quietness in high-speed driving.

● Smaller and lighter

The new CVT is the world's first to combine a belt-driven CVT with an auxiliary transmission. This unique and revolutionary design shortens the overall unit length by 10% and reduces the weight by 13% compared with existing CVTs in the same class.

● Reduced friction

Wider ratio coverage, smaller and lighter pulleys, reduced fluid churning resistance and other improvements combine to reduce friction by 30% compared with existing same-class CVTs, thereby improving the efficiency of the unit itself.

This next-generation CVT incorporates Adaptive Shift Control (ASC), an advanced control technology that enables selection of the optimal gear matching the driving conditions, including acceleration, deceleration, and hill climbing and descent. This results in a further improvement of vehicle launch response, acceleration performance, and other attributes.

3. ジヤトコの省エネ活動が専門誌に掲載

2009年9月，ジヤトコの省エネ活動が，「すぐに役立つ省エネ事例集 新電気8月別冊（オーム社刊）」に掲載された．

掲載内容は，「第一FRA/T工場 鍛造課」と「FFA/T工場 第六富士製造課」が，'08年度の省エネルギー事例発表会関東大会（財団法人省エネルギーセンター主催）で 発表した内容．

発表後に，すぐに役立つ事例として注目され，オーム社より執筆依頼が届き，今回の掲載となった．

【冷間鍛造ビレット材のSA熱処理の廃止で年間480トンのCO_2を削減】

ー掲載内容 要約ー

冷間鍛造工程において，これまでは，ビレット材に球状化焼鈍処理を施していたが，トライアル・検証を重ね，球状化焼鈍処理を廃止しても，冷間形成に問題がないことを発見． 廃止により，材料表面の油による新たな課題が出てきたが，これは，コンパクト 洗浄機を設置することで解決した． 今後は，社内に水平展開していく．

【効果】

□ CO_2:480トン/年削減

□ 省エネ効果:690万円/年

（波及効果含め総額:1,815万円/年）

【熱処理ソルト槽ヒータ見直しによる電力削減】

ー掲載内容 要約ー

歯車の熱処理工程で，使用電力量の調査を行ったところ，ソルト槽の使用電力が一番おおいことが判明．そこで，ソルト槽のヒータ稼動状態の見直しを

3. Specialist magazine coverage of JATCO's energy-saving activities

JATCO's energy-saving activities were written up in articles included in a supplement to the August issue of ShinDENKI, published by Ohmsha, Ltd. The supplement was entitled "Actual Examples of Immediately Useful Energy-Saving Techniques." The articles covered the activities presented at the fiscal 2008 Kanto convention and exposition of practical energy-saving examples sponsored by the Energy Conservation Center, Japan. The presentations were made by the Forging Section of FR A/T Manufacturing Department No. 1 and Fujinomiya Production Section No. 6 of the FF A/T Manufacturing Department. These activities attracted attention right after the convention because of their immediate usefulness. Ohmsha asked JATCO to write articles about the energy-saving activities that were included in the supplement and are summarized below.

"Annual CO_2 emission reduction of 480 tons by discontinuing spheroidizing annealing of cold-forged billets"

- Article summary -

Billets previously underwent spheroidizing annealing (SA) in the cold-forging process, but it was discovered after repeated trials and verifications that the SA treatment could be eliminated without affecting cold formability. As a result of discontinuing this SA treatment, a new issue emerged concerning an oil residue on the billet surface, but it was resolved by installing a compact washing machine. JATCO plans to implement this improvement at other plants in the future.

Benefits

- Annual CO_2 emission reduction of 480 tons
- Annual energy savings worth \6.9 million (including ripple effects, a total annual saving of \18.15 million)

"Reduction of electric power consumption by improving salt bath heaters used for heat treatment"

- Article summary -

A survey was made of the amount of electric power consumed in the heat treatment process for

行うと共に，効率化を追求し，維持した．同設備において，2009年度は，さらに10%削減することを目標に，現在も活動中．

【効果】

□ CO_2:39.2トン/年削減

□ 省エネ効果:78万円/年

4. ジヤトコ，中国 広州市の新工場でCVT生産を開始

中国における生産会社　ジヤトコ（広州）自動変速機有限公司（以下 ジヤトコ広州）は，この程，新工場でのCVTの本格生産を開始し，2009年9月28日，広州市の新工場に於いて，開所式を実施した．

新工場は，メキシコに続くジヤトコの2番目の海外生産工場であり，2.0～2.5リッタークラス車用のベルトCVTを生産する．投資額は40億円（約3億人民元）で，生産能力は年間14万台．現時点での従業員数は約250人で，今後増員する予定である．

開所式には，開発区管理委員会の石奇珠（Shi Qizhu）副主任，田尻和宏日本国駐広州総領事をはじめとする，地元政府，顧客，サプライヤー関係者など，合わせて200人以上が出席した．

ジヤトコは，2007年2月に中国での現地生産を発表，2007年4月にジヤトコ広州を設立し，新工場立ち上げに向けた準備を行ってきたが，これをもってすべての準備が整い，本格的な稼働を開始したことになる．

ジヤトコ広州で生産されたCVTは，東風日産乗用車有限公司で生産されるシルフィ，ティアナ，キャシュカイ，エクストレイルに搭載される．新工場では，日本，メキシコと同様，同社のグローバルな生産方式である

transmission gears. It was found that the salt baths consumed the most electricity. The operating conditions of the salt bath heaters were then improved, while pursuing and maintaining higher efficiency. Activities are currently under way to reduce the power consumption of the heaters by an additional target figure of 10% during fiscal 2009.

Benefits

■ Annual CO_2 emission reduction of 39.2 tons

■ Annual energy savings worth \780,000

4. Launching of CVT production at JATCO Guangzhou's new plant in Guangzhou, China

JATCO (Guangzhou) Automatic Transmission Ltd. (JATCO Guangzhou) held a ceremony on September 28, 2009 to inaugurate its new Guangzhou plant, which recently launched full-scale production of CVTs. The company is JATCO's manufacturing subsidiary in China.

The new plant is JATCO's second overseas production center after the factory in Mexico. It produces steel-belt CVTs for use on 2.0-2.5-liter class vehicles. The plant was built at an investment of 4 billion yen (about 300 million renminbi) and has an annual production capacity of 140,000 units. It currently has about 250 employees and plans to expand its workforce further in the future.

The inauguration ceremony was attended by over 200 people, including Vice Chairman Shi Qizhu of the Guangzhou Development District Administrative Committee, Consul General Kazuhiro Tajiri of the Japanese Consulate in Guangzhou, local government officials, customers, supplier company representatives and others.

In February 2007, JATCO announced a plan to

JEPS(JATCO Excellent Production System)を導入，グローバル基準に基づいた高い品質のCVTを提供する.

5. 第41回東京モーターショー2009開催

2009年10月21日(水)，千葉県 幕張メッセにおいて「第41回東京モーターショー2009」が，開幕した. CVT(無段変速機)生産台数世界一のジヤトコは，『環境CVTのジヤトコ』をテーマに，世界初の副変速機つきCVTをはじめとして，軽自動車用から3.5リッタークラス大型車用までのベルトCVTフルラインナップを展示.

また，FR7速ATをベースとした新開発のハイブリッド車用トランスミッションを展示，FR7速AT，FF6速ATなどのジヤトコ主力商品も出展.

ブースでは，可動式のモデルにより，ベルトCVTの作動の仕組みを体験していただけるよう期間中プレゼンテーションを毎日実施. CVTの優れた環境性能を紹介することが出来た.

launch local production in China and established JATCO Guangzhou in April of that year. Preparations were then undertaken for launching the new plant, and after all the work was successfully completed, full-scale production operations were initiated.

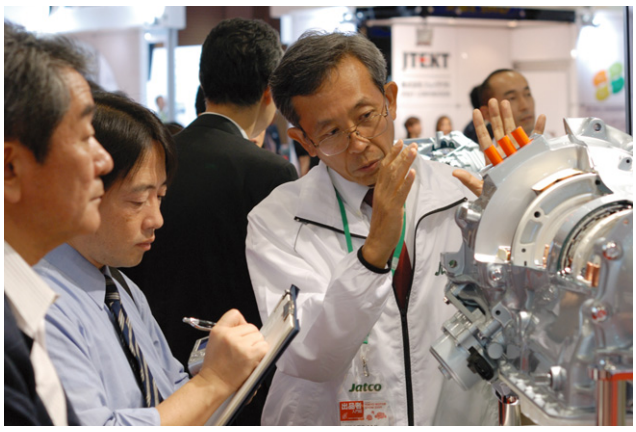
The CVTs built by JATCO Guangzhou are used on the Nissan Sylphy, Teana, Qashqai and X-Trail produced by Dongfeng Nissan Passenger Vehicle Co. The new plant has installed the JATCO Excellent Production System (JEPS), the global manufacturing system that is used in all JATCO plants in Japan and Mexico, and provides high-quality CVTs that meet international standards.

5. JATCO at the 41st Tokyo Motor Show in 2009

The 41st Tokyo Motor Show 2009 opened at Makuhari Messe in Chiba prefecture on Wednesday, October 21, 2009. As the world's leading producer of CVTs, JATCO exhibited its full lineup of steel-belt CVTs for use on vehicles ranging from minicars to large 3.5-liter passenger vehicles. This included the new next-generation CVT, the world's first CVT to incorporate an auxiliary transmission.

The theme of the exhibits was "JATCO, CVTs for the Environment." JATCO also exhibited a newly developed hybrid vehicle transmission based on a 7-speed AT for rear-drive vehicles, which was exhibited as well, and a 6-speed AT for front-drive cars, among other mainstay products.

During the show, presentations were given daily at the JATCO booth to explain to visitors the operating principle of a steel-belt CVT. Working CVT models were also displayed so that visitors could personally experience the operation of a CVT. In this way, the outstanding environmental performance of CVTs was



●新開発・次世代CVT（カットモデル）
　世界最大の変速比幅，7.3を実現し，鋭い発進加速と高速走行時の静粛性を両立
●新開発・ハイブリッド車用トランスミッション（カットモデル）
　1つのモーターと2つのクラッチを採用する，モーター単独走行も可能なパラレル方式ハイブリッド車用

6. 第11回 うるおいの森植樹祭にジヤトコ社員が参加

2009年10月31日（土），富士山麓の富士宮市 南陵工業団地で「第11回 うるおいの森植樹祭」が開催された．

ジヤトコ社員とご家族の計40名が参加，市民団体ら総勢1,200名とともに，10,000本の苗（ブナ，コナラ等，30種以上）を植樹した．

この活動は，新設される工業団地内に，富士山麓の生態系にあった広葉樹林を植樹することで，自然と調和した最先端工業の発展を目指しているもの．

そのため今回植えられた全ての苗は，富士山麓で採取した種子から育てられている．またその規模は，参加人数や苗木数共に，国内でも最大規模である．

7. 中部支部主催の技術講習会で講演

2009年11月13日（金），愛知県産業労働センターにおいて，自動車技術会 中部支部主催の技術講習会（自動車の周辺技術）が開催され，弊社から「自動車変速機の現状と今後の技術進化の方向性」というテーマで1時間にわたって講演が行われた．

講演ではCVTを中心とした自動変速機の技術開発史と環境対応技術の観点からその進化の方向性を述べ，参加者からの高い関心を得ることができた．

弊社のほかは，トヨタ自動車 安部静雄氏の「プラグイン・ハイブリッド車の取組み」，九州大学大学院教授 村瀬英一氏の「ガソリンエンジンの現状と将来動向」というテーマで講演が行われた．

emphasized to the show visitors.

● Cutaway model of the newly developed next-generation CVT
　Boasting the world's widest ratio coverage of 7.3 this CVT delivers quick start-off acceleration combined with quiet operation in high-speed driving.
● Cutaway model of the newly developed hybrid vehicle transmission
　Featuring a one-motor two-clutch system designed specifically for parallel hybrids, this unit also provides a motor-alone drive mode.

6. JATCO employees participate in the 11th Uruoi-no-Mori Tree Planting Festival

The 11th Uruoi-no-Mori ("Enriching the Forest") Tree Planting Festival was held at the Nanryo Industrial Park in the city of Fujinomiya at the foot of Mt. Fuji on Saturday, October 31, 2009. A total of 40 JATCO employees and their family members joined over 1,200 persons from various citizen groups to plant 10,000 saplings of more than 30 tree varieties, including beech and konara oak. This activity is aimed at fostering the development of cutting-edge industries in harmony with nature by planting on the grounds of this newly established industrial park forests of broadleaf trees suitable to the ecosystem at the foot of Mt. Fuji. For that reason, all of the saplings planted were grown from seeds gathered at the foot of the mountain. The scale of this activity in terms of the number of participants and saplings planted is one of the largest in Japan.

7. Presentation at a technical forum sponsored by JSAE Chubu Branch

A technical forum about automotive-related technologies was held at the Aichi Industry & Labor Center on Friday, November 13, 2009, sponsored by the Chubu Branch of the Society of Automotive Engineers of Japan (JSAE). A JATCO employee gave a one-hour presentation on the theme of "the current status of automotive transmissions and direction of their future technological evolution." The presenter explained the history of AT technology development, especially CVTs, and described the future direction of

8. 2009韓国自動車工学会(KSAE)学術大会で石田社長が特別講演及びKSAE法人会員勤続賞を受賞

2009年11月24日(火)～26日(木)にかけて，大韓民国　仁川広域市松島コンベンシアにおいて，2009韓国自動車工業会(KSAE)定期学術大会と展示会が開催された．

24日(火)にKSAE法人会員勤続賞の授賞式参加，26日(木)に弊社からの特別講演(「Recent Trends & Issues in AT/CVT」)，3日間を通じての展示会への出展と，大変盛りだくさんの内容となった．

展示会では，販売好調なルノーサムスンの新型SM3に搭載され韓国内でも注目が高まっているCVTに焦点をあて，JF009EとJF011Eのカットモデルをはじめ，CVTの先進技術や高い環境性能をまとめたパネルやCVT作動原理モデルを展示し，CVTの優位性をアピールすることができた．

9. ジヤトコ広州で生産能力拡大二期建設工事鍬入れ式開催

2009年11月25日(水)，ジヤトコ広州(JGZ)において，広州市開発区およびジヤトコ関係者が出席し工場生産能力拡大二期建設工事の鍬入れ式を行った．

ジヤトコは，環境技術として注目されているCVT(無段変速機)のグローバルな需要拡大に対応するため，メキシコに次ぐ同社2番目の海外生産拠点として，2007年4月，中国にジヤトコ広州を設立，2009年9月より，2.0～2.5リッタークラス車用のベルトCVTの本格生産を開始ししているが，今回の生産能力拡大は，中国市場で期待されるCVTの更なる

progress from the perspective of environmentally friendly technologies. Attendees expressed strong interest in these subjects.

Besides JATCO's presentation, Shizuo Abe of Toyota Motor Corporation talked about his company's efforts to develop plug-in hybrids, and Professor Eiichi Murase of Kyushu University Graduate School of Engineering gave a presentation on the theme of the present status and future trends of gasoline engines.

8. President Shigeo Ishida gives invited presentation at KSAE's 2009 Annual Convention and JATCO receives KSAE Corporate Member Continuous Service Award

The Korean Society of Automotive Engineers (KSAE) held its 2009 Annual Convention and Exhibition at the Songdo Convensia Convention Center in Incheon Metropolitan City, South Korea, from Tuesday-Thursday, November 24-26, 2009.

JATCO President and CEO Shigeo Ishida had a full schedule of activities at this event. On Tuesday, November 24, he attended the awards ceremony at which JATCO received a Continuous Service Award as a KSAE corporate member, and on Thursday, November 26, he gave an invited presentation on the topic of "Recent Trends and Issues in ATs/CVTs." He also appeared at JATCO's exhibits at the exhibition held during the three-day convention.

At the exhibition, JATCO displayed cutaway models of the JF009E and JF011E CVTs as well as models illustrating the working principle of CVTs. Panels were also displayed that explained the advanced technologies and outstanding environmental performance of CVTs. Special attention was focused on the CVT fitted on the new Renault Samsung SM3 sedan that is enjoying brisk sales, as interest in this CVT is also growing in the South Korean market. The exhibits served to emphasize the superior performance of CVTs.

9. Ground-breaking ceremony at JATCO Guangzhou for second phase construction to expand production capacity

JATCO (Guangzhou) Automatic Transmission Ltd. (JGZ) held a ground-breaking ceremony for the second phase construction to expand the production

需要拡大に対応するもので，生産能力24万台／年のラインを新設．これにより，現在の生産能力14万台／年とあわせて，ジヤトコ広州の生産能力は38万台／年となる．建屋増築，生産設備設置等の投資額は53億円（約4億元）で，新ラインの稼動は，2011年中頃の予定．また，この生産能力拡大によりジヤトコ広州の人員は約700名となり，現地雇用の創出を通じて，中国と広州の経済発展に更なる貢献ができると考えている．

10. 静岡県優秀技能者及び認定職業訓練及び技能検定に係る功労者表彰

2009年11月30日（月），静岡市東部勤労福祉センター「清水テルサ」にて優秀技能者と技能検定に係る表彰式が行われ，当社からは3名が以下の表彰を受けた．

・優秀技能者功労者表彰（県知事表彰）
・技能検定功労者（県知事表彰）
・職業能力検定関係功労者
（県職業能力開発協会長表彰）

優秀技能者功労者表彰は，優れた技能を持ち，広く社会一般に技能尊重気運を高揚し，技能者の社会的地位及び技能基準の向上を図るための表彰であり，表彰者には，

①有する技能がすぐれており，県内を通じて当該技能において第一人者と目されていること．
②就業を通じて後進者の技能の指導，教育訓練に携わり，技能者の育成に寄与したこと．
③勤務実績，日常行為等において，他の技能者の模範と認められる人物であること．

の全ての要件を満たしていることが求められる．

capacity of its Guangzhou plant. The event took place on Wednesday, November 25, 2009, attended by officials from the Guangzhou Development District Administrative Committee and related persons from JATCO.

JATCO established JGZ in China in April 2007 as the company's second overseas production center after its plant in Mexico in order to meet the increasing global demand for CVTs, which are attracting attention as an environmentally friendly technology. JGZ launched full-scale production of steel-belt CVTs for use on 2.0-2.5-liter class vehicles in September 2009. This expansion of its production capacity is intended to meet the expected increase in CVT demand in the Chinese market in the near future. A new production line with an annual production capacity of 240,000 units will be built to expand JGZ's yearly production capacity to 380,000 units, up from its current level of 140,000 units. The investment for this expansion, including expanding the plant building and installing the production equipment, will total 5.3 billion yen (about 400 million renminbi). The new line is expected to begin operating around the middle of 2011. This increase in production capacity will bring JGZ's workforce to approximately 700 employees. The creation of local employment is expected to contribute to further economic development in Guangzhou as well as elsewhere in China.

10. Shizuoka Governor's Awards for Outstanding Technician/Certified Vocational Training and Skill Certification Award

A ceremony was held at Shizuoka City's East District Labor and Welfare Center (Shimizu Terrsa) on Monday, November 30, 2009 to present awards to outstanding technicians and for skill certification. Three JATCO employees were honored with the following awards.

- Outstanding Technician Award (Governor's Award)
- Skill Certification Award (Governor's Award)
- Award for Contribution to Vocational Skill Certification (Prefectural Vocational Ability Development Association Chairman's Award)

The Outstanding Technician Award is presented to persons who possess excellent technical skills and who have worked to elevate respect widely among the

11. CTI欧州シンポジウムで講演

2009年11月30日～12月3日の4日間にわたり，ドイツのベルリンにてCTI欧州シンポジウムが開催され，今回も弊社社員により基調講演・学術講演が行われた．基調講演では CVTの開発史を紐解き，今後のCVTの発展性を述べるとともに，新型CVTのプレ紹介やジヤトコ中国工場を含めた中国でのCVTの供給体制に触れた．学術講演は，トランスミッションケース内のATFの飛沫現象のビジュアル化とモデリング工数の削減を目的に，ATFを粒子として取り扱う粒子法という流体解析シミュレーションを用い，ブリーザ室周辺とシャフト周辺のATFの挙動を予測する解析技術についての発表をおこなった．

12. ワークライフバランスシンポジウムに参加

2009年12月17日(木)，静岡県経済産業会館にて21世紀職業財団静岡事務所主催で実施された「仕事と生活の調和(ワーク・ライフ・バランス)シンポジウム」にパネリストとして参加した．

「様々な働き方のできる職場づくりを」と題したパネルディスカッションで，育児休職を利用した男性社員として，男性の育児休職取得に関する周囲・会社の理解及びフォローの重要性や，自身の育休の経験が仕事へも活きていることなどを話した．

当日の参加者のアンケートでは，「育児休職を取得した男性の貴重な意見が大変参考になった」など多くのコメントをもらった．

general public for technical abilities as well as striving to enhance the social standing of technicians and to improve technical standards. Winners of this award must satisfy all of the following conditions:

(1) Possesses outstanding technical skills and aims to be a leading expert in related disciplines throughout the prefecture.
(2) Has contributed to the development of technicians through on-the-job involvement in the guidance, education and training of the younger generation in technical abilities.
(3) Serves as a recognized model for other technicians with regard to work performance and daily activities.

11. Presentations at the International CTI Symposium in Europe

The International CTI Symposium was held in Berlin, Germany over a four-day period from November 30 to December 3, 2009. As in previous years, JATCO employees participated in this event, giving a keynote speech and a technical presentation. The keynote speech began with a historical review of the development of CVTs and their prospects for future progress. The speaker also gave a preliminary introduction of the new next-generation CVT and touched on the CVT supply system in China, including JATCO's plant in Guangzhou. The technical presentation described an analysis technique for predicting ATF behavior around the breather chamber and the shaft, using a fluid analysis simulation program in which a particle method is applied to treat the fluid as particles. This technique is aimed at mitigating ATF splattering in the transmission case by visualizing fluid behavior and at reducing the modeling time and effort.

12. Participation in a work-life balance symposium

A work-life balance symposium, sponsored by the Shizuoka office of the Japan Institute of Workers' Evolution, was held at the Shizuoka Prefecture Economy and Industry Hall on Thursday, December 17, 2009.

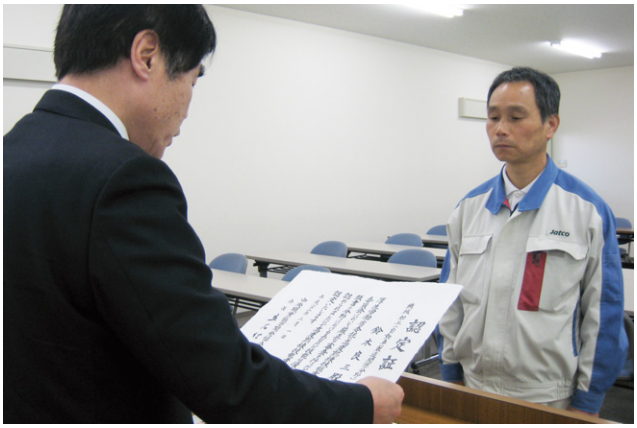
The theme of the discussion was "creating workplaces where various work styles are possible."

13. ジヤトコが交通安全優良事業所全国表彰を受賞 記事協力

2010年1月19日(火)，東京日比谷公会堂において，(財)全日本交通安全協会主催の「第50回交通安全国民運動中央大会」が開催され，ジヤトコは交通安全優良事業所として全国表彰を受賞．今回の受賞数は，全国で92事業所，静岡県では3事業所．この大会は，多年にわたり交通安全活動に尽力し，抜群な功績があった交通安全優良団体，優良事業所，優良学校，優良交通安全運転管理者協議会や，交通安全活動に顕著な功績のあった個人，団体，企業の表彰等も同時に行っているが，創設41年を迎えた富士地区の安全管理協会の中では，ジヤトコが初の受賞となる．

14. 平成21年度高度熟練技能者認定

2010年2月25日(木)，中央職業能力開発協会より認定証及び技能者章の交付及び伝達式が行われ，弊社社員2名が平成21年度高度熟練技能者に認定された．



As a male employee who took a child-rearing leave, Mr. Tanaka talked about the process of gaining the understanding of the company and co-workers by a male employee planning to take a child-rearing leave and the importance of follow-up. He also described how he is now making good use of his leave experience in his work.

A questionnaire conducted among the attendees that day produced many constructive comments, such as "hearing the views of a man who had taken a child-rearing leave was very valuable and instructive."

13. JATCO receives national award as an excellent business establishment for traffic safety

The Japan Traffic Safety Association held its 50th central convention for the national traffic safety campaign at Hibiya Public Hall in Tokyo on Tuesday, January 19, 2010. JATCO received a national award as an excellent business establishment with respect to traffic safety. There were 92 business establishments nationwide and three in Shizuoka prefecture that received this award. This convention commends traffic safety organizations, businesses, schools and councils of traffic safety managers for their excellence and notable accomplishments over many long years of endeavoring to promote traffic safety activities and also simultaneously recognizes individuals, groups and companies that have achieved outstanding results in traffic safety activities. Traffic safety management associations were first established in the Fuji area 41 years ago and JATCO became the first to receive this award.

14. Two JATCO employees certified as high-proficiency skilled workers in fiscal 2009

A ceremony was held on Thursday, February 25, 2010 to present certification certificates and skilled worker badges to persons certified as high-proficiency skilled workers by the Japan Vocational Ability Development Association in fiscal 2009. Two JATCO employees received this certification.

A high-proficiency skilled worker is one who can make high-precision, high-quality products, prototypes and other items using advanced skills for which there is no machine substitute, or one who can

高度熟練技能者とは，機械では代替できない高度な技能を駆使して，高精度･高品質の製品･試作品等を作り出すことが出来る技能者，または機械が作り出す製品と同等以上の高精度･高品質の製品の製造が出来る技能者で，国が認定する制度．

この制度は平成10年度に始まり，自動車部品製造関係では今回の53名を含めこれまでに全国で1049名，ジヤトコでは今回の2名を含め23名が認定されている．

15. 文部科学大臣表彰創意工夫功労賞･富士市優良従業員特別表彰　表彰式

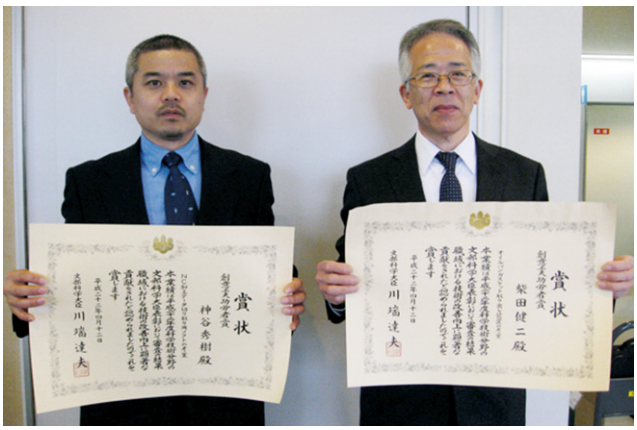
「平成22年度文部科学大臣表彰創意工夫功労者賞」の受賞式が，2010年4月16日(金)に静岡県県庁別館にて行われた．この賞は，職域における創意工夫によって作業能率の向上，品質向上，公害･災害防止など，技術の改善向上に貢献した人に贈られる賞である．

ジヤトコからは，

①NC加工データー切り取り用ソフトの考案 ②オイルパンガスケット取り外し装置の考案 で2名が受賞した．

4月23日(金)には富士商工会議所において，「富士市優良従業員特別表彰」が行われ，前年度文部科学大臣表彰受賞者と静岡県知事表彰受賞者が表彰を受けた．

21年度文部科学大臣表彰　2名
21年度静岡県優秀技能者功労表彰　1名
21年度静岡県知事褒章表彰　1名
の計4名が受賞



manufacture products of high precision and quality equal to or better than the products produced by machines.

This certification is awarded under a national system established in 1998. Including the 53 technicians certified this time, 1,049 technicians involved in auto parts manufacturing have received this certification nationwide to date. At JATCO, 23 persons have now been certified, including the latest two.

15. Minister of Education, Culture, Sports, Science and Technology Award for Originality and Invention and Fuji City's Special Award for Outstanding Employees

The Minister of Education, Culture, Sports, Science and Technology Award for Originality and Innovation in fiscal 2010 was presented to recipients in a ceremony held in the Annex of the Shizuoka Prefectural Government Office on Friday, April 16, 2010. This award is given to persons who have contributed to improving or advancing technology, such as by improving work efficiency, enhancing quality or preventing pollution or disasters through the exercise of originality or invention in occupational fields.

Two JATCO employees received this award for (1) creation of software for cutting/pasting NC machining data and (2) creation of a device for removing oil pan gaskets.

Fuji City's Special Award for Outstanding Employees was presented in a ceremony held at the Fuji City Chamber of Commerce and Industry on Friday, April 23. Four JATCO employees were recipients of the following awards.

Fiscal 2009 Minister of Education, Culture, Sports, Science and Technology Award: 2 persons
Fiscal 2009 Shizuoka Governor's Outstanding Technician Award: 1 person
Fiscal 2009 Shizuoka Governor's Medal of Honor: 1 person

16.【横浜F･マリノス】エスコートキッズ＆フラッグベアラーに参加

2010年5月1日(土)，日産スタジアムにおいて「横浜F･マリノス vs ジュビロ磐田」戦が行われ，ジヤトコグループ社員の子供たちが選手入場を盛り上げるエスコートキッズ＆フラッグベアラーとして参加した．

多数の応募者の中から，エスコートキッズ11名とフラッグベアラー6名が当選し，Jリーガーがプレーする夢の日産スタジアムのピッチに登場．晴れわたる青空の下，エスコートキッズはF･マリノスの選手入場を盛り上げ，フラッグベアラーはフェアプレーフラッグを携えフェアプレーをアピールした．

17. 人とくるまのテクノロジー展2010に出展

2010年 5月19日(水)～21日(金)，パシフィコ横浜において「人とくるまのテクノロジー展2010」が開催された．ジヤトコは「環境CVTのジヤトコ」をテーマにCVTフルラインナップを展示し，CVTの優れた環境性能を紹介した．

CVT(無段変速機)生産台数世界一のジヤトコは，『環境CVTのジヤトコ』をテーマに，世界初の副変速機付CVTをはじめとして，軽自動車用から3.5リッタークラス大型車用までのベルトCVTフルラインナップを展示，CVTの優れた環境性能を紹介した．

また，FR7速ATをベースとした新開発のハイブリッド車用トランスミッションも出展．

ジヤトコは，CVT性能向上のための研究開発や，エンジンとの協調制御の最適化，ユニットの小型軽量化等，燃費向上と快適な走りの提供に貢献する技術開発を広く紹介した． また，今年は国内のみ

16. Serving as Yokohama F-Marinos player escorts and flag bearers

Children of JATCO Group employees served as player escorts and flag bearers at a soccer match between Yokohama F-Marinos and Jubilo Iwata held at Nissan Stadium on Saturday, May 1, 2010. From among many applicants, 11 children were chosen to be player escorts and six to be flag bearers, enabling them to gain the unforgettable experience of appearing on the pitch of Nissan Stadium where official J League soccer matches are played. Under a sunny blue sky, the children escorted the players onto the pitch and carried fair play flags emphasizing good sportsmanship, all of which added to the excitement of the pre-match ceremony.

17. JATCO exhibits at 2010 Automotive Engineering Exposition

The 2010 Automotive Engineering Exposition was held at Pacifico Yokohama from Wednesday-Friday, May 19-21, 2010. JATCO displayed its full CVT lineup, publicizing the outstanding environmental performance of CVTs under the theme of "JATCO, CVTs for the Environment."

As the world's leading producer of CVTs, JATCO presented its complete lineup of steel-belt CVTs designed for use on vehicles ranging from minicars to large 3.5-liter passenger vehicles. The exhibits included the new next-generation CVT, the world's first CVT to feature an auxiliary transmission. In keeping with the theme of "JATCO, CVTs for the Environment," the exhibits served to introduce the superior environmental advantages of CVTs. Also on display was the newly developed hybrid vehicle transmission based on a 7-speed AT for rear-drive cars.

The exhibits publicized JATCO's wide-ranging efforts to develop technologies contributing to the provision of both improved fuel economy and driving comfort, including R&D work for enhancing CVT performance, optimizing cooperative engine/transmission control, and reducing the size and weight of transmissions. In addition to Japanese exhibitors, many overseas companies also displayed their products at this year's exposition. The venue was

ならず海外からも多くの企業が出展し，たくさんの業界関係者が会場を埋めつくし熱気あふれる展示会となった．

18. 自技会2010春季大会で論文発表

2010年 5月19日(水)～21日(金)，パシフィコ横浜 会議センターにおいて，自動車技術会2010春季大会が開催された．講演発表数438編95セッション，参加登録者数のべ4,339名という盛大な大会において，【EOCを目指した次世代小型CVT】として弊社からも論文発表が行われた．

19. 平成22年度 日本塑性加工学会 技術賞受賞

2010年5月28日(金)，東京都調布市にある電気通信大学において，平成22年度日本塑性加工学会 春季講演会と贈賞式が行われ，ジヤトコは「熱間鍛造による歯型一体CVT PULLYの開発」で技術賞を受賞した．

filled with people involved with the automotive industry, making the exposition a very lively and exciting event.

18. Presentation at JSAE 2010 Annual Spring Congress

The Society of Automotive Engineers of Japan (JSAE) held its 2010 Annual Spring Congress at the Pacifico Yokohama Convention Center from Wednesday-Friday, May 19-21, 2010. There were a total of 4,339 registered attendees at this large convention where 438 presentations were given in 95 different sessions. JATCO employees presented a paper entitled "Next-generation small CVT aimed at eco-friendliness."

19. Receives a Technology Award at the fiscal 2010 spring conference of the Japan Society for Technology of Plasticity

The Japan Society for Technology of Plasticity held its 2010 spring conference and awards ceremony at the University of Electro-Communications in Chofu City in Tokyo on Friday, May 28, 2010. JATCO received a technology award for the "development of an integrated parking gear-CVT pulley produced by hot forging."
(Evaluation details)
Two aspects were highly evaluated regarding the forming of parts with difficult shapes like an integrated parking gear and CVT pulley. One was the reduction of the environmental impact by adopting a non-graphite die lubricant. The other was the reduction of the number of forging trials by drawing upon the abilities of highly skilled employees to combine simulation results with experimental data.

【評価内容】
歯型一体PULLYのような難形状部品において，非黒鉛系潤滑剤採用による環境負荷低減と，シミュレーションの結果と実データを熟練技術者のスキルにより融合したことによる試作回数低減が評価された．

20. 田宿川で鮎の稚魚放流

2010年6月18日(金)に「いまいづみ幼稚園」年長組園児の皆さんの協力で，富士市を流れる田宿川に鮎の稚魚400尾を放流した．放流した鮎の稚魚は，社員が6月の環境月間期間中に自宅から持ち寄ったアルミ缶を売却し，その売却益を購入資金の一部にあてている．稚魚放流後には，幼稚園の先生方とジヤトコ社員による，「川を大切にしよう!」をテーマにした演劇を行い，小さな子供たちに自然の大切さをアピールした．

21. ジヤトコ広州でCVT累計生産10万台達成記念式典開催

2010年6月23日(水)，ジヤトコ広州でCVT累計生産台数が10万台に達したことを記念し，「CVT累計生産10万台達成記念式典」が開催された．ジヤトコ広州では，2009年9月よりJF011Eの本格生産を開始し，東風日産のティアナ(中国名:天籟)，シルフィ(同:軒逸)などに搭載され，2010年6月に生産10万台を達成した．

20. Release of juvenile sweetfish in the Tajuku River

With the help of the older children at the Imaizumi Kindergarten, 400 juvenile sweetfish were released in the Tajuku River that flows through the city of Fuji on Friday, June 18, 2010. The funds for purchasing these sweetfish juveniles came partly from the proceeds of selling aluminum cans that JATCO employees collected and brought from their homes during the Environment Month of June. After releasing the juvenile sweetfish, the kindergarten teachers and JATCO employees performed a play on the theme of "let's treasure the river" to emphasize the importance of nature to the small children.

21. Ceremony held to celebrate JATCO Guangzhou's cumulative CVT production milestone of 10,000 units

A ceremony was held at JATCO Guangzhou on Wednesday, June 23, 2010 to celebrate the attainment of cumulative CVT production of 10,000 units. JATCO Guangzhou launched full-fledged production of the JF011E in September 2009 and reached the 10,000 unit milestone in June 2010. Its CVTs are fitted on the Teana (Chinese model name: Tian Lai) and Sylphy (Chinese model name: Xuanyi) produced by Dongfeng Nissan Passenger Vehicle Co.

22. Receives Shizuoka Governor's Medal of Honor for activities related to the creation of a gender-equal society in Shizuoka in fiscal 2010

Individuals, organizations and publicly committed businesses that are working vigorously in Shizuoka prefecture to promote equal social participation by men and women as well as individual women and

22. 平成22年度静岡県男女共同参画社会づくり活動に関する知事褒賞を受賞

静岡県では，「静岡県男女共同参画推進条例」に基づき，男女共同参画の推進に関する取組を積極的に行っている個人・団体・宣言事業所の皆さんや，チャレンジした女性個人・女性団体を表彰しているが，ジヤトコは平成22年度静岡県男女共同参画社会づくり活動に関する知事褒賞を受賞し，7月22日（木）静岡県庁知事室において表彰された．

今回当社が受賞したのは，以下の理由による．

活動への取組 ⇒ 女性のポジティブアクション・職域拡大への取組

・経営幹部をメンバーとするダイバーシティ・ステアリング・コミッティを設置し，目標値をもって活動に取り組んでいる．
・社内公募制度により，性別に関わらず，意欲ある社員の積極的な形での配置を実施．
・ダイバーシティに関するアンケート実施により，女性活躍推進における課題を明確化し，解決に向けた取組
（ダイバーシティフォーラム・ロールモデルの紹介等）を実施．

仕事と家庭の両立を図るための取組

・ライフサポート休暇（年間12日）を半日単位取得可能に，また育児に関わる利用時期を小学校6年生年度末までに制度改定．（H22から）
・育児のための就業時間短縮の対象年齢を小学校3年生から6年生年度末までに引き上げ．
・労組代表と人事部で構成する「両立支援に関す

women's groups have been commended for the challenges they have undertaken. Such recognition is based on an ordinance to promote gender-free participation in society in Shizuoka prefecture. JATCO received the Shizuoka Governor's Medal of Honor for promoting activities to create a gender-equal society in Shizuoka in fiscal 2010. The award was presented in the Governor's office at the Shizuoka Prefectural Government Office on Thursday, July 22, 2010. The reasons why JATCO received this award are explained below.

Activity commitment: Positive action directed at women and efforts to expand their work areas

- Establishment of a diversity steering committee with senior executives as members and the promotion of activities that have numerical targets.
- Vigorous assignment of motivated employees regardless of gender, based on a system of open internal recruitment.
- Undertaking a questionnaire concerning diversity to clarify the issues involved in promoting women's active involvement and making efforts to resolve such issues, including defining role models and conducting a diversity forum.

Efforts to facilitate both work and family

- Revision of the employment system to allow days-off for family support (12 days annually) to be taken on a half-day basis and child-rearing leave to be used until children reach the end of sixth grade of elementary school (beginning from fiscal 2010).
- Extending the period of shorter working hours allowed for child rearing from third grade to the end of sixth grade of elementary school.
- Establishment of a labor-management committee composed of labor union representatives and the personnel department to study ways of supporting both work and family, and the implementation of studies and activities to create employee-friendly systems and workplace environments.
- Granting of child-rearing leave to two male employees in fiscal 2009 and acquisition of the Kurumin Mark certification for efforts conducive to the rearing of children as the next generation.

JATCO will continue its activities to make

る労使検討委員会」を設置し，誰もが働きやすい制度と職場環境について検討，推進活動を実施.
・平成21年度に男性育児休業取得者2名あり，次世代育成認定マーク「くるみん」取得.

当社は性別･国籍･年齢･学歴など，あらゆる領域の多様性を，受け入れて最大限に活用するダイバーシティ活動を今後も推進していく.

23. 厚木地区地域貢献活動(=ナイスウェーブ)
～茅ヶ崎ビーチクリーン活動参加～

2009年7月25日，当日は海風を受けながら，地元の方，ボランティア団体の皆さん達と一緒になって，砂浜に漂着したゴミや訪れた人が捨てたゴミを拾い集めた．ゴミと格闘すること約1時間，砂浜はすっかりきれいに．子供たちも大活躍で，気持ちのいい夏の一日となった.

24. 輝け！未来のエンジニア！
「キッズエンジニア2010」に出展

7月30日(金)･31日(土)の両日，パシフィコ横浜において自動車技術会の主催による，「キッズエンジニア2010」が開催された．今年は，教室型のプログラムが21件，展示型プログラム11件，その他1件，合計32件のプログラムが企画運営され，約6,500名

maximum use of diversity by welcoming diversity in every area regardless of gender, nationality, age, educational experience or other aspects.

23. Participation in Chigasaki "Nice Wave" beach cleanup: Contributing to the Atsugi area community

JATCO employees and family members joined local residents and members of volunteer organizations on July 25, 2009 in collecting trash that had washed ashore on the sandy beach or had been discarded by people. After struggling with piles of trash for approximately an hour amidst a sea breeze, the sandy beach was completely clean. The children also worked hard and everyone enjoyed a pleasant summer day on the beach.

24. Participation in Kid Engineers 2010 for budding future engineers

The Society of Automotive Engineers of Japan sponsored Kid Engineers 2010 at Pacifico Yokohama on Friday-Saturday, July 30-31, 2010. A total of 32 programs were planned and carried out, including 21 classroom-type activities, 11 exhibition activities and

の来場があった．ジヤトコからは講師2名，コーチ12名が参加し，「遊星ギヤって何だろう?」と題した教室型プログラムを実施．

2日間で200名を超えるキッズエンジニアが誕生した．

25. 厚木地区地域貢献活動～あつぎ鮎祭早朝清掃～

8月6日･7日，あつぎ鮎祭り花火大会の翌日早朝，社員の家族や他のボランティア団体と一緒に会場の清掃ボランティア活動を行った．あつぎ鮎まつりのメインイベントである大花火大会は県内最大規模の花火大会のひとつであり，年々盛大になっているが，その一方会場となる相模川河川敷には毎年祭り終了後に膨大なゴミが残ることから，ボランティアによって大規模な清掃活動が行われている．

Before

After

26. 富士山一斉清掃活動に参加

8月22日(日)，富士山富士宮口で「富士山をいつまでも美しくする会」主催の，富士山一斉清掃活動が行われ，ジヤトコからは富士宮工場を中心に55名が参加し，富士山5合目をスタートし宝永山火口付近を経由，遊歩道を廻ってスタート地点に戻るコースを清掃した．

登山者の意識向上により，ゴミは年々減少しているとはいえ，まだ多くのタバコのフィルターやビニル袋等が回収された．

one other activity. This event attracted some 6,500 attendees. JATCO provided two instructors and twelve coaches who undertook a classroom-type program focused on the question: "What in the world are planetary gears?" The program produced over 200 kid engineers during the two-day event.

25. Participation in early morning cleanup after Atsugi Ayu Festival: Contributing to the Atsugi area community

JATCO employees and family members took part in an early morning cleanup of the fireworks display site of the Atsugi Ayu Festival on August 6-7, 2010, together with members of other volunteer organizations. As one of the main events of the Atsugi Ayu Festival, the fireworks display is one of the biggest in Shizuoka prefecture and is increasing in scale every year. However, the dry riverbed of the Sagami River where the fireworks display is held is littered with mountains of trash every year after the festival, so volunteers gather to undertake a large-scale cleanup operation.

26. Participation in a general cleanup of Mt. Fuji

A general cleanup of Mt. Fuji was carried out on Sunday, August 22, 2010, organized by a group dedicated to keeping Mt. Fuji beautiful forever. Volunteers met at the starting point of the Fujinomiya Trail for climbing the mountain. Fifty-five JATCO employees, mainly from the Fujinomiya Plant, took part in this activity. They cleaned the course that begins at the fifth station on Mt. Fuji, skirts the Hoeizan Crater and returns to the starting point again via the hiking trail. Although the amount of trash has

27. 自動車技術会2009年度技術部門貢献賞を受賞

2010年8月23日(月)開催の自動車技術会技術会議合同会議において，2009年度技術部門貢献賞の受賞式がおこなわれた．昨年新たに創設されたばかりのこの賞は，技術会議傘下の部門委員会活動において多大な貢献を認められた方に贈る賞で，部門委員会活動の活性化を図る目的で創設されたもの．ジヤトコから1名が受賞した．

been decreasing every year thanks to the increased awareness of climbers, JATCO employees still collected lots of cigarette filters, plastic bags and other items.

27. Recipient of JSAE Technology Contribution Award for fiscal 2009

A ceremony was held on Monday August 23, 2010 to present the fiscal 2009 Technology Contribution Awards at a joint meeting of the committees under the Engineering and Professional Development Group of the Society of Automotive Engineers of Japan (JSAE). This award was newly established last year and is given to persons who are recognized for having made significant contributions in the activities of the Group's various committees. It was established with the aim of encouraging vigorous committee activities. One JATCO employee was honored with this award.

特　許　紹　介

Patents

オイルポンプ駆動機構

（Fig. 1）

出　願：出願日　2004.5.17　特願2004-146827
登　録：登録日　2008.4.18　特許第4113159号
名　称：オイルポンプ駆動機構
発明者：部品システム開発部 石川 昌範, 高橋祐二,
　　要素信頼性グループ 征矢 啓

Oil pump drive mechanism

(Fig. 1)

Application Number: 2004-146827
Application Date: 5.17,2004
Patent Number: 4113159
Registration Date: 4.18,2008
Title: Oil pump drive mechanism
Inventor: Ishikawa Masanori
(Hardware System Development Department)
Yuji Takahashi
(Hardware System Development Department)
Soya Hiromu
(Product Reliability Experiment Group)

【目的】

軸方向の寸法増大を抑えたオイルポンプ駆動機構の提供.

【発明の構成】

オイルポンプ駆動軸に設けられた第2スプロケット（図示せず）には，エンジンの駆動により回転するトルコンスリーブ23と嵌合した第1スプロケット34からチェーンを介して駆動を伝達している．トルコンスリーブ23には軸方向に延在された駆動爪23bを設け，第一スプロケット34のトルクコンバータ側の側面に開口した凹部34bに挿入嵌合させている.

【作用・効果】

駆動爪23bと凹部34bの少なくとも一部をオーバーラップして配置（:挿入嵌合）することで，第一スプロケット34とトルコンスリーブ23との嵌合構造において，軸方向の寸法増大を抑えている.

【SUMMARY OF THE INVENTION】

An oil pump driving apparatus including a rotation shaft in driving connection with a torque converter, a drive sprocket 34 rotatable about the rotation shaft and adapted to be connected with a driven sprocket disposed on the oil pump via the chain, a torque converter sleeve 23 disposed on a radial outside of the rotation shaft so as to be rotatable together with the torque converter, the torque converter sleeve 23 being engaged with the drive sprocket 34.

Recessed portion 34b of sprocket 34 axially extends to be open to at least an axial end face of sprocket 34, sprocket drive projections 23b of torque converter sleeve 23 is received in recessed portion 34b through the end opening. This arrangement can avoid increase in axial length of torque converter sleeve 23.

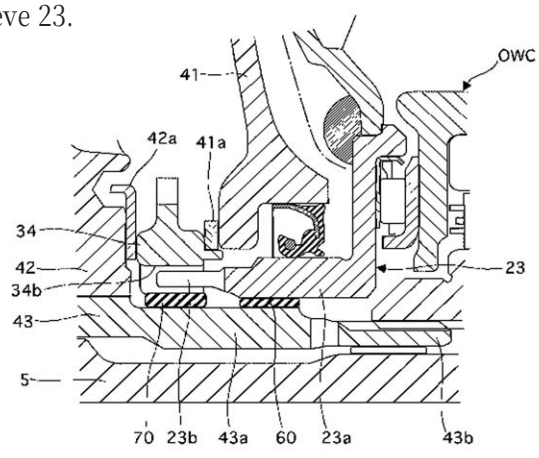


Fig. 1

ベルト式無段変速機

（Fig. 1）

出　願：出願日　2004.9.24　特願2004-278029
登　録：登録日　2008.8.1　特許第4164057号
名　称：ベルト式無段変速機
発明者：（退職）　山口　緑
先行技術開発室　兒玉　仁寿
日産　菊池　雅彦

belt-type continuously-variable transmission

(Fig. 1)

Application Number: 2004-278029
Application Date: 9.24,2004
Patent Number: 4164057
Registration Date: 8.1,2008
Title: belt-type continuously-variable transmission
Inventor: Yamaguchi Midori (Resigned from Jatco)
Kodama Yoshihisa
(Advanced Technology Development Office)
Kikuchi Masahiko (Nissan)

【目的】

油圧ポンプの負荷を抑制し，燃費を向上させる.

【発明の構成】

目標変速速度を決定する処理部B1と，プーリストローク速度倍率を求める処理部B2と，目標変速速度にプーリストローク速度倍率を乗算してプーリの目標ストローク速度を算出する処理部B3と，プライマリプーリの目標プーリ回転速度を求める処理部B4と，プライマリプーリの回転に対するプーリの目標ストローク量変化分を算出する処理部B5と，目標プーリ1回転当たりの目標ストローク量変化分に応じたプーリの過渡推力補正量を求める処理部B6とを備え，過渡推力補正量と定常推力を加算することによって，目標ストローク速度に応じて目標変速速度を達成する過渡油圧を算出する.

【作用・効果】

変速に必要な差推力を必要最小限の値に近づけられ，油圧ポンプの負荷を抑えてエンジンの燃費を低減することができる.

【SUMMARY OF THE INVENTION】

This belt type continuously variable transmission comprises a processing part B1 for deciding a target gear change speed, a processing part B2 for determining a pulley stroke speed magnification, a processing part B3 for calculating a target stroke speed of a pulley by multiplying the target gear change speed by the pulley stroke speed magnification, a processing part B4 for determining a target pulley rotating speed of a primary pulley, a processing part B5 for calculating a target stroke changed portion of the pulley to the rotation of the primary pulley, and a processing part B6 for determining transient thrust correcting quantity of the pulley corresponding to the target stroke changed portion per target pulley one rotation, transient thrust correcting quantity determined in up-shifting is added to steady thrust.

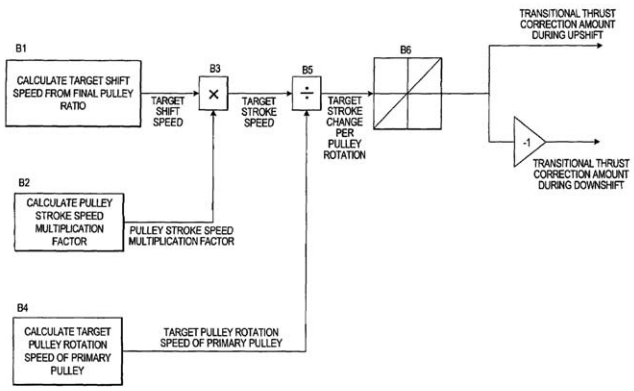


Fig. 1

社外技術発表一覧 （2010年1月1日～2010年12月31日）

発表月日	発表先	表題	発表者	
2010/1/29	(社)日本課車工業会 西日本支部　講演会	ジヤトコ(株)における 歯車製造技術の変遷	ユニット技術部	蔭山　二郎
2010/2/24	AMESim ハイドロリックセミナー	AMESim油圧モデルのT/M性能 検討への応用	解析技術センター	佐野　孝
2010/3/5	自動車技術会　関東支部 学術研究講演会	自動車用自動変速機の遊星歯車 及び多板クラッチの構造成立性 判定に関する研究	先行技術開発室 先行技術開発室	奥田　隆之 青田　和明
2010/3/5	自動車技術会　関東支部 学術研究講演会	ジヤトコ(株)の箱物軽量化に 対する取組み (生産技術開発への品質工学適用)	生産戦略部 生産戦略部 部品システム開発部	安納　義治 森　秀伸 平野　聡
2010/3/5	自動車技術会　関東支部 学術研究講演会	無段変速機による燃費改善	プロジェクト推進室	和田　恭平
2010/4/23	2010 International Symposium on Transmission Innovation and China Industrialization	JATCO Production System and Engineering Innovation of CVT	ジヤトコ株式会社	黒沢　実
2010/5/20	自動車技術会　春季大会	ECOを目指した 次世代新小型CVT	プロジェクト推進室 プロジェクト推進室 制御システム開発部 実験部 部品システム開発部	浦田　武史 中野　晴久 江口　岳 小島　克己 黒田　正二郎
2010/5/28	塑性加工春季講演会	熱間鍛造による歯形一体 CVT PULLEYの開発	部品技術部 生産管理部 部品技術部 部品技術部 部品技術部 部品技術部	斉藤　巌 加藤　直樹 砂﨑　貴人 竹下　達視 田澤　純 小野　良介
2010/6/8	4th CTI Symposium & Exhibition Automotive Transmissions and Drive Trains North America	New Next-generation small CVT designed for Eco-friendliness	部品システム開発部 プロジェクト推進室 プロジェクト推進室	立石　純一郎 中野　晴久 浦田　武史
2010/6/8	CDAJ CAE Solution Conference 2010 STAR Conference Day	圧縮性を考慮したVOF法のオート マチックトランスミッション 開発への適用	部品システム開発部	島田　勝
2010/6/18	KFPS-韓国油空圧System学会	自動変速機用VANE PUMPの吐 出圧NOISE特性解析 The Analysis of Discharge Pressure Noise Characteristics of Vane Pump for Automatic Transmission	JKE JKE JKE JKE	崔　潤龍 崔　浩種 李　尙炫 鄭　宇辰

発表月日	発表先	表題	発表者	
2010/6/18	KFPS-韓国油空圧System学会	自動変速機用SOLENOIDバルブの温度による電流(I)-制御圧(P)特性分析 Analysis of I-P characteristics change depending on temperature of solenoid valve for automatic transmission	JKE JKE JKE JKE	崔　潤龍 徐　承賢 李　尙炫 梁　幸植
2010/6/24	第53回 インターモールド・テクニカル・セミナー	トランスミッションケースの軽量化への取り組み	部品技術部 部品システム開発部	安納　義治 平野　聡
2010/7/26	日本機械学会 第2回歯車分科会	ギヤホーニング歯面仕上げ精度の向上について	部品技術部	松尾　浩司
2010/9/14	3rd ASIAFORGE MEETING	FORGING OF ENVIRONMENTALLY FRIENDLY CVT PULLEYS	部品技術部	廣藤　雅俊
2010/9/21	Metal Forming 2010	Resistance Heating of Side Wall of Cup for Warm and Hot Spline Forming	試作部 豊橋技術科学大学 三重大学 豊橋技術科学大学	上野　完治 森　謙一郎 牧　清二郎 有澤　直孝
2010/10/1	KFPS-韓国油空圧System学会	CAEを利用したCVT制御システムのバーチャル開発 Virtual Development of CVT Control System using CAE	JKE JKE JKE 解析技術センター 解析技術センター 解析技術センター	崔　潤龍 李　尙炫 鄭　宇辰 佐野　孝 勝　生水 渡邉　友晴
2010/10/2	日本鋳造工学会 第157回全国講演大会	鋳造金型の寿命向上技術開発	生産戦略部 生産戦略部	森　秀伸 畠山　武
2010/10/14	2010年DAFUL User Conference	CVT ベルトの挙動解析 The behavior analysis of the CVT belt	JKE JKE	張　泳夏 權　炳熙
2010/10/21	Henkel Global Powertrain Symposium	Innovation of Transmission	部品システム開発部	岡田　克彦
2010/10/28	第20回　設計工学・システム部門講演会	物理量次元インデクシングによる知識マネジメントの製品設計への応用 － FTA支援ツールの開発と適応事例 －	品質企画管理部 品質企画管理部	山本　克成 平岡　洋二
2010/10/28	第20回　設計工学・システム部門講演会	パネルディスカッション ‘ 価値創造のためのデザイン ’ －製品設計の課題と設計手法－	品質企画管理部 東芝 産総研 ソニー	平岡　洋二 大富　浩一 手塚　明 関　研一

発表月日	発表先	表題	発表者	
2010/11/2	自動車技術会 動力伝達系の最新技術2010	燃費と走りの良さを目指した 副変速機付きCVT	実験部 実験部 制御システム開発部	篠原　史 田中　寛康 野々村　良輔
2010/11/17	CVT/HEV2010	Light weighted, small, low friction & wide ratio coverage New CVT	ジヤトコ株式会社	土井　利政
2010/11/30	9th International CTI Symposium Innovative Automotive Transmissions	CVT Technological Development Capabilities to Meet Complex Market Requirements	ジヤトコ株式会社	野間　一俊
2010/11/30	9th International CTI Symposium Innovative Automotive Transmissions	Fuel Economy Improvement Technology and Control System in New-Generation Small CVT	制御システム開発部	野々村　良輔

社外技術発表（論文投稿）一覧 （2010年1月1日～2010年12月31日）

発表月日	発表先	表題	発表者	
2010/1/15	雑誌　汽车制造业(自動車製造業) 2010年第1/2期の合併号	実効的なCO_2削減を目指した CVT普及のとりくみ	商品開発室	服部　昇
2010/1/22	日本機械学会 (P-SCD359)歯車の高機能化と加工技術に関する調査研究分科会研究成果報告書	トランスミッション製造現場におけるギヤ音評価と問題点	ユニット技術部	蔭山　二郎
2010年5月	(社)日本塑性加工学会 塑性と加工	変速機用歯形部品の鍛造加工における工程設計	試作部 部品技術部 部品技術部 部品技術部 日産自動車(株) 豊橋技術科学大学	上野　完治 田澤　純 小野山　浩一 斎藤　巌 藤川　真一郎 森　謙一郎
2010/12号	塑性加工学会誌　特集号 「学会賞受賞記念特集号」12月号	熱間鍛造による歯形一体CVT PULLEYの開発	部品技術部 生産管理部 経営企画部 部品技術部 部品技術部 部品技術部	斉藤　巌 加藤　直樹 砂﨑　貴人 竹下　達視 田澤　純 小野　良介
2011年2月号	ターボ機械協会	自動車用トルクコンバータ・ステータの低速度比領域における流れ特性	部品システム開発部 千葉工業大学	岡田　克彦 江尻　英二

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