Canadian Automotive Repair and Service

Service d'Entretien et de Réparation Automobiles du Canada

Technology Advancements and the Impact on Skills Development for the Motive Power Repair and Service Industry Workforce

Final Report

October, 2009

Convergence Management Consultants Ltd.
289 - 1054 Centre St.
Thornhill, Ontario, Canada L4J 8E5
(T) 905-881-7463; (I): www.converge.ca

23 October, 2009

Ms. Jennifer Steeves
CARS Council
203 – 57 Auriga Dr.
Ottawa, Ontario K2E 8B2

Dear Ms. Steeves,

Re: Technology Advancements and the Impact on Skills Development for the Motive Power Repair and Service Industry Workforce Final Report

It is with pleasure that we provide our final report for the above-mentioned study.

This document includes our findings from Phase 1 research into the new vehicle and business technologies impacting the Motive Power Repair and Service Industry. It also includes relevant results from the 2009 Labour Market Update research with employers and employees conducted for CARS in parallel with, but separate from this engagement, supplemented by Phase 2 research conducted for this project.

Research with employers considers awareness of key emerging technologies and their preparedness to address the associated implications in respect of, for example, skills and training. Research with employees explores their awareness of the key technologies identified in the first phase of this project, the extent to which they have detailed knowledge, skills and training, the gaps they themselves perceive, the willingness of these employees to engage in upgrading themselves, and the training formats/channels they would wish to use.

This assignment has found the following:

- Employers perceive all new vehicle technologies dictate some amount of knowledge and skills upgrading for staff. Similarly, employees perceive that they will need to obtain new knowledge or enhanced skills to do their jobs and to cope with the new vehicle technologies that will be introduced over the next three years.

- Employers' perceptions as to the amount of knowledge and skills upgrading required by new vehicle technologies do not differ significantly by region and employers' intentions towards investments in business technologies also do not differ significantly by region.

- Employers' perceptions as to the amount of knowledge and skills upgrading required by new vehicle technologies and their planned investments in new business technologies do differ by subsector. Similarly, when considering employees' perceptions by subsector, it can be seen that employees in the different subsectors perceive the need for knowledge and skills upgrading differently.

- Automotive Service and Repair Shops and Parts Wholesalers, Retailers and Recyclers perceive onboard electronics, hybrid electric vehicles and diagnostics as areas of emphasis. These shops are less concerned with improvements in paint, frame and metal construction and lightweight and new materials but Collision Repair Shops view these last-mentioned areas to be of importance.

- There are many new vehicle technologies with which employees must contend and the amount and pace of change of vehicle technology advancements and new business technologies impact the workforce in all subsectors and occupations within the industry.

- Employers and employees generally understand the important need for knowledge and skills upgrading but employers are concerned with their companies' ability to afford and employees are concerned with their employers' ability to provide the training and facilities necessary to stay abreast of all the changes in technology underway in the industry.

- Clearly, the ability of repair, service and collision employees to adapt to the coming new vehicle and business technologies will depend in part on these employees having the appropriate tools, equipment and other relevant technologies, and training to perform their roles.

- It would appear that CARS is ideally positioned to help both employers and employees close the knowledge and skills gap for both new vehicles and business technologies while dealing with employers' cost concerns. CARS' e-learning and distance education provides an opportunity to cost reduce training. CARS could consider providing courses in areas where most of the new technologies are likely to be concentrated. For new vehicle technologies, this means focusing on innovations that relate to engines and fuel, and onboard electronics. Employers are particularly interested in closing their employees' skills gaps in respect of onboard electronics, hybrid electric vehicles and diagnostics.

- New business technologies likely to receive investment from the highest percentage of employers over the next 3 to 5 years include diagnostic systems and equipment; specialized shop floor tools, equipment and rooms; and Customer Relationship Management (CRM) systems. CARS might consider how best to assist employers in this respect. Options for consideration could include partnering with business technology vendors.

- Employers are generally interested in collaborating to identify and share best practices for managing human resources challenges brought about by technology advancements. There is potential to launch a Technology Roadmap if the benefits of such an initiative are clearly identified and described, and opinion leaders are involved early on.

Please let us know if you would like to discuss any aspect of this report.

We appreciate the opportunity to work with you and the Advisory Group on this most important assignment.

Sincerely,

Ian Gordon for
Convergence Management Consultants Ltd.

Acknowledgements

Convergence Management Consultants Ltd. wishes to acknowledge and thank the Canadian Automotive Repair and Service (CARS) Council and the Advisory Group that guided this assignment to a successful conclusion:

- Ms. Jennifer Steeves, Executive Director, CARS Council
- Ms. Sandra Allin, Industry Development Officer, Industry Canada Business Development Directorate, Government of Canada
- Ms. Heidi Bungay, Senior Analyst, Sector Council Program Division, HRSDC, Government of Canada
- Mr. Tony Canadé, President and Chief Operating Officer, Assured Automotive
- Mr. Dale Finch, Executive Vice President, National Automotive Trades Association of Canada (NATA)
- Mr. John Montgomery, Director, Customer Satisfaction, Volvo Trucks Canada Inc.
- Ms. Deborah Moynes-Keshen, Vice President, AIA Canada
- Mr. Douglas A. Muir, Canadian Council of Directors of Apprenticeship
- Mr. Phil Myers, Manager, Automotive Education, Canadian Tire Corporation, Ltd.
- Mr. Ed Nasello, Project Manager, CARS Council
- Mr. Robert Ouellet, Directeur général, Conseil provincial des comités paritaires de l'industrie des services automobiles,
- Ms. Corrie Robley, Executive Director, Nova Scotia Automotive Human Resource Sector Council
- Mr. Bob Stirling, AC Delco TSS & Import Product Manager, General Motors of Canada Ltd., Service Parts Operations
- Mr. Norm Thurston, Senior Manager, Training, Honda Canada Inc.
- Mr. John Watt, Manager, Certigard and Automotive, Petro-Canada Certigard
- Mr. Peter Woodall, Chairperson, Automotive and Motorcycle Programs, School of Transportation, Centennial College
- Ms. Christine Da Prat, Vice President and Managing Partner, Association Strategy Group and Project Manager, CARS Council

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1.0 Executive Summary

1.1 Introduction and Objectives

This report is the final deliverable of an engagement which has as its main goal the identification of critical skills needed today and in the next three to five years in response to the advanced technologies that are already or soon will be implemented in the automobile and/or light truck repair and service, collision repair, medium and/or heavy truck repair and service, and parts provisioning subsectors. More specifically, the study:

- determines the critical technologies currently impacting the workforce and those to be introduced within the next three to five years;
- identifies the major barriers and constraints, related to technology, and to the future development of the industry's businesses;
- identifies the critical skills needed now and in the next three to five years to work with new technologies; and,
- determines the industry's interest in the identification and sharing of best practices in managing human resource challenges brought about by technology advancements.

1.2 Method

The assignment was conducted in two study phases:

- Phase 1: Identification of the technological advancements impacting the industry; and
- Phase 2: Exploration of the current and future skills and knowledge needs of the workforce to work with the technologies identified in Phase 1.

The tasks in the first phase included secondary research and interviews with 56 industry stakeholders, including members of the Advisory Committee to benefit from their insight, guidance and direction.

In the second phase, selected research from the 2009 Labour Market Update was incorporated to inform aspects of this engagement. The 2009 Labour Market Update was conducted in parallel with, but separate from this engagement except to the extent that consultants on both projects collaborated to harmonize where appropriate. The Labour Market Update comprised 2181 telephone and online interviews with employers and 1480 employees in the industry. To complement the Labour Market Update, interviews were conducted for this engagement with 66 employers and 43 employees across Canada, randomly selected from a sample frame developed to describe companies in the relevant subsectors.

1.3 Key Findings and Conclusions

1.3.1 Critical technologies currently impacting the workforce and those to be introduced in the next three to five years

There are a large number of new vehicle technologies with which employees in the industry must become or remain familiar to do their work. This project has identified 95 OEM vehicle technologies[1] that have recently been incorporated into, or are likely to be incorporated into new car, light/medium truck and heavy truck vehicles over the next 3 to 5 years.

Business technologies are also proliferating. When considered in association with vehicle technologies, changes anticipated in business technologies further challenge knowledge and skills gaps to be closed by employers and employees, both because of the sheer number of technologies to be understood and the complexity of these technologies.

The sheer number of technologies makes it challenging to address every one of the knowledge and skills gaps that are likely to emerge over the next 3 to 5 years, so it is appropriate to consider areas in which to focus this development. Most of the new vehicle technologies are associated with engines and fuel, and onboard electronics, such as in the engine bays and passenger compartments of vehicles – 74% of the vehicle technologies identified are in these two categories. There may be an opportunity to focus training and skills development in these two areas, depending upon CARS current calendar and curriculum.

In addition, vehicle technologies may be categorized according to the likely scale of adoption and the skills gaps of current employees. From this it may be observed that many of the new OEM technologies in the marketplace over the next 3 to 5 years will be niche technologies that will be of modest scale such as those that will be in high end or specialized vehicles, and about a third of all new technologies will not require much new knowledge for today's workforce, which provides an opportunity to focus training and skills development further.

Over half of the new vehicle technologies are likely to experience intermediate or considerable adoption, and about two thirds of technologies are likely to face a medium to high knowledge gap for today's workforce. Combining these two considerations suggest that knowledge and skills development can be focused, leaving a much smaller number of vehicle technologies for knowledge upgrading or skills enhancement for today's workforce. Lightweight and advanced materials, and hybrid and electric motive power are two areas suggested by this consideration.

1.3.2 Critical skills needed now and in the next three to five years to work with the new technologies

Vehicle Technologies

Employers in Automotive Service and Repair Shops and Parts Wholesalers, Retailers and Recyclers perceive that onboard electronics, hybrid electric vehicles and diagnostics are areas to emphasize skills development. These shops are less concerned with improvements in paint, frame and metal construction and lightweight and new materials, which are areas of interest to employers in Collision Repair Shops on the other hand. Employers in Truck / Transport / Heavy Duty

[1] This excludes technologies that are in the research stage or in concept vehicles where significant adoption is more than five years away, and also excludes subassemblies, components and subcomponents for the technologies, fuels, products or assemblies.

Repair Shops also view onboard electronics and diagnostics as priorities but they are particularly interested in emissions controls.

Like employers, employees also perceive all areas of new vehicle technology will require some amount of knowledge or skills upgrading. Employees' views are also aligned with employers in each subsector as to the technology areas requiring most knowledge and skills upgrading, so it can be concluded that the awareness and interest employers and employees have in closing knowledge and skills gaps are similar.

Business Technologies

Three areas in which new enterprise knowledge will be required to address new business technologies over the next 3 to 5 years are diagnostic systems and equipment; specialized shop floor tools, equipment and rooms; and Customer Relationship Management (CRM) systems.

In addition, employees in specific subsectors seek to close knowledge or skills gaps in areas such as body shop management systems (for employees in auto body collision repair shops), online systems for customers to track vehicle repairs or make appointments over the Internet (heavy truck/trailer collision repair shops) and online procurement and purchasing (parts wholesalers, retailers and recyclers).

1.3.3 Major barriers and constraints related to technology and to the future development of the industry's businesses

The affordability of training is the main constraint faced by employers seeking to address knowledge and skills gaps. Not surprisingly in the context of current economic conditions, employers are most concerned about the state of the Canadian economy and consider this to be the number one factor limiting their ability to effectively address the challenges associated with new vehicle and business technologies. Employers are also concerned with costs such as the cost of training, new equipment, facilities and software.

Employees, on the other hand, are most concerned with actually "getting appropriate training" and "having the right equipment and facilities." Employees perceive cost to be an employer issue, but recognize costs may well limit their employers' ability to provide appropriate training as well as needed facilities and equipment in a timely manner.

The ability of repair, service and collision employees to adapt to the coming new vehicle and business technologies will depend in part on these employees having the appropriate tools, equipment and other relevant technologies, and training to perform their roles.

1.3.4 Industry's interest in the identification and sharing of best practices in managing human resource challenges brought about by technology advancements

Employers generally perceive a need for sharing of best practices for managing human resource challenges brought about by technology advancements although some employers do not wish to do so for competitive reasons. There is also much historical precedence for collaborating to share best practices such as in 20 Groups[2] so there is evidence that many employers are able to get past some of their competitive and other concerns when collaborating.

The Technology Roadmap (TRM) concept is an approach that can result in the identification and sharing of best practices in managing HR challenges. The TRM is a consultative process designed to help industry, its supply-chain, academic and research groups, and governments come together to jointly identify and prioritize the technologies needed to support strategic R&D, marketing and investment decisions. The TRM approach is not well understood in the industry and consideration will need to be given to the effective communication of TRM if such an initiative was launched.

1.4 Options for CARS' Consideration

1.4.1 Courses for new vehicle technology knowledge provision

Given the proliferation of new vehicle and business technologies and the cost and time associated with developing programs to address each knowledge area, there are likely too many areas for CARS to develop and deliver its own courses for complete coverage. Still, there are opportunities to focus course development. It has been noted that many of the new technologies will be associated with engines and fuel, and onboard electronics. In addition, employers perceive that onboard electronics, hybrid electric vehicles and diagnostics are particularly important for emphasizing skills development. This would seem to provide a basis for courses that will be of general interest and widely accepted as important to address.

In addition, each industry subsector has priorities that may merit focused course development and individualized treatment where generic courses are not sufficient. For example, in the collision repair subsector courses for paint and improvements in frame and metal construction appear to be needed. Truck/transport/heavy-duty repair shops want emissions control knowledge and skills upgrading.

CARS could consider these various preferences in the context of CARS' own calendar for training courses to establish whether existing programs provide sufficient coverage and, where gaps exist, it may be appropriate for CARS to evaluate new, upgraded or intensified training for employees.

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2 A "20 Group" comprises 20 or fewer business owners or managers who share knowledge about their respective businesses, on a confidential basis.

1.4.2 Courses for new business technology knowledge provision

High priority areas for employer investment include diagnostic systems and equipment, specialized repair and service and collision tools, equipment and rooms, and customer relationship management systems. Generally, training for business technology in areas such as these is provided by vendors but opportunities may exist for CARS to collaborate with selected vendors to provide training such as this on their behalf.

1.4.3 Cost of training and skills upgrading courses

Employers perceive the health of the economy and the auto industry, and the cost of employee training and new equipment limits their ability to provide training to employees. While the economic considerations are obviously beyond CARS' control, CARS is well positioned to help firms deal with the cost of employee training. CARS' current initiatives, including distance education and e-learning, help cost-reduce training provided by employers and employees likely to access their training via interactive distance education and e-learning, and continued communication of these cost-related benefits would seem to be beneficial and appropriate.

1.4.4 Technology Roadmap

Other than concerns of the competitive nature, many industry participants are willing to share information and collaborate to address relevant human resource knowledge, skills and training issues precipitated by new vehicle and business technologies. The Technology Roadmap (TRM) could apply in this context and has the potential to be a valuable process in the automotive sector if it can accomplish a number of important objectives:

- Add new and relevant knowledge over and above what industry participants already obtain from existing approaches for collaboration and assimilating new content (including that available from CARS),
- Be even more inclusive, involving a wide variety of industry participants who do not presently benefit from other mechanisms for information sharing and knowledge upgrading, and
- Focus on issues of common concern without concentrating heavily on issues which industry participants might consider could affect their competitive positions.

The concept of TRM is not generally or well understood in this sector and employers will need to receive a detailed explanation as to the nature of TRM and to understand the benefits they would derive from participating in a TRM initiative - more than simply sharing of best practices.

2.0 Background and Objectives

This report comprises the final submission for an assignment conducted for the Canadian Automotive Repair and Service (CARS) Council to assess technological changes in new passenger, light-medium truck and heavy truck vehicles and business innovation in the Canadian automotive aftermarket over the next 3 to 5 years, and key implications for human resource skills and training for personnel engaged in vehicle and light truck repair and service, collision repair and parts provisioning.

2.1 Objectives

The overall goal of this study is to identify critical skills needed today and in the next three to five years in response to the advanced technologies that are already or soon will be implemented in the sector. More specifically, the study:

- determines the critical technologies currently impacting the workforce and those to be introduced within the next three to five years;
- identifies the major barriers and constraints, related to technology, and to the future development of the industry's businesses;
- identifies the critical skills needed now and in the next three to five years to work with new technologies; and,
- determines the industry's interest in the identification and sharing of best practices in managing human resource challenges brought about by technology advancements[3].

2.2 New Technologies in the Automotive Sector

Technology development cycles are increasingly being driven not only by factors such as consumer acceptance, safety, cost reduction and fuel economy but increasingly manufacturers are also paying attention to greenhouse gas (GHG) emissions and the near-term challenges of surviving in the current global economic climate. Secondary research suggests that the following will be among some of the near-term changes in technology that will affect new vehicles (automobiles, light trucks and heavy trucks), the service repair and parts functions, automotive industry processes and inter- and intra-organizational collaboration.

- Consumer preference

  Noting consumer interest in adopting the latest technology, vehicle manufacturers continue to provide new technologies. The list of such technologies is becoming progressively longer and includes technologies that respond directly to consumer demand and may have additional benefits, such

[3] Industry Canada has developed a consultative process called a Technology Roadmap to help industry, its supply-chain, academic and research groups, and governments come together to jointly identify and prioritize the technologies needed to support strategic R&D, marketing and investment decisions.

as safety and performance features and benefits. Examples include Global Positioning System (GPS) mapping, satellite-enabled telephony (such as GM's OnStar), heads-up displays (HUD), remote starting systems, rear-seat DVD entertainment systems, navigation systems, rear seat video and audio entertainment systems, capacitative switches[4], self-repairing paint (to undo surface scratches), twin clutches, stolen vehicle slowdown via satellite remote shut-down, and heated windshield washer fluids.

- Safety

  Car manufacturers have gone beyond regulatory requirements and even the advanced technologies of just a few years ago, to equip vehicles with a wide array of new safety technologies. A few years ago technologies such as antilock braking, electronic brake-force distribution, electrochromic (auto-dimming) mirrors, side curtain airbags, traction control and active head restraints were considered state-of-the-art but now even more advanced technologies make these seem less revolutionary. These new technologies include electronically modulated damping of active and adaptive suspension systems, active yaw control, run-flat tires, headlamps that switch from high to low beam when approaching other vehicles, lane departure warnings, blind-side alerts, 4x180 degree cameras, sonar sensors, and tire pressure monitoring systems. Some technologies are yet more exotic, such as pre-collision safety systems that use radar to detect obstacles and, in the event of a pending accident, pretension seatbelts and apply brakes. Technologies such as these are already in some, typically high-end, vehicles[5].

- The regulatory environment and greenhouse gas (GHG) emissions

  Technology development cycles are increasingly being driven not only by factors such as consumer acceptance, safety, cost reduction and fuel economy but increasingly manufacturers are also paying attention to greenhouse gas (GHG) emissions and the near-term challenges of surviving in the current global economic climate. Technology change is being propelled by intense competition and marketplace demands, and regulatory change and government policy, such as the 2005 MOU by which the Government of Canada and the automotive industry agreed to material annual reductions in greenhouse gas emissions. The recently-announced $250 million federal government Automotive Innovation Fund and provincial initiatives, such as the Ontario Automotive Investment Strategy, Advanced Manufacturing Investment Strategy and the Next Generation of Jobs Fund have the additional potential for directing and focusing new technologies (and other innovation) in this sector.

  To respond to general societal concern about greenhouse gas emissions and more specifically to the MOU mentioned above, manufacturers have been developing vehicles that are more fuel-efficient and/or run on novel energy forms, sometimes in combination with fossil fuels. Fuel efficiency is being

4 These switches sense human touch - like the “wheel” on an iPod
5 For example, pre-collision safety systems are in the Lexus GS450h hybrid vehicle

improved by continuing weight reduction in vehicles, adopting new materials (such as graphite composites, plastics, aluminium, magnesium and other lightweight materials), and other technologies, such as:

- Transmission improvements including 6-speed transmissions and continuously variable transmissions,
- Engine improvements including cylinder deactivation/reactivation, variable valve timing, and
- Reduced rolling resistance including low-rolling-resistance tires.

New technology developments for vehicles are being complicated by the multiplicity of energy forms which manufacturers now necessarily consider in addition to fossil fuel for vehicles, whether gasoline or diesel, and also whether the fuels are derived from traditional technologies or new ones, such as GTL - gas to liquid synthetic fuel. To reduce GHG emissions, manufacturers choose from among motive power energy sources such as battery power, bio-diesel, ethanol, hydrogen fuel cells, hybrid energy systems (that today usually combine fossil fueled engines with electrical power and electricity generation), natural gas, propane and solar. In some cases, energy sources are combined, such as the E85 flex fuel vehicles that can run on 85% ethanol and 15% gasoline, and diesel-electric light trucks. The energy selection decision, in turn, has technology development implications that are related to the motive objective. Examples in this regard include battery storage technologies from battery suppliers, and regenerative braking technologies from in-house developers or brake companies.

Manufacturers of heavy duty vehicles are also focused on GHG emissions, the result of stricter environmental regulations such as regulations potentially affecting emissions and idling, for example.

- The economic climate and associated challenges and urgencies

Although not directly associated with advanced technologies, the currently volatile international economic and energy climate has material implications for the timing of technology deployment, investments in new technologies and, potentially, even the survival of specific manufacturers. In this new climate, capital is scarce and the likelihood of large-scale borrowing unlikely so vehicle manufacturers are working hard to conserve their existing financial resources and direct investments towards product development of more fuel-efficient vehicles over redevelopment of larger and less fuel-efficient platforms. For example, large SUV development will not be attracting much new development investment in the near-term from any of the major automotive companies and some car companies have already canceled development in this area (e.g. GM).

Once companies have addressed structural, operational and financial factors that have a bearing on their continued existence, they may consider how specific technologies could be deployed within their enterprises and between enterprises -- such as with their suppliers, to further increase operating efficiencies and customer satisfaction.

2.3 Changing skills requirements

New technologies bring associated changes in requirements for skills and training, and also new challenges in attracting sufficient knowledgeable personnel. This was also the case in 1999, when the CARS' *Bridging the Gaps* report noted technical skills gaps in areas such as electronics, diagnostics and emissions control. In 2005, the CARS' report entitled *The Road Ahead* noted the acceleration of technical complexity and described two key factors challenging industry participants: the pace of change and the increasing complexity of new vehicles. It was noted that automotive systems and diagnostic equipment are becoming increasingly computerized and that the (then pending) introduction of hybrid/alternative fuel vehicles and high fuel efficiency technologies was also expected to increase the complexity of training. Since the report was completed, many of the expected changes have come about and the pace and complexity of change, if anything, has further accelerated. In addition to the increasing number and complexity of new technologies, vehicle models are proliferating - especially for non-domestic brands[6], motive power formats, and onboard technologies, many of which are electrical or electronic in nature[7]. The complexity of vehicles - not to mention the safety implications of the high-voltage systems associated with some hybrid-electric systems - increasingly require that technicians and others engaged in the repair, service, collision and parts sectors become familiar with very complex electrical and electronic technologies and be able to understand and operate the more sophisticated technologies.

6 Recent announcements from General Motors regarding the discontinuation of Pontiac will reduce the number of models and the sale of GM divisions such as Saab, Saturn and Hummer (and Opel in Europe - which may affect some domestic models) may or may not lead to a reduced number of vehicle models in the market overall, depending on the intentions of the new owners. In addition, GM has announced it will likely continue with selected Pontiac vehicles under the Chevrolet brand, such as the Pontiac G8 which may continue as the Chevrolet Caprice. On the other hand, new model announcements continue to come from a number of brands headquartered outside North America -- e.g. South Korea's Hyundai, and India's Tata Motors (Jaguar division).

7 For example, the now-introduced Toyota Camry Hybrid has a four-cylinder gasoline engine producing 108 kW of power with torque of 187 Nm, and 650V, 29 kW electric motors powered by a 245 V nickel-metal-hydride battery.

3.0 Method

The assignment was conducted in two study phases:

- Phase 1: Identification of the technological advancements impacting the industry
- Phase 2: Exploration of the current and future skills and knowledge needs of the workforce to work with the technologies identified in Phase 1.

Phase 1 findings identify and describe the technological development / innovations that are employed currently and will be employed in the next three to five years in the motive power repair and service sector. To accomplish this Phase 1 objective, the following tasks were undertaken:

- Secondary research
  Secondary research was conducted with sources as noted in Appendices A and B. This research comprised reviews of reports examining new technologies and technology roadmaps, online research of the websites of many industry observers and participants, and a wide variety of press releases and publications. Appendix A presents a bibliography of sources and Appendix B websites that have been visited while conducting secondary research. Secondary research was conducted during December, 2008.

- Primary research
  Interviews were conducted with 57 industry stakeholders noted in Appendix D. The nature and scope of this primary research is categorized as described in Table 1, below.

Table 1: Phase 1 Respondent Categories and Research Objectives

Respondent Categories	**Main Objectives of Specific Research Components**	**Number of Interviews Completed**
Advisory committee	Direction regarding the focus of the assignment, sources to be contacted and reports to be reviewed	12
Informed industry observers • Federal and Provincial government representatives • Industry associations • Educational institutions • Trade press	Assessment of the principal categories in which technology is likely to change most over the next three years, and those technology changes most likely to impact the categories of occupations that are the focus of the study. Research organizations were not contacted because technologies now in the research phase will likely not be in the market within the 3 to 5 year time horizon of this assignment.	17
Assemblers of new cars, light trucks and heavy-duty trucks	The scope of technology change that will impact assemblers' vehicles over the next three to five years, the principal categories within which these changes will occur and the associated implications for repair, service and parts. Assessing interest in collaborating in Industry Canada's Technology	13

	Roadmap process and exploring any barriers to adoption.	
Suppliers of technology products, solutions or services used by industry participants	Exploring how specific new technology developments might be deployed over the project horizon, and how that would affect industry participants and the four occupational categories under consideration for this assignment	8
Dealers for new and used cars, repair and service, and aftermarket parts, retailers and wholesalers	As research with employers is to be conducted in the second project phase, this phase focused principally on developing an overview of the technologies that selected, well-informed industry participants in these categories (dealers, retailers and wholesalers) perceive will be adopted within the project horizon.	6

Interviews made use of interview guides (an exemplar of which appears in Appendix C) which were approved prior to the conduct of the interviews. Interviews were undertaken during January and February, 2009, principally by telephone.

- Advisory Committee workshop
  Following completion of most of the interviews, a workshop with the Advisory Committee for this engagement was undertaken on January 30, 2009. Guidance received at the workshop was incorporated in the assignment, including the focus for remaining interviews. Data were analyzed and a Phase 1 Report was issued in March 2009.

The objective of Phase 2 research was to explore the current and future skills and knowledge needs of the workforce to work with the technologies identified in Phase 1 of this engagement. More specifically, the primary objective of the second phase of the study was to determine how employers plan to address the key technologies identified in Phase 1, and how knowledgeable employees are about the new technologies that will affect them and how they would prefer to manage any skills gaps that they themselves perceive.

In Phase 2 of this assignment, research was to be conducted with employers and employees, as described in the following table:

Table 2: Interviews with employers and employees

***Employer* research**	*Atlantic Provinces*	*Québec*	*Ontario*	*Western Provinces*	*Total*
Automobile and/or light truck repair and service	10	10	10	10	40
Collision repair (any type of vehicle)	2	2	2	2	8
Medium and/or heavy truck repair and service	2	2	2	2	8
Parts warehousing and provisioning	2	2	2	2	8
Total	**16**	**16**	**16**	**16**	**64**

***Employee* research**	*Atlantic Provinces*	*Québec*	*Ontario*	*Western Provinces*	*Total*
Automobile and/or light truck repair and service	5	5	5	5	20
Collision repair (any type of vehicle)	2	2	2	2	8
Medium and/or heavy truck repair and service	2	2	2	2	8
Parts warehousing and provisioning	1	1	1	1	4
Total	**10**	**10**	**10**	**10**	**40**

Total targeted respondents for research with employers and employees	*Atlantic Provinces*	*Québec*	*Ontario*	*Western Provinces*	*Total*
Automobile and/or light truck repair and service	15	15	15	15	60
Collision repair (any type of vehicle)	4	4	4	4	16
Medium and/or heavy truck repair and service	4	4	4	4	16
Parts warehousing and provisioning	3	3	3	3	12
Total	**26**	**26**	**26**	**26**	**104**

- Sample frame

  The sample frame for the Phase 2 interviews with employers and employees was developed from a list of owners/managers engaged in the targeted sub-sectors, supplemented by online sources (as noted in Appendix G).

- Interview guides

  Interview guides were developed for both employer and employee research, and were approved by CARS prior to conducting the research program. Translations were also validated. Appendices H and I provide copies of the interview guides for employers and employees, respectively.

- Interviews with employers

  The actual number of telephone interviews completed with employers totaled 66. Employers were selected randomly from the sample frame. The following tables summarize the distribution of the interviews by region and sub-sector:

Table 3: Employer Interviews, by Region

Atlantic provinces	16
Québec	16
Ontario	16
Western provinces	18

Table 4: Employer Interviews, by Sub-sector

Automobile and/or light truck repair and service	42
Collision repair (any type of vehicle)	8
Medium and/or heavy truck repair and service	7
Parts warehousing and provisioning	9

Note: The abovementioned classification is by primary sub-sector. Several shops were involved with two or more sub-sectors.

- Interviews with employees

The actual number of interviews completed with employees was 43. Employees were identified by calling companies randomly selected from the sample frame. The following tables summarize the distribution of the interviews by region, sub-sector and occupation:

Table 5: Employee Interviews, by Region

Atlantic provinces	12
Québec	10
Ontario	10
Western provinces	11

Table 6: Employee Interviews, by Sub-sector

Automobile and/or light truck repair and service	21
Collision repair (any type of vehicle)	8
Medium and/or heavy truck repair and service	9
Parts warehousing and provisioning	5

Table 7: Employee Interviews, by Occupation

Automotive Service Repair Shops	
Automotive service technician*	12.5
Rim and tire technician	1
Fuel and electrical/electronics technician*	1.5
Service advisor	6
Collision Repair Shops	
Auto body and collision damage repair technician	3
Collision repair manager	2
Collision repair advisor	2
Automotive paint technician	1

Truck / Transport / Heavy Duty Repair Shops	
Truck/trailer service technician	9
Parts Wholesalers	
Parts counter person	1
Parts sales consultant	4

* Note: One technician performed both the role of both automotive service technician and fuel and electrical/electronics technician.

- Integration of data from 2009 Labour Market Update Study

  Research instruments for this engagement were aligned where appropriate with the 2009 Labour Market Update Study, an assignment conducted in parallel with this engagement by a research consultancy for CARS. The Labour Market Update Study included interviews with over 1800 employers and 1400 employees across Canada. Results from the surveys pertaining to technology were incorporated from the Labour Market Update Study into analysis and reporting for this engagement.

- Data analysis and reporting

  The data from the interviews were tabulated and analyzed, and this report was prepared from the ensuing analysis.

4.0 Emerging Vehicle and Business Technologies

This section of the report considers emerging vehicle and business technologies. New technologies likely to be deployed in vehicles over the next 3 to 5 years, as well as business innovations that will affect the automotive aftermarket, including the repair and service sub-sector, collision repair and parts provisioning.

4.1 Vehicle Technologies

Secondary research and interviews conducted identified 95 vehicle technologies that have recently been incorporated into, or are likely to be incorporated into new car, light/medium truck and heavy truck vehicles over the next 3 to 5 years. Where technologies have recently been incorporated, they have been selected for this list of new technologies because there is a strong likelihood that these technologies will be more widely adopted over the next 3 to 5 years. It is common that many technologies that first enter a market in high-end vehicles are subsequently to be found in the mass market. Table 8 provides a summary list of these new technologies.

While this list seeks to be as complete as possible, the number of technologies that could potentially be listed here is very large indeed, and this list is intended to present primarily those that respondents feel are among the most important, either because they are likely to have more widespread adoption over the 3 to 5 year horizon of this project or because they are important precursors of technological adoption to follow.

For the most part, this list does not include technologies that are in the research stage or in concept vehicles where significant adoption is likely to occur more than five years away. In addition and to focus this assessment, this list excludes subassemblies, components and subcomponents for the technologies, fuels, products or assemblies presented. This list is also primarily comprised of OEM technologies, not product technologies only available in the aftermarket.

Table 8: Summary List of New Vehicle Technologies

Category	Technology
Engine/fuel: gasoline, ethanol, diesel	1. Bio-diesel 2. Clean diesel technology 3. Cylinder deactivation/reactivation 4. Direct injection 5. Turbocharging 6. Exhaust after-treatment systems 7. Flex-fuel vehicles capable of using ethanol (E85) 8. Homogeneous Charge Compression Ignition (HCCI) 9. Misfire diagnostics (truck) 10. Start stop drive management system 11. Supercharging 12. Turbodiesel 13. Variable valve control 14. Variable valve timing (VVT) 15. Variable-vane turbocharging

Engine/fuel: electric or hybrid electric	16. Hybrid electric technology using gasoline or diesel 17. Hybrid energy systems using natural gas 18. Hybrid energy systems using propane 19. Pure electric/battery power (EV)
Engine/fuel: battery storage and energy systems	20. Capacitative energy systems 21. Lithium ion 22. NiMH - Nickel Metal Hydride 23. PbA - Lead Acid 24. PEM - Proton Exchange Membrane (Hydrogen fuel cells)
Energy/fuel: other or combined	25. CNG - Compressed Natural Gas 26. Diesel particulate filters 27. MeOH – Methanol 28. Propane 29. Selective Catalytic Reduction – SCR, including ammonia treatment systems
Drive train	30. 6-speed transmissions 31. Auxiliary gearboxes (truck) 32. Continuously variable transmissions (CVT) 33. Electrically controlled four-wheel drive 34. Full electronic/paddle shifters 35. Twin clutches
Suspension/steering/wheel and tires	36. Airless tires 37. Electronic power assisted steering (EPAS) 38. Low-rolling-resistance tires 39. Run-flat tires 40. Self inflating tires (truck) 41. Split rims/double rims (truck) 42. Truck wheel monitoring system
Axle/ brake/body control	43. Active suspension and Electronic Stability Control (ESC) & Active yaw control (AYC) 44. Anti-lock braking systems (ABS) 45. Electronic brake-force distribution (EBD) 46. Electronically modulated dampening of suspension 47. Regenerative braking systems 48. Traction control systems (TCS)
Body/exterior	49. Advanced front lighting systems (AFS) 50. Aluminium, magnesium, titanium, high-strength steel and other lightweight materials 51. Capless fuel filler 52. Carbon fiber body and panel construction, and other less frequently used composite materials and dual materials such as rubber plated steels 53. Retractable hardtop 54. Self-healing paint
Interior and onboard electronics: telematics	55. Automotive navigation systems 56. Dynamic route guidance and navigation 57. Electronic highway toll and parking payment systems 58. Driving-based behaviour service/scheduling/alerts/notifications 59. In-car Internet 60. Motorist information systems e.g. incidents, special events, weather, work zones 61. Remote vehicle diagnostics, remote vehicle prognostics and self-healing 62. Satellite telephony 63. Stolen vehicle recovery systems 64. Stolen vehicle slow/shut down

	65. Vehicle software download systems 66. Vehicle use data, vehicle profiles and dealer use data
Interior and onboard electronics: entertainment and other onboard, local consumer electronics	67. Bluetooth 68. HD radio 69. MP3-player interfaces 70. Rear-seat entertainment systems 71. Voice-activated in-car communication and entertainment system
Interior and onboard electronics: interior cabin safety technologies	72. Active head restraints 73. Automatic headlights 74. Active cruise control (ACC) 75. Blind-side alerts 76. Collision avoidance systems, automatic emergency braking & other pre-collision safety actions 77. Heads-up displays (HUD) 78. Heated windshield washer fluid 79. Knee, side curtain and other airbags 80. Lane departure warning systems (Drifting monitors) and vibrating steering wheel drift alert 81. Night vision thermal imaging cameras/pedestrian recognition night vision 82. Passenger presence and proximity sensors 83. Radar, laser and sonar detection 84. Seat belt pretensioners 85. Sobriety detectors 86. Tire pressure monitoring systems
Interior and onboard electronics: convenience technologies	87. Advanced key system/remote keyless entry/remote keyless ignition 88. Active noise control 89. Advanced parking guidance systems (APGS)/active park assist 90. Backup cameras and a 360° vision cameras 91. Electrochromatic (auto-dimming) mirrors 92. Massaging seats 93. Radio frequency identification 94. Solar panel sunroofs for unattended vehicle air recirculation 95. 110 V AC plug access/DC conversion

Most of the new technologies are associated with engines and fuel, and onboard electronics, such as in the engine bays and passenger compartments of vehicles. Table 9 notes that 74% of the number of technologies identified are in these two categories. This is not to suggest that these are the two most important categories from an OEM investment or consumer preference point of view, but it does imply that much of the technological change is likely to occur in these two areas.

Table 9: New Vehicle Technologies, by Category

	Number	Percent
Engine/Fuel	29	31%
Drive Train	6	6%
Suspension/Steering/Wheels & Tires	7	7%
Axle/Brake/Body Control	6	6%
Body/Exterior	6	6%
Interior/Onboard Electronics	41	43%
Total	95	100%

74%

These technologies may be categorized according to two important factors:

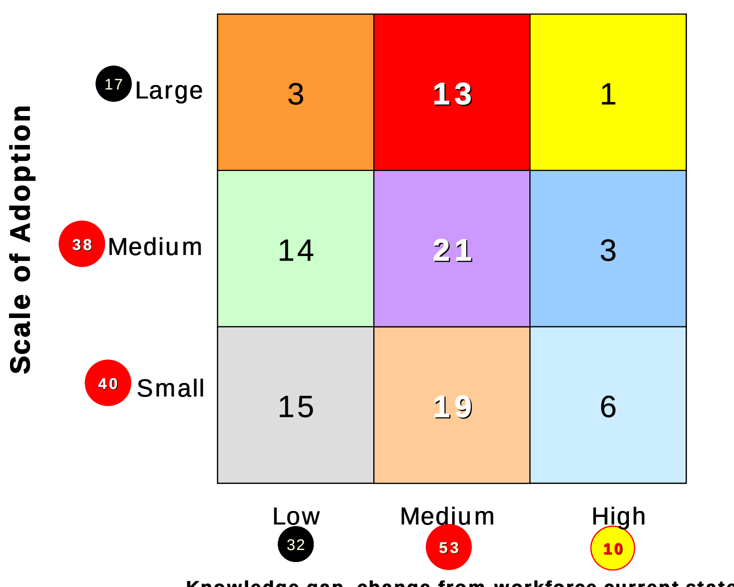
- The likely scale of marketplace adoption over the next 3 to 5 years -- i.e. the absolute volume of these technologies likely to be seen in the marketplace over the horizon of this project. Respondents did not possess information that would allow them to state definitively in what volumes the technologies would likely appear in the marketplace, but they were able to provide their perceptions of the relative rankings of the technologies under review. Accordingly, these relative rankings were used for a qualitative scale indicating the position of each technology, and

- The knowledge gap that respondents perceive exists at present in the Canadian aftermarket workforce that is engaged in vehicle repair, service, collision repair and parts provisioning. Respondents were not asked to distinguish between qualitative and quantitative knowledge gaps -- i.e. whether today's workforce needs to be upgraded or more employees with the requisite skills need to be hired. That is, the intent was not to be prescriptive about a solution but descriptive of knowledge gaps, and respondents provided their perceptions of the knowledge gaps that exist in today's workforce for the various technologies under discussion. These relative rankings were used to indicate the position of each technology on a qualitative scale describing knowledge gaps.

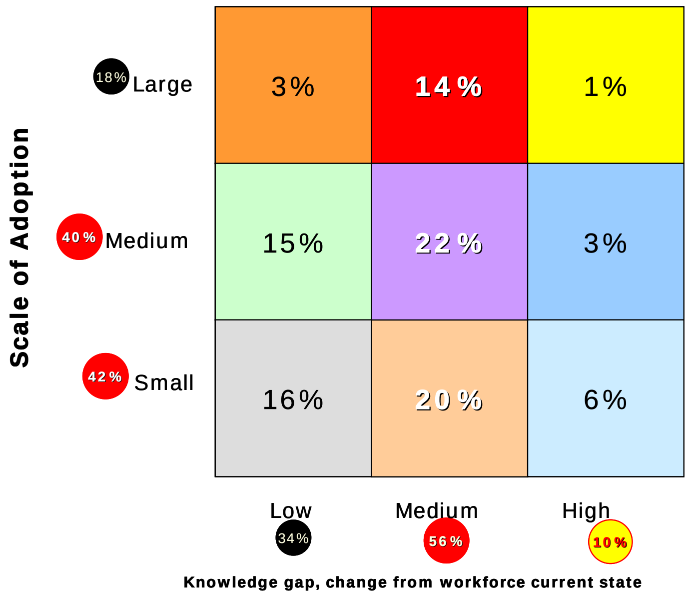
That is, for each of the 95 technologies, relative rankings were obtained to describe both the likely scale of marketplace adoption and aftermarket employee knowledge gap. Based on this assessment, the 95 technologies may be charted in a matrix format where the two axes of the matrix are “scale of marketplace adoption” and “knowledge gap”, as noted above. Data describing the ranking of each technology appear in Appendix D.

Diagram 1 presents the number of new technologies and Diagram 2 shows these same technologies as a percentage of the number of technologies reviewed.

Diagram 1: Number of Product Innovations, by Scale and Knowledge Gap



<u>*Diagram 2: Percentage of Product Innovations, by Scale and Knowledge Gap*</u>



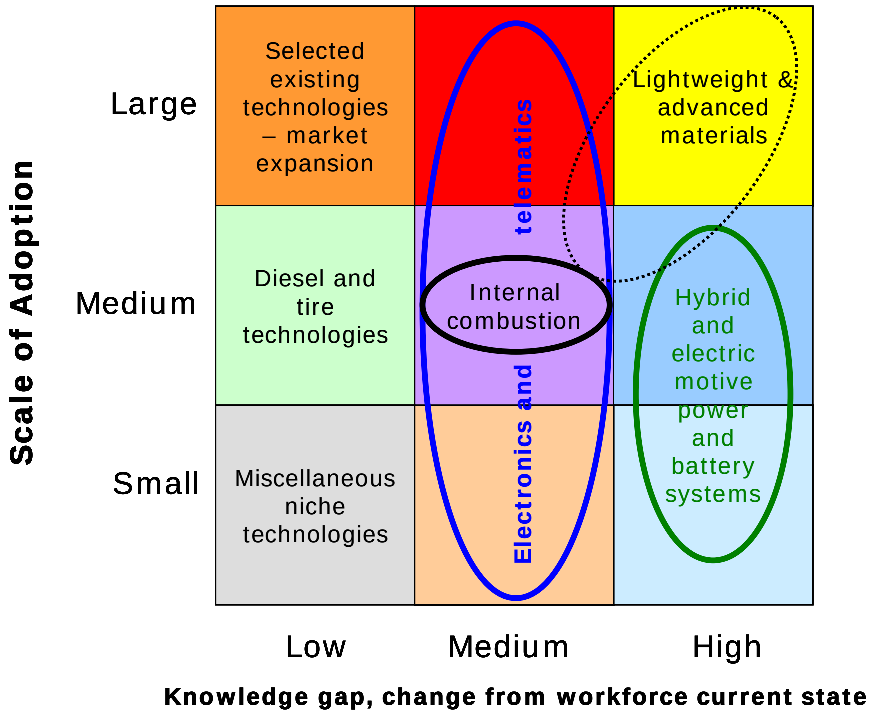
Diagrams 1 and 2 suggest that many of the new OEM technologies in the marketplace over the next 3 to 5 years (42%) will be of a “small” scale -- mostly for niche technologies that have not fully penetrated the marketplace or are in high end or specialized vehicles. About 34% of new technologies may be described as being close to the existing knowledge of today's workforce with a resultant “low” knowledge gap in these cases. Taken together, the box in the bottom left hand corner of the matrix comprises 16% of the 95 technologies reviewed and for these, there appears to be less need for new knowledge and associated training.

On the other hand, 58% of the number of technologies reviewed are likely to experience a medium to large scale of adoption, and 66% of the technologies are likely to face a medium to high knowledge gap for aftermarket occupations. Combining these two considerations, there are likely to be about 40% of the technologies (in the top four boxes on the right-hand side of the matrix) for which technologies are likely to be fairly widely adopted and knowledge gaps can be characterized as medium to high. Training will likely be needed to address employee knowledge gaps and the skills and occupational impacts of these technologies.

4.2 <u>Technology Priorities</u>

By considering each individual technology’s position in the matrices presented in Diagrams 1 and 2, and then by aggregating the categories of technology in each area, technologies can be assigned to the areas in the matrix described in Diagram 3, in general. This suggests, for example, that lightweight materials are likely to be adopted on a larger scale of the next 3 to 5 years, and the automotive and truck repair, service, collision repair and parts provisioning of some among these technologies will experience a material knowledge gap when compared to the knowledge and skills of today's workforce. (In this case, some respondents perceive that a particular gap exists in the collision repair subsector of the automotive aftermarket.) Similarly, electronics and telematics technologies can be assigned to the three matrix boxes associated with a medium knowledge gap, and hybrid and electric motive power and battery systems can be assigned to small and medium scale adoption matrix boxes, as per Diagram 3 below. Other technologies are positioned as described in the diagram.

Diagram 3: Product Innovation Priorities, by Technology Area



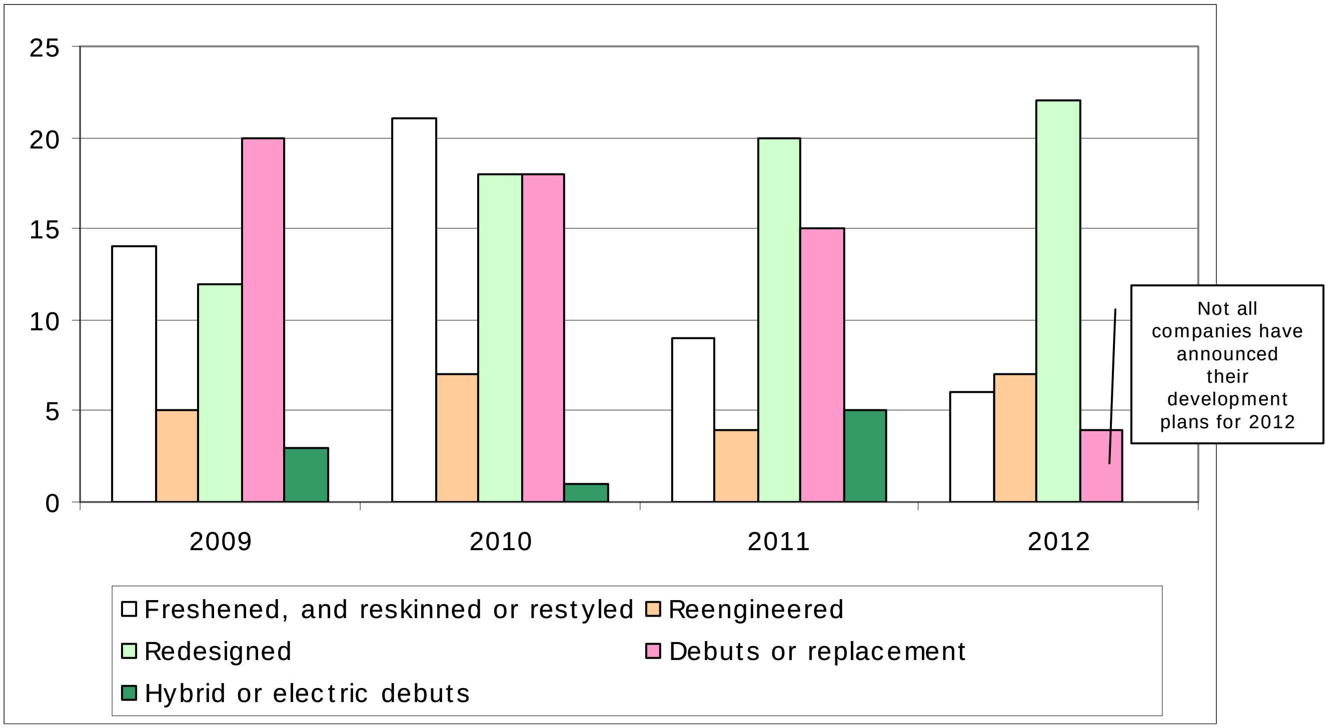
4.3 Product Development Plans

Product development plans for all new vehicles to be introduced into North America have been reviewed, based on source data available from industry publication *Automotive News*, as of the first and second quarters of 2008. Subsequent to the announcement of these plans, the economic turmoil and disruption of the automotive industry will likely cause some vehicle introductions and changes to be put on hold, others to be deferred and some to be downgraded, such as from a reengineered car to one that is freshened, reskinned or restyled. Nevertheless, the product development plans have value as a statement of intent and strategic direction for the years up to 2011[8]. Based on these data, it appears likely that there will be an increasing number of hybrid and hybrid electric vehicles introduced over the next few years, but the numbers will still be small with five or fewer new hybrids being introduced each year, insufficient it would seem to completely revolutionize the motive power by which North Americans transport themselves and their goods. On the other hand, there will be about 30 to 35 redesigned or entirely new high-volume passenger vehicles being introduced to North America

[8] Not all companies have announced their development plans for 2012

each year over the next few years, and most of these vehicles will employ internal combustion engines with increasing levels of technology to provide fuel economy, emission control, safety, entertainment and other features and benefits, as noted previously.

Chart 1: Number of High-Volume Vehicles to Be Introduced or Changed in North America

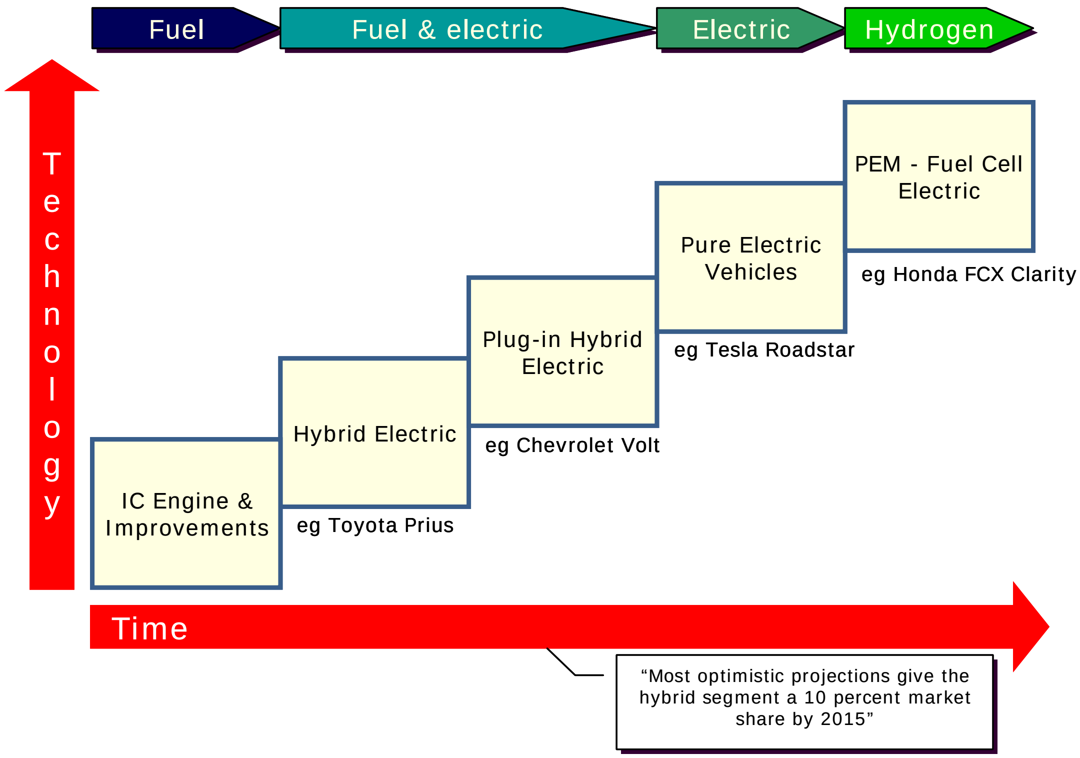


Source: Based on data from *Automotive News*, 2008 tables (various). Not included in these charts: niche or lower volume brands such as Alfa Romeo, Aston Martin, Bentley, Bugatti, Ferrari, Lagonda, Lamborghini, Land Rover, and Maserati, as well as Indian, Chinese, Korean, Malaysian and other Asian or South American brands, and limited volume or emerging brands

A number of manufacturers have declared their intent to develop and introduce more energy-efficient vehicles over the next few years, largely in response to the significant increase in gas prices experienced in 2008. Industry analysts expect that, while new technologies will initially seek to make existing internal combustion engines more fuel-efficient, over time the automotive industry can expect an evolution towards progressively greener motive power from more hybrid electric vehicles to plug-in electrics (that have a small ancillary fuel powered engine), then pure electric vehicles (with no ancillary engine), and, over time, increasing numbers of fuel cell, hydrogen-powered electric vehicles[9]. Diagram 4 presents this evolutionary perspective.

[9] Sometimes called Proton Exchange Membrane (PEM)

Diagram 4: Potential Evolution of Motive Power



Source: Diagram based (in part) on Analyst Note, PwC Automotive Institute, November 19, 2008
Quotation: Bandivadekar, Anup P. *"Evaluating the Impact of Advanced Vehicle and Fuel Technologies in U.S. Light-Duty Vehicle Fleet,"* February 2008

Diagram 4 presents a direction for motive power evolution but the speed with which this will occur is uncertain. As noted in the diagram, most optimistic projections give the hybrid segment a 10 percent market share by 2015. Some studies suggest that global sales of electric cars will be 10 million annually by 2016. Nissan/Renault predicts that 10 percent of the world's car market will employ electric motive power by 2020, but a number of industry observers predict lower levels of penetration – around 0.5 percent market penetration by 2015 for pure electrics.[10] Still, the penetration of specific motive power technologies cannot be projected definitively for the shorter term - 3-5 year - horizon which has been the focus of this engagement. One article states as follows: "the truth is, everyone is making only educated guesses about how many electric vehicles will be sold next year, let alone in 2016 and beyond."[11] The pace by which motive power evolves from internal combustion engines to fuel-cell electrics will be affected by a number of factors including energy costs, vehicle availability, pricing of lagging technologies, and the extent to which regulations push the industry towards incorporating more electric power in their vehicles and encourage consumers to buy these vehicles.

Regulatory pressure for accelerated adoption of electrically driven vehicles is

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10 *Plugged In*, The Globe and Mail, September 3, 2009, p. G8. CSM Automotive predicts 0.5% market penetration for pure electrics, a view shared by J.D. Power and Associates.

11 Ibid.

coming from a number of directions, including directly from regulators concerned with energy, transportation and the environment, and potentially indirectly through governments' ownership positions in General Motors and Chrysler. Successive US administrations have sought independence from foreign energy sources as a key to security and additionally wish to lower average fuel consumption, conserve energy and reduce greenhouse gas emissions. The Energy Independence and Security Act (EISA) passed in December, 2007 mandates that Corporate Average Fuel Economy (CAFE) standards for manufacturers be not less than a combined average of 35 miles per gallon (6.72 litres per 100 km) by the 2020 model year, a minimum requirement which the National Highway Traffic Safety Administration (NHTSA) can adjust or accelerate. The 2020 standard represents a 40 percent increase above the average of approximately 25 mpg for the current combined fleet and will increase pressure on the automobile industry to continue improving the average fuel economy of their vehicles. Recent NHTSA announcements will require that the 35 mpg CAFE standard for the 2020 model year now be accomplished by manufacturers for the 2016 model year, providing further impetus for innovation and likely affecting the speed with which new motive power alternatives will be rolled out. In addition to other manifestations such as increased adoption of low weight/high-strength materials, there are early indications that manufacturers are considering alternatives to the internal combustion engine for larger, low mpg fossil fuel vehicles e.g. hybrids for large SUVs such as the Cadillac Escalade. The NHTSA estimates that the 2011 model year standards will raise the industry-wide combined average to 27.3 mpg and the timing of CAFE standards for subsequent model years will pay attention to technological feasibility, among other factors, according to the NHTSA[12]. NHTSA documents describe consideration of the technological feasibility of motive power options when developing CAFE standards[13]. Given that the feasibility of hybrids and other new motive power vehicles has already been demonstrated in current and upcoming vehicles[14], there would appear to be little regulatory reason for a holdup of increasing CAFE standards. If these standards rise, the impact would be felt in Canada as well as the North American marketplace and regulatory environment is integrated. Vehicle manufacturers in Canada are voluntarily committed to meeting annual Company Average Fuel Consumption (CAFC) standards under Transport Canada's Motor Vehicle Fuel Consumption Standards (MVFCS) Program. The Canadian CAFC standards are similar to the US CAFE standards.

A number of Canadian provinces have initiated rebate programs for vehicles that have no or less reliance on fossil fuels. The following summarizes selected Provincial programs[15] to illustrate the increasing use of public sector incentives to

12 In addition to technological feasibility, NHTSA is concerned with economic practicability, the effect of other standards on fuel economy and the need for the US to conserve energy. Source: http://www.nhtsa.dot.gov/CARS/rules/CAFE/overview.htm

13 *Final Regulatory Impact Analysis - Corporate Average Fuel Economy for MY 2011, Passenger Cars and Light Trucks*, Office of Regulatory Analysis and Evaluation, National Center for Statistics and Analysis, NHTSA, March 2009

14 Such as plug-in hybrids like GM's Volt, pure electrics such as Tesla's vehicles and fuel cell cars to which Honda appears committed

15 *Hybrid and Electric Vehicle Incentives: A Canadian overview*, Electric Mobility Canada, 1 August, 2009. http://www.emc-mec.ca/webfm_send/60. The low speed, all-electric vehicle noted as a Quebec program may be similar to cars made by Zenn.

accelerate marketplace adoption of vehicles propelled by alternatives to traditional internal combustion engines:

- In British Columbia, a Provincial government program provides a PST tax reduction up to a maximum of $2,000 on the purchase of hybrid electric vehicles.
- In Manitoba, the Provincial government has instituted a program that offers a $2000 rebate on a lease or purchase of a hybrid electric vehicle[16].
- In Ontario, the Provincial government has announced a program whereby consumers will be offered between $4,000 and $10,000 in rebates for plug-in hybrids and battery electric vehicles.[17]
- In Prince Edward Island, the Provincial government has instituted a program providing a tax incentive of up to $3,000 on the purchase or lease of a hybrid electric vehicle.
- In Quebec, tax credits are offered on the purchase of a hybrid electric vehicle, up to $2,000 and a credit of up to $4,000 is available to owners of low-speed, all electric vehicles.

4.4 Occupations Impacted

The incorporation of new technologies into vehicles will obviously affect those occupations that repair and service cars and trucks, provide collision repair services and parts, as well as the people who manage and support these occupations. Respondents perceive that the new technologies will impact parts provisioning more or less similarly but that repair, service and collision repair will likely face different challenges. For example, the incorporation of new electronic technologies and advanced materials in cars has significant impact on collision repair. Technicians in this sub-sector need to know how to repair vehicles made with high strength steels and aluminium, for example, and even more exotic metals, materials and combinations such as rubber-coated steels, magnesium, titanium and carbon. They also need to be able to repair more sophisticated electronics, in some cases resulting in the subletting of repairs back to manufacturers' dealers where the electronics repair skills are absent in the facility. Based on input received from respondents, Table 10 summarizes occupational areas most affected by each technology area.

16 Government of Manitoba web-site: http://www.gov.mb.ca/stem/climate/mb_doing/hybrid/index.html

17 *A Plan for Ontario: 1 in 20 by 2020*, Ontario government press release, July 15, 2009

Table 10: Occupations Affected, by Technology Area

Technology area	Occupations most likely to be affected (to be validated by upcoming research Phase 2 of project)
Engine/Fuel	▪ Automotive service technicians, fuel and electrical/electronics technicians, and diesel technicians
Drive Train	▪ Automotive service technicians, transmission technicians, truck/trailer service technicians, and truck coach
Suspension/Steering/Wheel & Tires	▪ Automotive service technicians, rim and tire technicians, alignment and brake technicians, fuel and electrical/electronics technicians, auto body and collision damage repair technicians
Axle/Brake/Body Control	▪ Automotive service technicians, alignment and brake technicians, fuel and electrical/electronics technicians, auto body and collision damage repair technicians, truck/trailer service technicians, truck coach
Body/Exterior	▪ Automotive service technicians, fuel and electrical/electronics technicians, auto body and collision damage repair technicians, automotive paint technicians, truck/trailer service technicians, truck coach
Telematics -- telecommunications/information electronics	▪ Automotive service technicians, automotive electronic accessory technicians, fuel and electrical/electronics technicians, truck/trailer service technicians, truck coach
Entertainment and other onboard, local consumer electronics	▪ Automotive service technicians, automotive electronic accessory technicians, fuel and electrical/electronics technicians, truck/trailer service technicians, truck coach
Onboard and interior cabin safety technologies	▪ Automotive service technicians, automotive electronic accessory technicians, fuel and electrical/electronics technicians
Convenience technologies	▪ Automotive service technicians, automotive electronic accessory technicians, fuel and electrical/electronics technicians

The relative scale of the technological adoption and the knowledge gap that exists in respect of these technologies for today's workforce suggests that the individual technologies may be categorized for their occupational impact according to the figure presented in Diagram 5. This suggests that automotive and heavy duty service and repair technicians will need to address an increasingly wide range of new OEM technologies, such as those noted in Appendix D and summarized in Diagram 3. As mentioned, collision repair occupations will need to manage vehicle repairs where advanced and lightweight materials are increasingly to be found, as well as repairing collision damage for new motive power systems - such as hybrid electric - and other technologies.

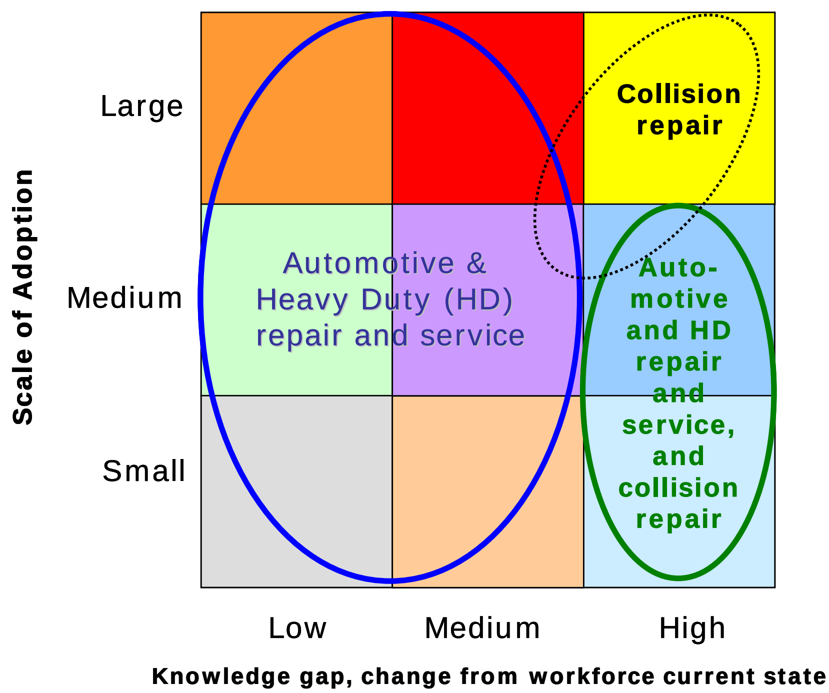
The training implications of these occupational impacts include the following, according to respondents interviewed:

- Manufacturers generally assume responsibility for training their technicians, including in the many niche technologies that are employed in the firm's vehicles. As many of these niche technologies are not material departures from the current knowledge of technicians, the training can evolve the knowledge of technicians rather than provide knowledge in entirely new areas.

- Collision repair facilities, coping with an increasing array of new technologies, need new knowledge for managing repairs that involve advanced and lightweight materials as well as other technologies. Rather than receive training in all the many new technologies, collision repair facilities may sublet certain repairs back to manufacturers' dealers where the requisite knowledge and equipment resides.

- Based on the perceptions of marketplace participants interviewed for this engagement, there remains a significant knowledge gap for vehicle service and repair for new motive power systems, such as hybrid electric. This can apply both to technicians engaged in vehicle service and repair, and collision repair, where these technicians have not yet received adequate training. Respondents repeatedly noted the dire safety implications for technicians and others (e.g. first responders to accident scenes) who are unaware of the hazardous nature of high-voltage hybrid electric power systems.

Diagram 5: Technological Change and Its Impact on Occupational Areas



4.5 Business Technologies

In addition to new product technologies, there are a number of business innovation technologies that are likely to be introduced or experience increased adoption over the next 3 to 5 years and that will affect the ways in which business is conducted or occupations performed. These business innovation technologies include expanding the existing enterprise technology infrastructure that exists within companies and for communication between companies, new processes that the new technologies require or enable, and business model changes caused or enabled by the new technologies. According to respondents, selected exemplars of these business innovation technologies include the following:

- Expansion of enterprise technology infrastructure
  - Electronic access to electronic service manuals;

- Jobbers making investments in technology to improve inventory, shipping and receiving – e.g. barcode scanning;
- Jobbers using GPS tracking to track their trucks;
- Online parts ordering - using CARRUS and other jobber management systems; and
- Technicians' workstations - typing into a shop management system such as CARRUS and then printing out work orders. (One of the implications of this is that all technicians now need to be computer literate to do their jobs).

- New processes required by or enabled by technologies
  - Collision repair of vehicles using glue rather than welds, for example;
  - Dealer appointment pre-booking – e.g. OnStar and via Internet; and
  - Segregation of aluminium repair into separate tool rooms in collision repair facilities to reduce likelihood of cross contamination between steel and aluminium.

- Business models changing with new technologies
  - Service and repair
    - Service, repair and parts represent an increased portion of dealer profits in this era of weaker vehicle sales and are important drivers of new technologies being adopted by dealers such as software for Customer Relationship Management - CRM, production scheduling, inventory management and online interactions;
    - Higher quality vehicles require less service, impacting the business models of firms dependent on service revenues which, as mentioned, is increasingly important to dealers;
    - Routine maintenance service is being done on an assembly line basis, to maximize productivity and accelerate customer and vehicle handling. This provides stable – but not typically upwardly mobile – employment; and
    - Radio frequency communication can be used to trigger work orders in advance of vehicle entering the service bay, accelerating and reducing the costs of the order preparation process.
  - Collision repair
    - Less work is available to collision repair facilities because vehicles with high levels of technology and expensive/exotic materials are more likely to be written off at lower threshold levels of collision repair; and
    - Collision repair are more likely to focus more on physical damage and sub-let technology work to dealerships.

5.0 Vehicle Technology Knowledge and Skills

This section of the report considers relevant aspects of employees' vehicle technology knowledge and skills and related perspectives of employers in the Automotive Service and Repair, Collision Repair, Medium and Heavy-duty Truck and Parts Wholesaling, Retailing and Recycling subsectors in Canada. Data for this section of the report were drawn from research conducted for the CARS 2009 Labour Market Update Study, a project conducted in parallel with this engagement by a third-party research consulting firm. These data were supplemented and selected additional issues explored in interviews conducted by Convergence Management Consultants with 66 employers and 43 employees across Canada.

In the following, employees are considered first in each subsection and then relevant employer perspectives are explored, except where issues pertain to only employees or employers.

5.1 Technology Areas of Most Interest

Employees understand the importance of acquiring new knowledge and skills to deal with new vehicle technologies - virtually all the employees interviewed (93%[18]) perceive that they will need to obtain new knowledge or enhanced skills to do their jobs to cope with the new vehicle technologies that will be introduced over the next three years.

Among the few employees responding negatively in this regard, some are retiring and others feel they get enough information on the job to understand and deal with new vehicle technologies. The following are illustrative verbatim comments:

- "Most of it is computer generated stuff and has weekly updates"
- "(name of manufacturer) provides all the training I need"
- "I am retiring this year - already received a lot of training"

Employees and employers generally agree that hybrid electric vehicles are of particular interest for knowledge and skills upgrading for vehicle technologies. Other areas in which employees and employers both agree that knowledge and skills upgrading is necessary -- *although not in terms of rank order of importance*, are onboard electronics, diagnostic systems, advanced braking and body control systems and emissions controls.

Sixty-nine percent of employees indicate they need some or considerable new knowledge or skills upgrading for hybrid electric vehicles and also for onboard electronics. Advanced braking and body control systems, emissions controls, diagnostics, drive trains and transmissions and air conditioning and climate control are other areas in which over 60% of employees indicate a need for some or considerable knowledge or skills upgrading.

Table 11 provides additional detail.

18 Source: Convergence interviews

Table 11: Employees' ratings as to the amount of knowledge or skills upgrading required, by vehicle technology area

	None	Some	Considerable	Some or Considerable	Doesn't apply
Hybrid electric vehicles	12%	25%	44%	69%	19%
Onboard electronics	13%	40%	29%	69%	18%
Advanced braking and body control systems	16%	41%	24%	65%	19%
Emissions controls	16%	39%	25%	64%	20%
Diagnostics	16%	36%	28%	64%	20%
Drive train and transmissions	17%	41%	21%	62%	21%
Air conditioning and climate control	18%	42%	20%	62%	21%
Light weight and new materials	20%	39%	20%	59%	21%
Tires, wheels and related technologies	25%	42%	17%	59%	16%
Airbags	19%	40%	19%	59%	22%
Diesel engines	19%	33%	22%	55%	26%
Internal combustion gasoline engines	24%	39%	15%	54%	21%
Telematics systems	23%	28%	23%	51%	25%
Frame and metal construction	24%	28%	15%	43%	33%
Paint	26%	23%	17%	40%	33%
Glass	32%	25%	11%	36%	32%

Source: 2009 Labour Market Update
Note: In some cases, rows (other than cells summing some and considerable) may not add to 100% due to rounding

Employers generally perceive all new vehicle technologies merit some knowledge and skills upgrading for staff. Like employees, employers also perceive that hybrid electric vehicles are of particular interest for knowledge and skills upgrading -- 48% of respondents indicate hybrid electric vehicles require considerable knowledge and skills upgrading for employees. Onboard electronics, diagnostic systems, advanced braking and body control systems and emissions controls are other areas in which approximately three quarters of employers reported they want employees to have some or considerable knowledge and skills upgrading.

Table 12: Employers' ratings of the amount of knowledge or skills upgrading required by employees, by vehicle technology area

	None	Some	Considerable	Some or Considerable
Onboard electronics	19%	45%	36%	81%
Hybrid electric vehicles	21%	31%	48%	79%
Diagnostics	22%	41%	37%	79%
Advanced braking and body control systems	25%	48%	27%	75%
Emissions controls	26%	44%	30%	74%
Drive train and transmissions	30%	47%	23%	70%
Air conditioning and climate control	30%	50%	20%	70%
Airbags	33%	47%	20%	67%
Tires, wheels and related technologies	35%	47%	18%	65%
Light weight and new materials	27%	45%	18%	63%
Telematics systems	38%	38%	24%	62%
Diesel engines	39%	38%	23%	61%
Internal combustion gasoline engines	39%	42%	19%	61%
Paint	45%	31%	24%	55%
Frame and metal construction	46%	35%	19%	54%
Glass	60%	31%	9%	40%

Source: 2009 Labour Market Update

5.2 Subsectors' Perspectives

Needs for knowledge and skills upgrading for vehicle technologies between subsectors vary. For example, while Automotive Service and Repair Shops are generally not concerned with improvements in paint, frame and metal construction and light weight and new materials, Collision Repair Shop employers view these areas seriously. Truck/Transport/Heavy Duty Repair Shops report more need for knowledge and skills upgrading in relation to improvements in diesel engines and emissions controls than other subsectors.

There is substantial alignment between the perspectives of employees and employers within specific subsectors, as can be seen in Table 13 which summarizes the different needs of employees and employers by subsector and lists the top three areas for knowledge and skills upgrading preferences for employees (based on data from Table 14) and employers (based on data from Table 15)

Table 13: Knowledge and Skills Upgrading Preferences, by Subsector

Subsector	Employee preferences	Employer preferences
Service and repair of cars and light trucks	• Onboard electronics • Hybrid electric vehicles • Advanced braking and body control systems	• Onboard electronics • Hybrid electric vehicles • Diagnostics systems and equipment
Autobody and collision repair	• Paint • Frame and metal construction • Light weight and new materials	• Paint • Hybrid electric vehicles • Frame and metal construction
Service and repair of heavy trucks and trailers	• Onboard electronics • Diesel engines • Drive train and transmissions	• Onboard electronics • Diagnostics systems and equipment • Emissions controls
Heavy truck and trailer collision repair	• Onboard electronics • Diagnostics • Tires, wheels and related technologies	• Onboard electronics • Diagnostics systems and equipment • Emissions controls
Parts wholesale, retail, distribution or recycling subsector	• Hybrid electric vehicles • Onboard electronics • Emissions controls	• Onboard electronics • Hybrid electric vehicles • Diagnostics systems and equipment

Table 14 summarizes the vehicle technology areas of “some” or “considerable” interest to employees in each of the subsectors considered.

Table 14: Percentage of employees in each subsector indicating a need for some or considerable knowledge or skills upgrading over the next three years, for vehicle technologies

	Service and repair of cars and light trucks	Autobody and collision repair	Service and repair of heavy trucks and trailers	Heavy truck and trailer collision repair	Parts wholesale, retail, distribution or recycling
Advanced braking and body control systems	74%	47%	59%	53%	65%
Air conditioning and climate control	65%	56%	57%	55%	63%
Airbags	64%	64%	46%	51%	53%
Diagnostics	74%	47%	63%	56%	60%
Diesel engines	61%	32%	66%	52%	61%
Drive train and transmissions	71%	41%	64%	47%	65%
Emissions controls	74%	39%	63%	52%	67%
Frame and metal construction	37%	67%	33%	41%	42%
Glass	34%	53%	30%	36%	33%
Hybrid electric vehicles	75%	63%	50%	42%	71%
Internal combustion gasoline engines	64%	33%	46%	35%	60%
Light weight and new materials	61%	65%	42%	45%	58%
Onboard electronics	76%	56%	67%	57%	69%
Paint	30%	70%	27%	39%	46%
Telematics systems	62%	38%	39%	28%	53%
Tires, wheels and related technologies	65%	49%	58%	56%	60%

Source: 2009 Labour Market Update

Table 15 provides employer data describing knowledge or skills upgrading in each subsector.

Table 15: Percentage of employers in each subsector indicating a need for some or considerable knowledge or skills upgrading over the next three years, for vehicle technologies

	Automotive Service Repair Shops	Autobody and Collision Repair	Truck/ Transport/ Heavy Duty Repair Shops	Heavy Truck/Trailer Collision Repair	Parts Wholesalers, Retailers, Recyclers
Advanced braking and body control systems	77%	65%	76%	77%	79%
Airbags	68%	78%	59%	68%	65%
Air conditioning and climate control	69%	69%	69%	77%	75%
Diagnostics	81%	66%	81%	84%	80%
Diesel engines	63%	41%	77%	75%	67%
Drive train and transmissions	72%	55%	74%	72%	76%
Emissions controls	77%	56%	80%	80%	77%
Frame and metal construction	45%	80%	49%	63%	48%
Glass	39%	51%	36%	43%	38%
Hybrid electric vehicles	82%	80%	65%	73%	81%
Internal combustion gasoline engines	66%	44%	53%	51%	65%
Light weight and new materials	62%	75%	58%	74%	62%
Onboard electronics	83%	78%	82%	85%	83%
Paint	43%	82%	37%	68%	54%
Telematics systems	67%	55%	59%	66%	63%
Tires, wheels and related technologies	67%	58%	65%	62%	68%

Source: 2009 Labour Market Update

5.3 Regional Perspectives

Needs for knowledge and skills upgrading for vehicle technologies between regions or provinces do not vary much. Table 16 shows the top three vehicle technologies for which employees and employers perceive the need for knowledge and skills upgrading (highest perceived need listed first, from data as described in Table 17). As can be seen, the three top areas for upgrading are similar in each of the regions, although employees as a whole place greater emphasis on hybrid electric vehicle knowledge and skills upgrading while employers focus more on onboard electronics and diagnostics.

Although Table 16 shows the top three vehicle technologies, a number of other areas are often fairly close to the third most important area of preference for both employees and employers.

Table 16: Knowledge and Skills Upgrading Preferences, by Region/Province

Subsector	Employee preferences	Employer preferences
Atlantic Canada	• Hybrid electric vehicles • Onboard electronics • Advanced braking and body control systems	• Onboard electronics • Diagnostics • Hybrid electric vehicles
Québec	• Hybrid electric vehicles • Advanced braking and body control systems • Onboard electronics	• Onboard electronics • Diagnostics • Hybrid electric vehicles
Ontario	• Hybrid electric vehicles • Onboard electronics • Diagnostics	• Onboard electronics • Hybrid electric vehicles • Diagnostics
Western Canada	• Onboard electronics • Advanced braking and body control systems • Hybrid electric vehicles	• Onboard electronics • Hybrid electric vehicles • Diagnostics

Employees cite hybrid electric vehicles as their number one technology interest for some or considerable knowledge or skills upgrading in all regions of Canada except Western Canadian provinces, where onboard electronics are seen to be most important and hybrids are of third most interest.

Table 17: Percentage of employees indicating a need for some or considerable knowledge or skills upgrading for vehicle technologies, by province or region

	Atlantic	Québec	Ontario	West
Advanced braking and body control systems	72%	61%	63%	66%
Air conditioning and climate control	70%	56%	59%	64%
Airbags	67%	51%	56%	63%
Diagnostics	69%	56%	66%	64%
Diesel engines	57%	51%	50%	60%
Drive train and transmissions	69%	56%	62%	63%
Emissions controls	71%	59%	63%	65%
Frame and metal construction	47%	46%	37%	46%
Glass	41%	35%	34%	35%
Hybrid electric vehicles	76%	64%	69%	65%
Internal combustion gasoline engines	62%	55%	52%	51%
Light weight and new materials	66%	54%	57%	59%
Onboard electronics	75%	59%	68%	72%
Paint	45%	48%	33%	40%
Telematics systems	61%	49%	50%	49%
Tires, wheels and related technologies	65%	58%	58%	57%

Source: 2009 Labour Market Update

As illustrated in Table 18, the rankings of employers' perceptions regarding knowledge and skills upgrading for vehicle technologies are somewhat similar in the Atlantic, Quebec, Ontario and the West.

Table 18: Percent of employers indicating a need for some or considerable knowledge or skills upgrading over the next three years, by vehicle technology area and region

	Atlantic	Quebec	Ontario	West
Onboard electronics	80%	83%	78%	86%
Hybrid electric vehicles	75%	82%	78%	81%
Diagnostics	76%	82%	75%	80%
Advanced braking and body control systems	73%	81%	71%	79%
Emissions controls	72%	81%	68%	77%
Drive train and transmissions	72%	75%	65%	75%
Air conditioning and climate control	70%	73%	67%	71%
Airbags	70%	70%	65%	68%
Tires, wheels and related technologies	68%	72%	63%	63%
Light weight and new materials	59%	65%	62%	65%
Telematics systems	56%	66%	58%	67%
Diesel engines	60%	60%	56%	67%
Internal combustion gasoline engines	62%	68%	55%	63%
Paint	61%	56%	51%	55%
Frame and metal construction	52%	56%	51%	57%
Glass	43%	42%	38%	41%

Source: 2009 Labour Market Update

5.4 Occupations Impacted

Most employers perceive that knowledge and/or skills upgrading is required by employees in their operations. The following lists the top three occupations employers consider will need new knowledge and/or skills upgrading over the next 3 to 5 years in each subsector:

Automotive repair shops:
- Automotive electronic accessory technician,
- Automotive service technician, and
- Fuel and electrical/electronics technician.

Collision repair shops:
- Auto body and collision damage repair technician,
- Owner/operator, and
- Collision repair manager.

Truck/transport/heavy duty vehicle repair shops:
- Truck/trailer service technician,
- Owner/operator, and
- Truck coach.

Parts wholesalers, retailers and recyclers
- Parts manager,
- Parts counter person, and
- Parts sales consultant and automotive recycler (tie).

5.5 Barriers and Constraints

Employees perceive that the most significant factors in their workplaces that could limit their ability to learn what they need to know about new vehicle technologies over the next 3 to 5 years are "getting appropriate training" and "having the right equipment and facilities for the technologies." These two factors are of similar overall importance to employees.

In order of importance (with the most important listed first), the following are the factors employees indicate limit their ability to learn vehicle technologies:

- Getting appropriate training,
- Having the right equipment and facilities for the technologies,
- The cost of employee training,
- Getting training on-the-job for skills development,
- Getting time off for training, and
- Knowing how to use a computer effectively.

There is some subsectoral variation in the relative importance of the factors that employees perceive limit their ability to learn. In automotive service repair shops, employees consider the "somewhat" or "very significant" limiting factors are getting appropriate training and knowing how to use a computer effectively. In collision repair shops getting appropriate training is also considered most important, while having the right equipment and facilities for the technologies is of equal importance as a limiting factor. In truck, transport and medium/heavy-duty repair shops, employees think the most important limiting factors are getting training on-the-job for skills development, having the right equipment and facilities for the technologies, and the cost of employee training. Employees in the parts wholesaling subsector consider that the most important limiting factors are getting time off for training, getting training on-the-job for skills development, having the right equipment and facilities for the technologies, and the cost of employee training.

The ability of repair, service and collision employees to adapt to the coming new vehicle and business technologies will depend in large measure on having what they need to perform their roles successfully including having the appropriate tools, equipment and training.

5.6 Preferred Training Formats

A majority (52%) of employees indicate a preference for their technical training to be on-the-job, while 40% state this preference for non-technical training. In addition to on-the-job training, employees have a preference for technical training to be in-house, e-learning or online, or provided by manufacturers or parts suppliers at the worksite. A similar rank order of preferences applies for non-technical training. Table 19 provides detail.

Table 19: Formats in which employees would like to receive their technical and non-technical training

	Technical	Non-technical
On-the-job training	52%	40%
In-house training, such as formal classes provided at the worksite	28%	23%
E-learning or online training	27%	25%
Manufacturer or parts supplier provided training at the worksite	25%	17%
Short course such as a weekend or week-long course	22%	17%
Manufacturer or parts supplier funded training at an educational institution or private training facility	19%	13%
Any of these formats would be suitable	17%	22%
After-hours continuing education course at an educational or training institution	14%	9%
Full-time course at an educational or training institution	11%	7%
Interactive distance learning such as satellite courses	10%	8%
Mobile training programs offered by colleges	8%	6%
I do not need any technical/non-technical training	8%	12%

Source: 2009 Labour Market Update

Research conducted for this assignment focusing on vehicle and business technology training suggests a rank order of training formats for employees considering both vehicle and business technology training, is as follows[19] (highest percentage expressing a format training preference mentioned first):

1. On-the-job training
2. E-learning or online training
3. Interactive distance learning such as satellite courses but not e-learning
4. In-house training, such as formal classes provided at the worksite
5. Manufacturer-funded training at an educational institution
6. Manufacturer-provided training

That is, these data seem to suggest that, in addition to on-the-job training, e-learning and interactive distance learning are considered to be important training options for employees wanting to upgrade their knowledge and skills for vehicle and business technologies.

19 Care should be taken when interpreting these results as the number of interviews is 43, insufficient to provide full statistical assurance in these data. As a result, these data are not provided in detailed tabular format.

6.0 Business Technology Knowledge and Skills

This section of the report considers relevant aspects of employees' business technology knowledge and skills and related perspectives of employers in the Automotive Service and Repair, Collision Repair, Medium and Heavy-duty Truck and Parts Wholesaling, Retailing and Recycling sub-sectors in Canada. Data for this section of the report were drawn from research conducted for the CARS' 2009 Labour Market Update Study. These data were supplemented and selected additional issues explored in interviews conducted for this engagement with 66 employers and 43 employees across Canada.

In the following, employer are considered first in each subsection and then relevant employee perspectives are explored, except where issues pertain to only employers or employees, in which case employers or employees are considered independently.

6.1 Technology Areas of Most Interest

Diagnostic systems and equipment, specialized shop floor tools, equipment and rooms and Customer Relationship Management systems top the list of business technologies in which employers plan to invest over the next three years. Where investments are made in new business technologies, it is likely that less than $50,000 will be invested by each employer. Ten percent or fewer employers intend to invest more than $50,000 in each new business technology. Table 20 provides additional detail.

Table 20: Investment intentions in business technologies over next three years

	None	Less than $50,000	$50,000 to $100,000	More than $100,000	Total Percent Investing
Diagnostic systems and equipment	39%	51%	8%	2%	61%
Specialized shop floor tools, equipment and rooms	59%	33%	6%	2%	41%
Customer Relationship Management	63%	34%	2%	1%	37%
Online systems for customers to track vehicle repairs and make appointments	69%	29%	1%	1%	31%
Online procurement/purchasing	71%	26%	2%	1%	29%
Jobber Management Systems	78%	19%	2%	1%	22%
Systems integration services	79%	18%	2%	1%	21%
Radio-frequency and other specialized handheld devices	80%	19%	1%	0%	20%
Body Shop Management Systems	83%	15%	2%	0%	17%
Warehouse Management Systems	88%	10%	1%	1%	12%
GPS vehicle and fleet tracking systems	89%	9%	1%	1%	11%
Fleet Management Systems	89%	10%	1%	0%	11%

Source: 2009 Labour Market Update

The larger employers are, the more likely they are to invest in specific business technologies. For example, 54% of employers with fewer than three service bays intend to invest in diagnostic systems and equipment, while 64% of employers with 3 to 9 service bays intend to do likewise. A similar assessment applies to other business technologies. Annual gross revenue metrics yield a similar perspective, as does the number of employees; the number of employees shows a very linear relationship between size of business and investment intent. Table 21 provides additional detail.

Table 21: Percent of Employers Planning Investments in Business Technologies over Next Three Years, By Size of Business

	Diagnostic systems and equipment	Specialized shop floor tools, equipment and rooms	Customer Relationship Management	Online systems for customers to track vehicle repairs and make	Online procurement/purchasing	Jobber Management Systems	Systems integration services	Radio-frequency and other specialized handheld devices	Body Shop Management Systems	Warehouse Management Systems	GPS vehicle and fleet tracking systems	Fleet Management Systems
Number of Service Bays												
Up to 2	54	32	25	22	22	15	17	15	12	6	11	10
3 to 9	64	40	38	32	27	21	20	21	16	9	8	12
10 to 24	69	51	42	37	32	28	26	25	22	16	11	11
25 or greater	61	50	61	37	33	27	30	18	34	18	15	15
Annual Gross Revenues												
Less than $250,000	49	36	20	19	18	16	13	10	13	6	8	9
$250,000 to $500,000	62	41	35	33	28	19	17	22	13	9	11	10
$500,000 to $1 million	67	41	36	35	29	24	21	22	17	10	6	12
$1 million to $2 million	64	46	46	36	36	27	26	23	21	19	13	14
$2 million or greater	64	42	49	32	37	26	28	28	23	20	15	14
Number of Persons Employed												
Less than 5	51	41	28	28	25	15	13	16	14	8	8	9
5 to 9	55	39	36	29	30	24	19	19	20	12	11	12
10 to 19	66	40	38	32	29	22	25	22	16	14	11	13
20 or more	75	43	49	35	32	30	27	27	19	14	12	11

Source: 2009 Labour Market Update

Many employees perceive that they need knowledge or skills upgrading for business technologies. As described in Table 22, 59% percent of employees indicate an interest in improving themselves for Customer Relationship Management systems, 58% for diagnostic systems and equipment, and 47% for online systems for customers to track vehicle repairs and make appointments over the Internet.

Table 22: Employees' ratings of the amount of knowledge or skills upgrading required, by business technology area

	None	Some	Considerable	Some or Considerable	Doesn't apply
Customer Relationship Management Systems	22%	42%	17%	59%	19%
Diagnostics systems and equipment	20%	36%	22%	58%	22%
Online systems for customers to track vehicle repairs or make appointments over the Internet	25%	31%	16%	47%	28%
Online procurement and purchasing	28%	32%	14%	46%	27%
Jobber Management Systems	28%	32%	10%	42%	30%
Specialized repair and service and collision tools, equipment and rooms	26%	27%	15%	42%	32%
Systems integration services	29%	29%	11%	40%	32%
Radio-frequency and other specialized handheld devices	31%	25%	13%	38%	32%
Fleet Management Systems	33%	22%	9%	31%	37%
Warehouse Management Systems	35%	22%	8%	30%	35%
GPS vehicle and fleet tracking systems	33%	20%	10%	30%	37%
Body Shop Management Systems	31%	19%	10%	29%	40%

Source: 2009 Labour Market Update

6.2 Subsectors' Perspectives

Diagnostic systems tops the list of investments in business technologies that employers intend to make in several subsectors of the industry - 68% of employers in Automotive Service and Repair Shops, 63% of employers in Truck / Transport / Heavy Duty Repair Shops and 62% of Parts Wholesalers, Retailers and Recyclers indicate they plan to invest in these systems over the next three years. Sixty-three percent of employers in Collision Repair Shops plan to invest in specialized shop floor tools, equipment and rooms. Table 23 provides additional detail.

Table 23: Percentage of employers in each subsector intending to invest in new Business Technologies

	Automotive Service Repair Shops	Autobody and Collision Repair	Truck/Transport/Heavy Duty Repair Shops	Heavy Truck/Trailer Collision Repair	Parts Wholesalers, Retailers, Recyclers
Diagnostic systems and equipment	68%	45%	63%	54%	62%
Specialized shop floor tools, equipment and rooms	38%	63%	32%	41%	36%
Customer Relationship Management	41%	26%	29%	32%	41%
Online systems for customers to track vehicle repairs and make appointments	34%	30%	29%	23%	30%
Online procurement/purchasing	28%	25%	25%	19%	35%
Jobber Management Systems	23%	16%	16%	15%	25%
Systems integration services	23%	16%	13%	9%	24%
Radio-frequency and other specialized handheld devices	23%	12%	19%	12%	23%
Body Shop Management Systems	12%	40%	10%	17%	13%
Warehouse Management Systems	9%	6%	11%	6%	18%
GPS vehicle and fleet tracking systems	9%	7%	16%	13%	14%
Fleet Management Systems	12%	6%	15%	10%	12%

Source: 2009 Labour Market Update

The relative importance employees place on business technology knowledge and skills upgrading varies according to the subsector under consideration. The following are the top 3 business technologies in which the highest percentage of employees in each subsector has some or considerable interest in knowledge or skills upgrading (highest percentage mentioning some or considerable skills upgrading listed first):

Service and repair of cars and light trucks:

1. Diagnostics systems and equipment
2. Customer Relationship Management Systems
3. Online systems for customers to track vehicle repairs or make appointments over the Internet

Autobody and collision repair:

1. Specialized repair and service and collision tools, equipment and rooms
2. Body Shop Management Systems
3. Customer Relationship Management Systems

Service and repair of heavy trucks and trailers subsector:

1. Customer Relationship Management Systems
2. Diagnostics systems and equipment
3. Online systems for customers to track vehicle repairs or make appointments over the Internet

Heavy truck and trailer collision repair subsector:

1. Online systems for customers to track vehicle repairs or make appointments over the Internet

2. Customer Relationship Management Systems
3. Diagnostics systems and equipment

Parts wholesale, retail, distribution or recycling subsector:
1. Customer Relationship Management Systems
2. Online procurement and purchasing
3. Diagnostics systems and equipment

Table 24 details the business technology areas of “some” or “considerable” interest to employees in each of the subsectors considered.

Table 24: Percentage of employees in each subsector indicating a need for some or considerable knowledge or skills upgrading over the next three years, for business technologies

	Service and repair of cars and light trucks	Autobody and collision repair	Service and repair of heavy trucks and trailers	Heavy truck and trailer collision repair	Parts wholesale, retail, distribution or recycling
Body Shop Management Systems	21%	56%	24%	40%	27%
Customer Relationship Management Systems	60%	51%	59%	52%	65%
Diagnostics systems and equipment	66%	42%	58%	50%	53%
Fleet Management Systems	31%	22%	47%	40%	33%
GPS vehicle and fleet tracking systems	32%	20%	41%	32%	34%
Jobber Management Systems	44%	31%	44%	43%	51%
Online procurement and purchasing	43%	35%	50%	45%	55%
Online systems for customers to track vehicle repairs or make appointments over the Internet	51%	45%	53%	55%	47%
Radio-frequency and other specialized handheld devices	42%	24%	42%	42%	37%
Specialized repair and service and collision tools, equipment and rooms	36%	58%	37%	49%	40%
Systems integration services	41%	36%	43%	45%	43%
Warehouse Management Systems	27%	21%	32%	36%	44%

Source: 2009 Labour Market Update

6.3 Regional Perspectives

Employer intentions towards investments in business technologies do not differ significantly by region, as detailed in Table 25.

Table 25: Percentage of employers in each region intending to invest in new business technologies

	Atlantic	Quebec	Ontario	West
Diagnostic systems and equipment	57%	56%	60%	66%
Specialized shop floor tools, equipment and rooms	36%	32%	42%	46%
Customer Relationship Management	33%	40%	35%	41%
Online systems for customers to track vehicle repairs and make appointments	25%	30%	32%	33%
Online procurement/purchasing	26%	35%	26%	30%
Jobber Management Systems	23%	14%	24%	24%
Systems integration services	19%	24%	17%	25%
Radio-frequency and other specialized handheld devices	14%	24%	20%	24%
Body Shop Management Systems	16%	15%	17%	18%
Warehouse Management Systems	11%	18%	11%	10%
GPS vehicle and fleet tracking systems	6%	11%	11%	11%
Fleet Management Systems	7%	10%	12%	13%

Source: 2009 Labour Market Update

There are also limited provincial/regional differences in the business technologies in which the highest percentage of employees are interested in receiving some or considerable knowledge or skills upgrading. The following lists the top 3 business technologies in which employees in four Canadian regions or provinces perceive a need for some or considerable knowledge or skills upgrading (highest perceived need listed first). It can be seen that the top three technologies are similar across the various regions/provinces although the rank order may differ.

Atlantic Canada

1. Diagnostics systems and equipment
2. Customer Relationship Management Systems
3. Online systems for customers to track vehicle repairs or make appointments over the Internet

Québec

1. Customer Relationship Management Systems
2. Online procurement and purchasing
3. Diagnostics systems and equipment

Ontario

1. Diagnostics systems and equipment
2. Customer Relationship Management Systems
3. Online systems for customers to track vehicle repairs or make appointments over the Internet

Western Canada
1. Customer Relationship Management Systems
2. Diagnostics systems and equipment
3. Online systems for customers to track vehicle repairs or make appointments over the Internet

Table 26 provides additional detail.

Table 26: Percentage of employees indicating a need for some or considerable knowledge or skills upgrading for business technologies, by province or region

	Atlantic	Québec	Ontario	West
Body Shop Management Systems	32%	30%	25%	31%
Customer Relationship Management Systems	59%	63%	54%	61%
Diagnostics systems and equipment	61%	51%	60%	58%
Fleet Management Systems	27%	27%	31%	36%
GPS vehicle and fleet tracking systems	30%	29%	30%	33%
Jobber Management Systems	41%	38%	41%	46%
Online procurement and purchasing	44%	58%	38%	47%
Online systems for customers to track vehicle repairs or make appointments over the Internet	46%	48%	44%	50%
Radio-frequency and other specialized handheld devices	40%	37%	36%	38%
Specialized repair and service and collision tools, equipment and rooms	46%	38%	38%	46%
Systems integration services	38%	39%	39%	42%
Warehouse Management Systems	31%	42%	24%	30%

Source: 2009 Labour Market Update

6.4 Barriers and Constraints

Canada and the global economy were in recession when research was conducted for this assignment. Not surprisingly, therefore, the state of the Canadian economy was noted as the number one factor limiting employers' ability to effectively address the challenges involved with new vehicle and business technologies. Other factors employers consider as important barriers and constraints to effectively adapt to new vehicle technologies and to effectively implementing new business technologies are as follows (most important mentioned first):
- Health of economy and auto industry
- Cost of employee training
- Cost of equipment and facilities required by new vehicle technologies
- Cost of software and equipment for new business technologies
- Recruiting sufficient numbers of qualified people
- Keeping sufficient numbers of qualified people
- Sourcing appropriate training for employees

There is some variation in the relative importance employers in different subsectors place on constraining factors but the cost of employee training is important to employers in all subsectors considered. The following lists the top three factors for each subsector:

Auto service repair shops:

- Health of economy and auto industry,
- Cost of employee training, and
- Cost of equipment and facilities required by new vehicle technologies, and Cost of software and equipment for new business technologies (tie)

Collision repair shops:

- Cost of employee training,
- Cost of equipment and facilities required by new vehicle technologies, and
- Cost of software and equipment for new business technologies.

Truck/transport/heavy duty repair shops:

- Cost of employee training,
- Cost of equipment and facilities required by new vehicle technologies, and
- Health of economy and auto industry, Recruiting sufficient numbers of qualified people, and Sourcing appropriate training for employees (tie).

Parts wholesalers, retailers and recyclers:

- Cost of employee training,
- Health of economy and auto industry, and
- Cost of software and equipment for new business technologies.

Employees perceive that the most significant factors in their workplaces that could limit their ability to learn what they need to know about new business technologies over the next 3 to 5 years are as follows, with the most important factor mentioned first:

- Getting appropriate training,
- Getting training on-the-job for skills development,
- The cost of employee training,
- Knowing how to use a computer effectively,
- Having the right equipment and facilities for the technologies, and
- Getting time off for training.

There is some variation in the relative importance of the factors that employees in different subsectors perceive are potentially material limitations on their ability to learn new business technologies. In automotive service repair shops, many employees consider the most important limiting factors are “getting appropriate training”, “knowing how to use a computer effectively” and “the cost of employee training”. In collision repair shops, most respondents consider that “getting appropriate training” and “having the right equipment and facilities for the technologies” are similarly important limiting factors. In truck, transport and medium/heavy-duty repair shops, employees think the most important limiting factors are “getting time off for training” and “having the right equipment and facilities for the technologies.” Employees in the parts wholesaling subsector consider that all factors are similarly important.

7.0 Collaboration and Best Practices

This section of the report considers selected collaboration and best practice considerations, and includes a review of the Technology Roadmap in this regard.

7.1 The Technology Roadmap (TRM)

The Technology Roadmap (TRM) concept is a consultative process that is designed to help industry, its supply-chain, academic and research groups, and governments come together to jointly identify and prioritize the technologies needed to support strategic R&D, marketing and investment decisions. The technologies on which a TRM focuses are generally chosen because of their critical importance to an industry in the next five to ten years. According to Industry Canada, in developing a TRM, companies within a sector come together in a joint commitment to identify the critical technologies as well as the skills required to properly utilize the technologies of the future. The TRM is a means to achieve a joint decision on future research and development, future skills development, and to establish a commitment to work together to address these challenges.[20]

Also according to Industry Canada[21], technology roadmapping is both a process and a forecasting tool that:

- predicts the technologies imperative to addressing future markets;
- charts a path for commercialising the right technologies;
- helps industry seize new market opportunities;
- guides technology R&D decisions;
- builds new partnerships and R&D collaborations, both within Canada and internationally;
- provides crucial input to government policy.

Recognizing this background and observing that the above-mentioned approach to roadmapping has previously often focused principally on products and bringing new technologies to market rather than services and providing a roadmap for the management of technologies once they are already introduced, interviews were conducted with three sector councils[22] to understand their processes for introducing the technology roadmap with a view to guiding subsequent research to explore the potential of technology roadmaps for this engagement.

The interviews suggest that the TRM can be applied in sectors that do not strictly have a “product” focus as would be the case with CARS.

Interviews also suggested that processes for engaging with the sector councils’ constituencies prior to the introduction of technology roadmaps varied according to the level of analysis that preceded the initiative and the methods for

[20] *Introduction to Technology Roadmapping*, Industry Canada, http://www.ic.gc.ca/eic/site/trm-crt.nsf/eng/h_rm00049.html

[21] *Technology Roadmapping: Charting the Course to Innovation*, industry Canada, http://www.ic.gc.ca/eic/site/trm-crt.nsf/eng/h_rm00229.html

[22] The Cultural Human Resources Council, the Canadian Printing Industries Council, and the Wood Manufacturing Council

communication with stakeholders. Some, like the Cultural Human Resources Council, started with a visioning exercise to which guests were invited and a roundtable session held to discuss the development of a technology roadmap. In the case of the Canadian Printing Industries Sector Council, technologies were identified that would affect the industry in the next five years and then the technology roadmap project was communicated to a broader industry audience. The Wood Manufacturing Council perceived that everyone in their industry already recognizes the importance of technology and its impact on skills and training, so they launched the initiative to their full audience at the outset.

The experience of other sector councils suggests that the committed involvement of selected senior personnel, such as innovative suppliers to the industry and Board members, can help accelerate informed communication and draw peers into the process. It has been helpful to establish an Advisory Committee to guide the technology roadmap process and be closely involved in the visioning exercise at the start of the initiative. It is also helpful to trust the process for technology roadmapping to result in the desired outcome and at the outset, this process involves a visioning exercise to frame the focus for the remaining components of the technology roadmap.

Initial research with industry participants and observers other than the sector councils noted above suggests that the concept of technology roadmaps is not generally or well understood and accordingly Phase 1 research on this topic yielded inconclusive results as to the merits of proceeding with such an initiative in this sector. This initial research suggested it would be beneficial for subsequent Phase 2 research to explore TRM indirectly by focusing on issues such as employers' need for best practices and their willingness to collaborate with one another. Accordingly, Phase 2 research focused on assessing the respondents' interest in best practices information and their willingness to share data to facilitate the development of best practices.

7.2 Sharing of Best Practices

When asked if they think businesses involved in vehicle repair and service, collision repair and aftermarket parts would benefit from the identification and sharing of best practices in managing human resource challenges brought about by new vehicle and new business technologies, most employers (about three in four) are positive. Parts wholesalers, retailers and recyclers appear less likely to be willing to share best practice information than employers in other subsectors but, even in this case, over half the employers report an interest in so doing.

Employers who are negative on the sharing of best practices are concerned that such sharing of information would hurt their competitive position. Others with similar concerns suggest that best practice information could only be shared with others within the same franchise, and about 10 to 20% of employers in automotive service repair shops and collision repair shops have this view.

Table 27: Percentage of employers in each subsector reporting businesses would benefit from sharing human resource best practice information

	Automotive Service Repair Shops	Collision Repair	Truck / Transport / Heavy Duty Repair Shops	Parts Wholesalers, Retailers, Recyclers
Yes	71%	75%	86%	56%
Yes, but only within franchise	7%	25%	0%	0%
No	12%	0%	14%	22%
Uncertain	10%	0%	0%	22%

Source: Based on 66 telephone interviews.
Note: Care should be used when interpreting these data, given the small number of respondents by sub sector.

7.3 Shared Approach to Resolving Human Resource Issues

While many employers think businesses should collaborate to share human resource best practice information for new vehicle and business technologies, it appears that fewer would actually do so. Still, at least half employers interviewed for this engagement appear willing to work together to develop a shared approach to resolving human resource issues affected by new vehicle and business systems technologies. Collaboration is additionally possible within a franchise, and employers in these environments are often willing to work together but not with competitors from outside the franchise. From 10% to 20% of employers are not willing to share information to resolve human resource issues.

Table 28: Percentage of employers in each subsector willing to work together to develop a shared approach to resolving human resource issues affected by new vehicle and business systems technologies

	Automotive Service Repair Shops	Collision Repair	Truck/Transport/Heavy Duty Repair Shops	Parts Wholesalers, Retailers, Recyclers
Yes	47%	50%	86%	78%
Yes, but only within franchise	12%	12%	0%	0%
No	26%	12%	0%	22%
Uncertain	15%	26%	14%	0%

Source: Based on 66 telephone interviews
Note: Care should be used when interpreting these data, given the small number of respondents by sub sector.

8.0 Conclusions and Options for CARS' Consideration

This section of the report provides conclusions for the engagement and suggests selected options for CARS to consider as possible initiatives for implementation.

8.1 Conclusions

8.1.1 Critical technologies currently impacting the workforce and those to be introduced in the next three to five years

There will be a continuing proliferation of vehicle and business technologies which has the potential to challenge employers' and employees' abilities to run their businesses or do their work effectively, respectively.

Secondary research and interviews identified 95 vehicle technologies that have recently been incorporated into, or are likely to be incorporated into new car, light/medium truck and heavy truck vehicles over the next 3 to 5 years. For the most part, this list does not include technologies that are in the research stage or in concept vehicles where significant adoption is likely to occur more than five years away. This list also excludes subassemblies, components and subcomponents for the technologies, fuels, products or assemblies and is also primarily comprised of OEM technologies, not product technologies only available in the aftermarket.

Business technologies are also proliferating and are complex and, when considered in association with vehicle technologies, technological change further challenges knowledge and skills gaps to be closed by employers and employees, both because of the sheer number of technologies to be understood and the complexity of these technologies.

Most of the new vehicle technologies are associated with engines and fuel, and onboard electronics, such as in the engine bays and passenger compartments of vehicles. Seventy four percent of the vehicle technologies identified are in these two categories from which it can be concluded that there is an opportunity to focus training and skills development.

Because the sheer number of technologies makes it challenging to address every one of the knowledge and skills gaps that are likely to emerge over the next 3 to 5 years, vehicle technologies may be categorized according to the likely scale of adoption and the skills gaps of current employees. From this it may be observed that many of the new OEM technologies in the marketplace over the next 3 to 5 years will be niche technologies that will be of modest scale such as those that will be in high end or specialized vehicles, and about a third of all new technologies will not require much new knowledge for today's workforce, which provides an opportunity to focus training and skills development further.

Over half of the new vehicle technologies are likely to experience intermediate or considerable adoption, and about two thirds of technologies are likely to face a medium to high knowledge gap for today's workforce. Combining these two considerations, opportunities to focus knowledge and skills development can be identified, leaving a much smaller number of vehicle technologies for knowledge upgrading or skills enhancement for today's workforce. Lightweight and advanced materials, and hybrid and electric motive power are two areas suggested by this consideration.

8.1.2 Critical skills needed now and in the next three to five years to work with the new technologies

Employers and employees provide empirical support of conclusions regarding the areas in which knowledge and skills upgrading is perceived to be in greatest need. In the following, conclusions regarding critical skills needed for new vehicle technologies are presented and then new business technologies.

8.1.2.1 New vehicle technologies

Employers in Automotive Service and Repair Shops and Parts Wholesalers, Retailers and Recyclers perceive onboard electronics, hybrid electric vehicles and diagnostics as areas to emphasize skills development. These shops are less concerned with improvements in paint, frame and metal construction and lightweight and new materials. Employers in Collision Repair Shops, on the other hand, view these last-mentioned areas seriously. Employers in Truck / Transport / Heavy Duty Repair Shops also view onboard electronics and diagnostics as priorities, however, they report more need for knowledge and skills upgrading in relation to improvements in emissions controls than other sectors.

Like employers, employees also perceive all areas of new vehicle technology will require some amount of knowledge or skills upgrading. Employees' views are also aligned with employers in each subsector as to the technology areas requiring most knowledge and skills upgrading, so it can be concluded that the awareness and interest employers and employees have in closing knowledge and skills gaps are similar and that initiatives that effectively address relevant knowledge and skills gaps are likely to be equally accepted by employers and employees.

8.1.2.2 New business technologies

Diagnostic systems and equipment, specialized shop floor tools, equipment and rooms, and Customer Relationship Management (CRM) systems are three areas in which new enterprise knowledge will be required over the next three or five years by virtue of the investment intentions of employers. In addition, employees in specific subsectors seek to close knowledge or skills gaps in areas such as body shop management systems (for employees in auto body collision repair shops), online systems for customers to track vehicle repairs or make appointments over the Internet (heavy truck/trailer collision repair shops) and online procurement and purchasing (parts wholesalers, retailers and recyclers).

Employers plan to make new investments in a number of new business technologies over the next three to five years. The top two areas in which employers in each subsector are planning to invest are summarized in Table 29. (The figures that appear in brackets are the percentage of employers in each subsector intending to make an investment of the next 3 to 5 years in the specific technology). Diagnostic systems and equipment is the area of greatest investment interest to employers as a whole - 61% of employers intend to invest here over the next 3 to 5 years. The second most important area is specialized repair and service and collision tools, equipment and rooms, where 41% of employers expect to invest. The third most important area for investment is CRM systems, of investment interest to 37% of employers.

Table 29: Employers' Top New Business Technology Areas

Automotive Service Repair Shops	Autobody and Collision Repair	Truck / transport / heavy duty Repair Shops	Heavy Truck/trailer Collision Repair	Parts wholesalers, Retailers, Recyclers
Diagnostic systems and equipment (69%)	Specialized shop floor tools, equipment and rooms (62%)	Diagnostic systems and equipment (62%)	Diagnostic systems and equipment (54%)	Diagnostic systems and equipment (62%)
Customer Relationship Management systems (40%)	Diagnostic systems and equipment (46%)	Specialized shop floor tools, equipment and rooms (32%)	Specialized shop floor tools, equipment and rooms (41%)	Customer Relationship Management systems (41%)

Source: 2009 Labour Market Update
Note: Figures that appear in brackets indicate the percentage of subsector employers intending to invest in the specific technology over the next 3 to 5 years

Employees understand the areas in which employers intend to make business technology investments. Table 30 summarizes employees' perspectives of the top 2 new business technologies in which they consider they need most knowledge and skills upgrading, revealing considerable alignment with employers' intended investments.

Table 30: Employees and New Business Technologies

Automotive service repair shops	Autobody and Collision Repair	Truck / transport / heavy duty shops	Heavy Truck/trailer Collision Repair	Parts Wholesalers, Retailers, Recyclers
Diagnostic systems and equipment	Specialized shop floor tools, equipment and rooms	Customer Relationship Management systems	Online systems for customers to track vehicle repairs or make appointments over the Internet	Customer Relationship Management systems
Customer Relationship Management systems	Body shop management systems	Diagnostic systems and equipment	Customer Relationship Management Systems	Online procurement and purchasing

Source: 2009 Labour Market Update

8.1.3 Major barriers and constraints related to technology and to the future development of the industry's businesses

The principal constraint faced by employers wanting to close knowledge or skills gaps in today's marketplace relates to the affordability of training. Employers are most concerned about the state of the Canadian economy and consider this to be the number one factor limiting their ability to effectively address the challenges associated with new vehicle and business technologies, not a surprising finding given the recent global economic downturn. Employers are also concerned with costs such as the cost of training, new equipment, facilities and software.

Employees, on the other hand, are most concerned with actually "getting appropriate training" and "having the right equipment and facilities." Employees perceive cost to be an employer issue, but recognize costs may well limit their employers' ability to provide appropriate training as well as needed facilities and equipment in a timely manner.

8.1.4 Industry's interest in the identification and sharing of best practices in managing human resource challenges brought about by technology advancements

Employers generally perceive a need for sharing of best practices, albeit with some collaboration restrictions. Some employers do not wish to share business and best practice data with other employers in their industry for competitive reasons but there remains much interest in best practices and many employers are indeed willing to share such relevant data. In addition, many dealers already participate in best practice initiatives such as 20 Groups[23] so there is evidence that many employers are able to get past some of their competitive and other concerns when collaborating.

The Technology Roadmap (TRM) concept is an approach that can result in the identification and sharing of best practices in managing HR challenges. The TRM is a consultative process designed to help industry, its supply-chain, academic and research groups, and governments come together to jointly identify and prioritize the technologies needed to support strategic R&D, marketing and investment decisions. The TRM approach is not well understood in the industry and consideration will need to be given to the effective communication of such an initiative if one was launched.

A TRM initiative would likely be beneficial for the industry. Research suggests that most employers consider that businesses involved in vehicle repair and service, collision repair and aftermarket parts would benefit from the identification and sharing of best practices in managing human resource challenges brought about by new vehicle and new business technologies. Employers believing otherwise were concerned that sharing of best practice information could include disclosure of competitive intelligence and weaken a firm's competitive position. Some employers with similar concerns suggested that, as a result, best practice information should be shared on a non-competitive basis within the same franchise.

From this it may be concluded that there likely is an opportunity for a technology roadmap to be conducted in this sector. Although early technology roadmaps were

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[23] A "20 Group" comprises 20 or fewer business owners or managers who share knowledge about their respective businesses, on a confidential basis.

mostly focused on technology per se, subsequent TRMs have dealt with services and it is possible for such a TRM to be conducted in this sector.

8.2 Options for CARS' Consideration

The conclusions from this assignment suggest a number of possible opportunities and options for CARS to consider, as described below.

8.2.1 Courses for new vehicle technology knowledge provision

This assignment has noted the proliferation of new vehicle technologies (95 new vehicle technologies were identified) and in particular, technologies associated with engines and fuel, and onboard electronics, such as in the engine bays and passenger compartments. Research has demonstrated the interest of both employers and employees in securing new knowledge and skills upgrading for employees. While most employees and employers suggest all the technology advancements will require some amount of new knowledge or skills upgrading, each industry subsector has different priorities. For example, automotive service repair shop employers' top priorities are onboard electronics, hybrid electric vehicles and diagnostics, while employer priorities in the collision repair subsector include paint, hybrid electric vehicles and improvements in frame and metal construction. Truck/transport/heavy-duty repair shops share the interests of other subsectors in onboard electronics and diagnostics, but also place considerable emphasis on emissions control knowledge and skills upgrading. Employees in these same subsectors are similarly interested. Accordingly, it would seem appropriate for CARS to consider these various preferences in the context of CARS' own calendar for training courses to establish whether all the areas of interest are sufficiently covered by existing programs, particularly in the areas where there is likely to be a proliferation of new vehicle technologies such as engines and fuel, and onboard electronics. Where gaps exist, it may be appropriate for CARS to evaluate whether to provide new, upgraded or intensified training for employees to respond to their requirements and those of their employers.

8.2.2 Courses for new business technology knowledge provision

This assignment has noted that employers intend to make investments in a number of new business technologies over the next 3 to 5 years. For example, high priority areas for employer investment include diagnostic systems and equipment, specialized repair and service and collision tools, equipment and rooms, and customer relationship management systems. Generally, training for business technology in areas such as these is provided by vendors but opportunities may exist for CARS to collaborate with selected vendors to provide training on their behalf. This may be especially beneficial to CARS in situations where specific vendors enjoy a high market share so that CARS does not need to tailor training to the solutions of a wide variety of vendors. The benefit to vendors from collaborating with CARS could be to cost-reduce the provision of training through this collaboration, which could take many forms ranging from co-development of asynchronous e-learning training solutions[24] to satellite distance learning featuring the trainers from the various vendors, for example. Although not specifically assessed for this engagement, general experience suggests that business technology vendors would likely also appreciate the training and technology capabilities and professionalism of CARS and CARS' access to businesses in the entire sector.

8.2.3 Cost of training and skills upgrading courses

Employers perceive that there are two important barriers limiting their willingness or ability to provide knowledge and skills upgrading to their employees, as follows: the health of the economy and the auto industry, and the cost of employee training and new equipment. While the health of the economy and the auto industry are obviously factors beyond CARS' control, CARS is well positioned to help firms understand how the organization can help them address the second issue - the cost of employee training. CARS' current initiatives, including distance education and e-learning, help cost-reduce training provided by employers and employees likely to access their training via interactive distance education and e-learning, and continued communication of these cost-related benefits would seem to be beneficial and appropriate.

Additional opportunities to reduce or restructure prices for training are indicated and CARS is already doing much to accomplish this objective. Where CARS has not already undertaken specific initiatives suggested below, the following could be areas for additional consideration or the measurement of ongoing progress with a view to further refinement of these initiatives:

- Passing along cost reductions derived from any partnering alignments with suppliers as noted previously,
- Entering into new partnering arrangements with other training organizations including educational institutions, with possible cost savings for employers,
- Developing standard "skins" for e-learning content - the appearance of sequential screens - and harmonizing teaching pedagogy to cost reduce time investment for new course development,
- Considering new pricing structures or alternative methods or models for pricing in addition to, or instead of, current approaches. These alternatives could include charging an access fee and no per course usage charge, setting a price per user, per dealership or service organization, pricing for potential access to content whether or not it is actually used, menu-based pricing or tiered pricing for specific content, and establishing a subscription

[24] There are two main methods for delivering e-learning: asynchronous and synchronous delivery. Asynchronous training is delivered without instructors and involves learners accessing the training themselves -what can be termed a "learner-led" process. Synchronous training is delivered in real-time with instructors interacting with students concurrently with training delivery. Technologies employed with synchronous training delivery can include teleconferencing, Internet messaging (IM), web conferencing and wireless communications. Synchronous training is generally instructor-led.

pricing model - setting a flat charge, perhaps on an annual basis, by which content can be consumed without regard to volume. The various combinations suggested by the preceding are many, as are possible pricing strata, say according to size of organization.

Given the importance of price to employers, strategic approaches to reframe cost reduction may merit additional consideration by CARS. The following are speculative, if significant, options offered here only to illustrate the kinds of considerations that might be derived from such an exercise:

- Allowing other sectoral councils or private sector firms in the industry to use CARS' training facilities and expertise, on a cost sharing basis,
- Obtaining advertising revenues from CARS' websites, and
- Exporting online education to organizations, employers and employees in foreign countries.

There may be additional opportunities for CARS to develop new revenues. Employers note concerns associated with the cost of equipment and facilities required by new vehicle technologies, and the cost of software and equipment for new business technologies. While it would be expected that CARS' mandate might not suggest direct intercession here (say by negotiating blanket purchasing arrangements), it would appear that information provision might be beneficial to help employers understand alternative solutions, prices or price ranges, approaches for evaluating their technology options, implementation considerations, and so on, and potentially some among these services could yield additional revenues for the organization.

8.2.4 Technology Roadmap

Other than concerns of a competitive nature, many industry participants are willing to share information and collaborate to address relevant human resource knowledge, skills and training issues precipitated by new vehicle and business technologies. The Technology Roadmap (TRM) could apply in this context and has the potential to be a valuable process in the automotive sector if it can accomplish a number of important objectives:

- Add new and relevant knowledge over and above what industry participants already obtain from existing approaches for collaboration and assimilating new content (including that available from CARS),
- Be even more inclusive, involving a wide variety of industry participants who do not presently benefit from other mechanisms for information sharing and knowledge upgrading, and
- Focus on issues of common concern without concentrating heavily on issues which industry participants might consider could affect their competitive positions.

The concept of TRM is not generally or well understood in this sector and employers will need to understand the benefits they would derive from participating in a TRM initiative - more than simply sharing of best practices. Employers would also need to receive a detailed explanation as to the nature of TRM if they are to consider participating in the initiative.

The success of the overall initiative would appear to depend heavily upon early inclusion of key industry decision leaders in an advisory or steering panel and other methods that could lead to broad and rapid industry participation, and a positive outcome of the visioning exercise that is typically undertaken early in the TRM process.

One of the first steps of the TRM process is typically to undertake a visioning exercise. This would be particularly important in order to define which best practices are to be considered in this exercise in which might be explored in the ongoing (non-TRM) initiatives that CARS undertakes. Additionally, defining where to focus will be of importance given the restrictions some employers will likely place on data sharing.

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Appendix B: Web-sites (Phase 1)

	Organization	Web Address
1	ABI/Inform (online database)	www.proquest.com/en-US/catalogs/databases/detail/abi_inform.shtml
2	ADP	http://www.adp.ca
3	ALLDATA	http://www.alldata.com/
4	Alliance of Automobile Manufacturers-AAM	www.autoalliance.org
5	Aluminum Technology Centre (ATC),Saguenay	http://imi.cnrc-nrc.gc.ca/CTA/default_e.html
6	Association of International Automobile Manufacturers of Canada – AIAMC	www.aiamc.com
7	Association of International Automobile Manufacturers, Inc. (AIAM)	www.aiam.org
8	Autelligence	www.autelligence.com
9	Auto Week	www.autoweek.com
10	AUTO21 (national research initiative)	www.auto21.ca
11	Autofacts	www.autofacts.com
12	Automobilwoche.	www.automobilwoche.de
13	Automotive Warehouse Distributors Assoc. (AWDA)	www.aftermarket.org
14	Automotive Career Development Center	www.auto-careers.org
15	Automotive Components and Parts Manufacturers	www.automotive-online.com
16	Automotive Industries Association of Canada	www.aiacanada.com/
17	Automotive News	www.autonews.com
18	Automotive News Europe	www.autonews.com/section/ANE
19	Automotive Parts Manufacturers Association of Canada (APMA)	www.apma.ca
20	Automotive Technology	www.automotive-technology.com
21	Automotive World (incl. Automotive Quarterly Review & the World Car & Truck reports)	www.automotiveworld.com
22	AWKnowledge	www.awknowledge.com
23	Azure Dynamics Corporation	www.azuredynamics.com
24	Better Place	www.betterplace.com
25	CAMI Automotive Inc. (CAMI)	www.cami.ca
26	CAMM: Centre for Automotive Materials & Manufacturing	www.camm.queensu.ca
27	Canadian Auto Workers	www.caw.ca
28	Canadian Automobile Association	www.caa.ca
29	Canadian Automobile Dealers Association (CADA)	www.cada.ca

30 Canadian Automotive Partnership Council (CAPC) www.capcinfo.ca

31 Canadian Council of Motor Transport Administrator www.ccmta.ca

32 Canadian Transportation Equipment Association www.ctea.ca

33 Canadian Vehicle Manufacturers Association (CVMA) www.cvma.ca

34 Centennial College www.centennialcollege.ca

35 Centre d'expérimentation des véhicules électriques du Québec (CEVEQ) www.ceveq.qc.ca/ English http://www.ceveq.qc.ca/cgi-cs/cs.waframe.content?topic=35262&lang=2

36 Centre de recherche en plasturgie et en composites (CREPEC) www.polymtl.ca/recherche/rc/unites/details.php?NoUnite=39

37 Centre de recherche industrielle du Quebec (CRIQ) www.criq.qc.ca

38 Centre for Automotive Research www.cargroup.org

39 Centre for Composites, Concordia University www.concom.encs.concordia.ca

40 Chrysler Canada www.chrysler.ca

41 Comite Sectoriel de ain-d'oeuvre des services automobiles www.csmo-auto.com

42 Collision Industry Information Alliance (CIIA) www.ciia.com

43 Concordia Centre for Advanced Vehicle Engineering (CONCAVE) www.concave.concordia.ca

44 Conseil Provincial des Comites Paritaires de l'industrie de l'automobile www.esourcecanada.com/profile.asp?company_id=19655333&type=regular

45 Daimler / Freightliner / Western Star www.daimler.com

46 Datamonitor www.datamonitor.com

47 Delaware Power Systems www.delawarepowersystems.com

48 Delta Power Systems www.deltapowersystems.com

49 Durham College www.durhamcollege.ca

50 Ecole Polytechnique (polymer composites) www.polymtl.ca

51 EIN Publishing www.eco-web.com/cgi-local/sfc?a=index/

52 Electric Drive Transportation Association www.electricdrive.org

53 Electric Mobility Canada www.emc-mec.ca

54 Electrovaya www.electrovaya.com

55 Energy Future www.energy-future.com

56 Environment Canada www.ec.gc.ca/CEPARegistry/regula

		tions/
57	ETVI	www.etvi.org/
58	Euromonitor	www.euromonitor.com
59	European Automobile Manufacturers Association	www.acea.be
60	EV World	www.evworld.com
61	Ford Motor Company	www.ford.com
62	Ford Motor Company of Canada	www.ford.ca
63	Frost & Sullivan	www.frost.com
64	Fuel Advantage Magazine	www.fuelpub.com
65	General Motors	www.gm.com
66	General Motors of Canada	www.gm.ca/gm
67	Georgian College	www.georgianc.on.ca
68	Green Car Journal	www.greencar.com
69	Heavy Duty Distributor Council (HDDC)	www.hddc.on.ca
70	Hera Hydrogen	www.herahydrogen.com
71	Hino Motors (USA)	www.hino.com
72	Honda	http://automobiles.honda.com
73	Honda Canada	www.honda.ca
74	Hydro-Québec	www.hydroquebec.com
75	Hymotion	www.a123systems.com/hymotion
76	Identifix	www.identifix.com
77	ims Automotive Interiors Worldwide	www.imsautomotive.com
78	Industrial Materials Institute	imi.cnrc-nrc.gc.ca/Default_e.html
79	Institut de recherche sur l'hydrogené Université du Quebec	irh.uqtr.ca/bienvenue/index-en.php
80	Institut du transport avancé du Quebec (ITAC)	www.itaq.qc.ca/
81	Intelligent Materials and Systems Institute (IMSI) Université de Sherbrooke	www.imsi.usherb.ca/
82	International Organization of Motor Vehicle Manufacturers (OICA)	www.oica.net/
83	Japan Automobile Manufacturers Association	www.jama.org
84	Japan Automobile Manufacturers Association (Canada)	www.jama.ca/
85	Just-Auto	www.just-auto.com/
86	Kenworth/PACCAR/Peterbilt (Ste-Therese, QC)	www.peterbilt.com
87	Kwantlen University College, Vancouver	www.kwantlen.ca
88	Manitoba Hydro	www.hydro.mb.ca/
89	McGill Metals Processing Centre	www.mmpc.mcgill.ca/

90	Mid-Del Technology Center	www.evtraining.com
91	Mitchell 1	www.mitchell1.com
92	Motor and Equipment Manufacturers Association	www.mema.org/
93	National Alternative Fuels Training Consortium	www.naftc.wvu.edu/
94	National Association of Trailer Manufacturers (NATM)	www.natm.com
95	National Biodiesel Board	www.biodiesel.org/
96	National Ethanol Vehicle Coalition	www.e85fuel.com/index.php
97	National Institute for Automotive Service Excellence	www.ase.com
98	National Research Council Canada - Centre for Surface Transportation	www.nrc-cnrc.gc.ca
99	Natural Resources Canada	www.nrcan-rncan.gc.ca/com/subsuj/tratra-eng.php
100	National Truck Equipment Association (NTEA)	www.ntea.com
101	Nissan Canada	www.nissan.ca
102	North American Automobile Trade Association	www.naata.org/
103	North American Bus Industries, Inc.	www.nabiusa.com
104	Northeast Advanced Vehicle Consortium	www.navc.org/
105	Office of Aerospace and Automotive Industries (OAAI)	www.trade.gov/mas/manufacturing/OAAI/index.asp
106	Ontario Trucking Association (OTA)	www.ontruck.org
107	Original Equipment Suppliers Association	www.oesa.org/
108	Pollution Probe	www.pollutionprobe.org/
109	Private Motor Truck Council (PMTC)	www.pmtc.ca
110	Purolator Courier	www.purolator.com/
111	Renault	www.renault.com
112	Reynolds and Reynolds	www.reyrey.com
113	Saskatchewan Institute of Applied Science and Technology (SIAST)	www.siast.sk.ca
114	Southern Alberta Institute of Technology (SAIT)	www.sait.ab.ca
115	Society of Automotive Analysts	www.cybersaa.org/
116	Society of Automotive Engineers (SAE)	www.sae.org
117	Society of Motor Manufacturers and Traders	www.smmt.co.uk/home.cfm
118	Southwest Research Institute	www.swri.org
119	Supplier Business	www.supplierbusiness.com/
120	Telsa Motors	www.teslamotors.com/
121	Toyota	www.toyota.com

122	Toyota Canada	www.toyota.ca
123	Transport Canada	http://www.tc.gc.ca/en/tc-main.htm
124	Transportation Equipment and Special Vehicles Manufacturers Association	www.ametvs.com/
125	Truck Trailer Manufacturers Association (TTMA)	www.ttmanet.org
126	U.S. Department of Energy Clean City Coalitions	www1.eere.energy.gov/cleancities/coalitions.html
127	U.S. Deparment of Energy, Alternative Fuels & Advanced Vehicles Data Center	www.afdc.energy.gov/afdc/vehicles
128	Unicell	www.unicell.com/
129	Universite du Quebec a Chicoutimi (UQAC), & Centre universitaire du recherche sur l'aluminium (CURAL)	www.uqac.ca
130	Universite du Quebec a Trois-Rivieres (hydrogen safety and infrastructure)	www.uqtr.uquebec.ca/InfoGen/Anglais/
131	University of Manitoba	www.umanitoba.ca
132	US Department of Energy - Vehicle Technologies Program	www1.eere.energy.gov/vehiclesandfuels/
133	Used Car Dealers Association of Ontario (UCDA)	www.ucda.org
134	Volvo Trucks	www.volvotrucks.com
135	Ward's Automotive	www.wardsauto.com
136	West Virginia University	www.wvu.edu
137	ZENN Motor Company	www.zenncars.com

Appendix C: Interview guide (example)

Target Respondent's Name:

Date:

Title:

Company Name:

Address:

Telephone:

Introduction

Hello, my name is ____________________. Our firm, Convergence Management Consultants Ltd., is working with the CARS (Canadian Automotive Repair and Service) Council to study how advances in technology are impacting the occupational skills required by those involved in the industry. We are currently seeking input from a variety of organizations and individuals involved in the industry. More specifically, we wish to speak with the person in your organization knowledgeable about how advances in technology are impacting the skills required in automotive and heavy duty repair and service, collision repair and auto parts provisioning.
Would you be the best person to speak with?
(If no) Is there someone else in your organization that I might speak to?
Name:_____________________ Title:________________
Telephone:__________________
(If yes) May I take some time with you now to explore these issues with you? If you prefer, I could send you the survey and call back in half and hour to provide you time to consider your answers?
(If yes to proceed right away) Proceed to questionnaire
(If no) May I contact you again at a more convenient time?
(If yes) Confirm date ____________ and time ____________for discussion. Email survey to respondent.

Questionnaire

1. Hybrid electric vehicles, plug-in hybrid electric vehicles and pure electric vehicles are likely to be in increased production over the next 3-5 years. What challenges does each technology present to the nature and extent of skills required for vehicle repair and service, collision repair and parts provisioning?

Hybrid electric vehicles

Plug-in hybrid electric vehicles

Pure electric vehicles

2. Based on your knowledge and experience, what other automotive and heavy duty vehicle product innovations, in addition to those mentioned above, will impact the skills needed for automotive and heavy duty repair and service, collision repair and parts provisioning over the next 3-5 years? *(Please specify using form below.)*

2(b) For each of the technologies mentioned, please specify:

i) The primary drivers behind the technology
ii) The prime movers involved (companies or groups of companies)
iii) The types of vehicles involved (cars, vans/SUVs, trucks, heavy duty trucks, buses, etc.)
iv) The scale of adoption (small, medium or large) overthe next 3-5 years.
v) The gap in knowledge (small, medium or large) each technology represents for today's workforce.

Question 2a	Question 2bi					Q 2bii	Question 2biii						Q 2biv			Q 2bv		
Technology (Specify)	Enablers/Drivers (Check those that apply)					Prime Movers (Specify companies or categories of companies)	Vehicles Involved (Check those that apply)						Scale of Adoption over next 3-5 years			Gap in Knowledge		
	Safety	Emissions	Fuel economy	Alternative Fuels	Consumer demand		Cars	SUVs and Vans	Trucks	Heavy Duty Trucks	Buses	Other (specify)	Small	Medium	Large	Small	Medium	Large

3 (a) What <u>business innovations</u> -- including innovations of a process nature, such as how diagnostics are performed, how dents are removed or coatings applied, and how parts are ordered -- are impacting or likely to impact how employees in the automotive service and repair, collision and parts fields perform their jobs? Please specify.

___

___

___

3. (b) For each innovation mentioned, please specify:
   i) The key enablers or drivers behind its adoption
   ii) The key companies or groups of companies involved in its adoption
   iii) The scale of its adoption (small, medium, large) over the next 3-5 years
   iv) Any barriers, obstacles or key dependencies impacting adoption
   v) The gap in knowledge the technology has on the skills needed for automotive and heavy duty repair and service, collision repair and parts provisioning.

Question 3a	Question 3bi	Q 3bii	Q 3biii			Q 3biv	Q 3bv		
Technology (Specify)	Enablers/Drivers (Specify)	Prime Movers (Specify companies or categories of companies)	Scale of Adoption			Key Barriers, Obstacles, Dependencies (Specify)	Gap in knowledge		
			Small	Medium	Large		Small	Medium	Large

4. Are some categories of dealerships and repair and service shops or parts distributors better positioned to deal with the impacts of new technologies more than others? If so, which categories and why? *(Probe brands, size and location of dealership, etc.)*

___

___

___

___

5. Are you aware of any initiatives currently underway or in development to address the critical skills and knowledge gaps that will be needed to effectively, safely and productively distribute parts and repair and service vehicles with the new technologies previously mentioned? If so, please specify.

___

___

___

6. Are you aware of any studies, reports or articles about the technologies and/or their impacts on the skills required in automotive and heavy duty repair and service, collision repair and auto parts provisioning? If yes, please specify.

7. As new vehicle and business technologies change, it might be said that human resource skills and training should adapt as appropriate to the new technologies. Do you think that it would be helpful for the industry to undertake a formal examination of best practices for business and/or human resource processes that adapt to advanced and changing technologies?

8. Do you think that a similar best practices study would be helpful for the industry if it focused only on training for skills upgrading to adapt to advanced and changing technologies?

9. Are there any additional individuals or organizations that you recommend we speak with concerning new technologies and/or their impacts on the skills required in automotive and heavy duty repair and service, collision repair and auto parts provisioning? If yes, please specify.

Thank you for your time. We very much appreciate your input to our study.

Appendix D: Interview respondents (Phase 1)

Name	Title/area	Organization
Advisory Committee		
1. Bob Stirling		AC Delco Canada
2. Deborah Moynes-Keshen	Vice President	AIA Canada
3. Tony Canadé	President & COO	Assured Automotive
4. Doug Muir		Canadian Council of Directors of Apprenticeship
5. Phil Myers	Manager Automotive Education	Canadian Tire Corporation
6. Peter Woodall	Chairperson Automotive Programs	Centennial College
7. Robert Ouellet	Directeur général	Conseil provincial des comités paritaires de l'industrie des services automobiles
8. Norm Thurston	Manager Training	Honda Canada
9. Sandra Allin	Industry Development Officer	Industry Canada Business Development Directorate
10. Shannon Smith	Executive Director	Nova Scotia Automotive Human Resource Sector Council
11. Heidi Bungay	Senior Analyst	Sector Council Program Division, HRSDC
12. John Montgomery	Director, Customer Satisfaction	Volvo Trucks Canada Inc.
Industry Organizations and Observers, and Government Representatives		
13. Craig Van Batenburg	CEO	Automotive Career Development Center
14. Gerry Fedchun	President	Automotive Parts Manufacturers Association of Canada (APMA)
15. Angie Wilson	V.P. Marketing & Communications	Automotive Service Assoc. (ASA)
16. John Norris		Collision Industry Information Alliance
17. Drazenka Pantic	Project Manager	Canadian Printing Industries Sector Council
18. Susan Annis	Executive Director	Cultural Human Resources Council
19. Peter Griffin	Business & Industry Development Services	Durham College
20. Jean-Francois Roi	Senior Program Engineer	Environment Canada
21. Allan Tucker		Heavy Duty Distributors Council
22. Geoff Nimmo	Technology Roadmaps	Industry Canada

23. Tony Molla	V.P. Communications	National Institute for Automotive Service Excellence
24. Fabian Allard	Senior Chief, Vehicle Efficiency	Natural Resources Canada
25. Geoff Wilkinson	President	Ontario Auto Dealers Association
26. Bruce Richards	President	Private Motor Truck Council of Canada
27. Jim Kerr	Program Head	Saskatchewan Institute of Applied Science & Technology (SIAST)
28. Brian Moukperian	Dean of the Transportation Dept.	Southern Alberta Institute of Technology (SAIT)
29. Peter Frise	Scientific Director, CEO Executive Director of Automotive Research	AUTO21 University of Windsor
30. Richard Lipman	President	Wood Manufacturing Council

Assemblers/Manufacturers

31. National Training Manager	Chrysler Canada
32. Sales Manager	Commercial Babcock Inc.
33. Trailer Sales	Durabody Industries Limited
34. Manager, Service Training Operations	General Motors
35. Government Relations	General Motors
36. Training/technical services	General Motors
37. Training/technical services	General Motors
38. Senior Manager, Technical Operations	Honda Canada
39. Sales Manager	Loadstar Trailers Inc.
40. District Service Manager, Northern Ontario and Atlantic Canad	Mack Canada Inc./Volvo Trucks Canada Inc.
41. Regional Service Manager	PACCAR Canada
42. Corporate Planning Manager	Toyota Manufacturing
43. Training	Toyota Canada

Suppliers

44. Vice-President & General Manager	ADP Dealer Services
45. Owner CAIS	Alldata (CAIS -Canadian Distributor)
46. Training	CARS/ AC Delco
47. Training	CARS/ AC Delco
48. Training	CARS/ AC Delco

49. Senior Territory Sales Manager, Eaton Transmissions

50. Canadian Field Manager, iCar collision training

51. Vice President, Sales Reynolds and Reynolds

Dealers

52. Service Manager Acura West
53. Service Manager Airdrie Pontiac Buick GMC
54. Service Manager Amherst Toyota Ltd.
55. Service Manager Currie Truck Centre
56. Service Manager Harper Ontario Truck Centres
57. Owners Collision Repair Ltd.

Appendix E: Product Innovation Technology Advancements

Colours used in the following tables correspond with graphics summarizing the data in the body of the report.

Table E-1: Gasoline, Ethanol or Diesel Engine/Fuel Technologies

Subcategory		Technology	Scale of Adoption (over next 3 to 5 years)			Knowledge gap/Degree of Change (from Current State)		
			Small	*Med*	*Lg*	*Low*	*Med*	*H*
Engine/Fuel	**Occupations most affected include automotive service technicians, fuel and electrical/electronics technicians, and diesel technicians**							
Gasoline, ethanol, diesel								
	1	Bio-diesel	X				X	
	2	Clean diesel technology		X			X	
	3	Cylinder deactivation/reactivation		X			X	
	4	Direct injection		X			X	
	5	Turbocharging		X			X	
	6	Exhaust after-treatment systems	X					X
	7	Flex-fuel vehicles capable of using ethanol (E85)		X			X	
	8	Homogeneous Charge Compression Ignition (HCCI)	X				X	
	9	Misfire diagnostics (truck)			X		X	
	10	Start stop drive management system	X			X		
	11	Supercharging	X			X		
	12	Turbodiesel		X		X		
	13	Variable valve control		X		X		
	14	Variable valve timing (VVT)			X		X	
	15	Variable-vane turbocharging			X		X	

Table E-2: Electric, Hybrid Electric, Battery, Storage and Other Selected Engine/Fuel Technologies

Subcategory		Technology	Level of Impact/Scale of Adoption (over next 3 to 5 years)			Knowledge gap/Degree of Change (from Current State)		
			Small	*Med*	*Lg*	*Low*	*Med*	*Hi*
Electric or hybrid electric								
	16	Hybrid electric technology using gasoline or diesel		X				X
	17	Hybrid energy systems using natural gas	X					X
	18	Hybrid energy systems using propane	X					X
	19	Pure electric/battery power (EV)	X					X
Battery storage and energy systems								
	20	Capacitative energy systems	X					X
	21	Lithium ion		X				X
	22	NiMH - Nickel Metal Hydride		X			X	
	23	PbA - Lead Acid			X	X		
	24	PEM - Proton Exchange Membrane (Hydrogen fuel cells)	X					X
Other or combined								
	25	CNG - Compressed Natural Gas	X				X	
	26	Diesel particulate filters		X		X		
	27	MeOH – Methanol	X				X	
	28	Propane	X			X		
	29	Selective Catalytic Reduction – SCR, including ammonia treatment systems		X			X	

Table E-3: Drivetrain, Suspension, Steering, Wheel, Tire, Axle, Brake and Body Control Technologies

Subcategory		Technology	Scale of Adoption (over next 3 to 5 years)			Knowledge gap / Degree of Change (from Current State)		
			Small	Med	Lg	Low	Med	Hi
Drive Train	**Occupations most affected include automotive service technicians, transmission technicians, truck / trailer service technicians, and truck coach**							
	30	6-speed transmissions			X		X	
	31	Auxiliary gearboxes (truck)		X		X		
	32	Continuously variable transmissions (CVT)		X			X	
	33	Electrically controlled four-wheel drive		X			X	
	34	Full electronic/paddle shifters			X		X	
	35	Twin clutches	X				X	
Suspension / Steering / Wheel & Tires	**Occupations most affected include automotive service technicians, rim and tire technicians, alignment and brake technicians, fuel and electrical / electronics technicians, auto body and collision damage repair technicians**							
	36	Airless tires	X			X		
	37	Electronic power assisted steering (EPAS)		X			X	
	38	Low-rolling-resistance tires		X		X		
	39	Run-flat tires		X		X		
	40	Self inflating tires (truck)	X			X		
	41	Split rims/double rims (truck)		X		X		
	42	Truck wheel monitoring system	X			X		
Axle / Brake / Body Control	**Occupations most affected include automotive service technicians, alignment and brake technicians, fuel and electrical / electronics technicians, auto body and collision damage repair technicians, truck / trailer service technicians, truck coach**							
	43	Active suspension, Electronic Stability Control (ESC) & Active yaw control (AYC)			X		X	
	44	Anti-lock braking systems (ABS)		X		X		
	45	Electronic brake-force distribution (EBD)		X		X		
	46	Electronically modulated dampening of suspension		X		X		
	47	Regenerative braking systems		X			X	
	48	Traction control systems (TCS)		X		X		

Table E-4: Body / Exterior and Telematics Technologies

Subcategory		Technology	Scale of Adoption (over next 3 to 5 years)			Knowledge gap / Degree of Change (from Current State)		
			Small	Med	Lg	Low	Med	Hi
Body / Exterior	**Occupations most affected include automotive service technicians, fuel and electrical / electronics technicians, auto body and collision damage repair technicians, automotive paint technicians, truck / trailer service technicians, truck coach**							
	49	Advanced front lighting systems (AFS)		X			X	
	50	Aluminium, magnesium, titanium, high-strength steel and other lightweight materials			X			X
	51	Capless fuel filler	X			X		
	52	Carbon fiber body and panel construction, and other less frequently used composite materials and dual materials such as rubber plated steels			X		X	
	53	Retractable hardtop	X				X	
	54	Self-healing paint	X				X	
Interior and onboard electronics								
Telematics – telecommunications / information electronics	**Occupations most affected include automotive service technicians, automotive electronic accessory technicians, fuel and electrical / electronics technicians, truck / trailer service technicians, truck coach**							
	55	Automotive navigation systems		X		X		
	56	Dynamic route guidance and navigation		X			X	
	57	Electronic highway toll and parking payment systems	X				X	
	58	Driving-based behaviour service/scheduling/alerts/notifications			X		X	
	59	In-car Internet		X			X	
	60	Motorist information systems e.g. incidents, special events, weather, work zones		X			X	
	61	Remote vehicle diagnostics, remote vehicle prognostics and self-healing		X			X	
	62	Satellite telephony	X				X	
	63	Stolen vehicle recovery systems	X				X	
	64	Stolen vehicle slow/shut down	X				X	
	65	Vehicle software download systems			X		X	
	66	Vehicle use data, vehicle profiles and dealer use data		X			X	

Table E-5: Entertainment and Other Onboard Consumer and Interior Cabin Safety Technologies

Subcategory		Technology	Scale of Adoption (over next 3 to 5 years)			Knowledge gap/Degree of Change (from Current State)		
			Small	Med	Lg	Low	Med	Hi
Entertainment and other onboard, local consumer electronics	**Occupations most affected include automotive service technicians, automotive electronic accessory technicians, fuel and electrical/electronics technicians, truck/trailer service technicians, truck coach**							
	67	Bluetooth		X			X	
	68	HD radio	X			X		
	69	MP3-player interfaces			X		X	
	70	Rear-seat entertainment systems		X		X		
	71	Voice-activated in-car communication and entertainment system	X				X	
Onboard and interior cabin safety technologies	**Occupations most affected include automotive service technicians, automotive electronic accessory technicians, fuel and electrical/electronics technicians**							
	72	Active head restraints	X				X	
	73	Automatic headlights		X		X		
	74	Active cruise control (ACC)	X				X	
	75	Blind-side alerts	X				X	
	76	Collision avoidance systems, automatic emergency braking & other pre-collision safety actions	X				X	
	77	Heads-up displays (HUD)	X			X		
	78	Heated windshield washer fluid	X			X		
	79	Knee, side curtain and other airbags			X		X	
	80	Lane departure warning systems (Drifting monitors) and vibrating steering wheel drift alert	X				X	
	81	Night vision thermal imaging cameras/pedestrian recognition night vision	X				X	
	82	Passenger presence and proximity sensors			X		X	
	83	Radar, laser and sonar detection		X			X	
	84	Seat belt pretensioners			X		X	
	85	Sobriety detectors	X			X		
	86	Tire pressure monitoring systems			X	X		

Table E-6: Convenience Technologies

Subcategory		Technology	Scale of Adoption (over next 3 to 5 years)			Knowledge gap/Degree of Change (from Current State)		
			Small	Med	Lg	Low	Med	Hi
Convenience technologies	**Occupations most affected include automotive service technicians, automotive electronic accessory technicians, fuel and electrical/electronics technicians**							
	87	Advanced key system/remote keyless entry/remote keyless ignition		X			X	
	88	Active noise control	X			X		
	89	Advanced parking guidance systems (APGS)/active park assist		X				X
	90	Backup cameras and a 360° vision cameras	X			X		
	91	Electrochromatic (auto-dimming) mirrors			X	X		
	92	Massaging seats	X			X		
	93	Radio frequency identification		X			X	
	94	Solar panel sunroofs for unattended vehicle air recirculation	X				X	
	95	110 V AC plug access/DC conversion	X			X		

Appendix F: New Product Development Plans

Table F-1: US brands -- Chrysler Corp. and Ford Motor Co.

New vehicle product development plans				
	2009	2010	2011	2012
United States brands				
Chrysler Corporation				
Chrysler	***Aspen hybrid debuts***	Possible Sebring reskin	Town and Country freshened	300 restyled, reengineered
Dodge	Base, R/T Challengers debut	Hornet debuts	Grand Caravan likely freshened	Possible Caliber redesign
	Journey debuts	Possible Avenger freshening	Possible Durango redesign	Charger restyled, reengineered
	Durango hybrid debuts	Possible Nitro freshening (or 2011)		
	Ram restyled, reengineered			
Jeep		Grand Cherokee redesign (or 2011)	Possible Compass freshening	
			Patriot freshened	
Ford Motor Company				
Ford	Flex crossover debuts	Fusion restyled	Fiesta debuts	Possible small minivan or crossover
	Escape reengineered	Taurus restyled, reengineered	Focus redesigned	C-Max small minivan expected
	Reengineered, restyled F-150	Reskinned, reengineered Mustang	Edge restyled	Escape redesigned
		Possible Expedition freshening	Likely Explorer redesign	Flex restyled
		Small Transit Connect van debuts	Super Duty freshened	Possible Expedition redesign
				F-100 pickup debuts
				Full sized Transit van debuts
Lincoln	MKS sedan debuts	MKZ restyled	MKX restyled	Small crossover debuts
		MKT crossover debuts		Possible Navigator redesign
		Possible Navigator freshening		
Mercury	Mariner reengineered for 2008 model year	Milan restyled		
	XC90 reskinned			

Source: Automotive News, 2008 tables (various) not included: Indian, Chinese, Korean, Malaysian and other Asian or South American brands, and limited volume or emerging brands

Table F-2: US brands -- General Motors Corp.

New vehicle product development plans				
	2009	**2010**	**2011**	**2012**
United States brands				
General Motors				
Buick		LaCrosse redesigned	Possible Enclave freshening	Possible small imported car debuts
Cadillac	XLR freshened	CTS wagon debuts	Possible small sedan debuts	Possible CTS restyled
		CTS coupe debuts	***Possible plug in hybrid vehicle***	
		SRX redesigned		
Chevrolet	Traverse debuts	Cruze sedan debuts	Aveo redesigned	Possible Malibu reengineered, restyled
		Camaro debuts	***Volt plug-in hybrid sedan debuts***	Impala redesigned
		Equinox restyled, reengineered	HHR redesigned	
			Possible reengineered heavy-duty Silverado	
GMC		Possible Acadia freshening	Terrain debuts	Possible Canyon redesign
Hummer	H3T pickup debuts			
Pontiac	G3 debuts	Possible G5 replacement		Possible small imported car
	Solstice Coupe debuts	G8 sport truck debuts		
	Vibe restyled, reengineered			
Saturn		Likely Aura freshening	Astra restyled, redesigned	Possible restyled reengineered Aura
			Sky reskinned	Possible small crossover debuts
			Possible mini minivan debuts	

Source: Automotive News, 2008 tables (various) not included: Indian, Chinese, Korean, Malaysian and other Asian or South American brands, and limited volume or emerging brands

convergence management consultants ltd.

Table F-3: Japanese brands -- Honda/Acura, Mazda, Mitsubishi, Nissan/Infiniti

New vehicle product development plans				
	2009	2010	2011	2012
Japanese brands				
Honda/Acura				
Acura	TSX redesigned		Luxury sedan debuts (or 2012)	
	TL redesigned		NSX debuts	
	RL reskinned		RDX redesigned	
			MDX redesigned	
Honda	Fit redesigned	***Dedicated hybrid five door hatchback debuts***	***Dedicated CR-Z hybrid coupe debuts***	
	Fuel-cell FCX Clarity debuts	Element redesigned	Civic redesigned	
	Pilot redesigned	Possible Stream mini minivan		
	Ridgeline freshened	Odyssey redesigned		
Mazda				
Mazda	Mazda6 redesigned	Mazda3 re-styled, reengineered	Mazda2 debuts	
			Mazda5 redesigned	
			Possible CX5 crossover debuts	
Mitsubishi				
Mitsubishi	Eclipse models freshened		Eclipse redesigned (or 2012)	Possible Lancer redesigned
	Galant reskinned		Galant redesigned (or 2012)	
Nissan/Infiniti				
Infiniti	G37 convertible debuts	M restyled (or 2011)		
Nissan	Maxima redesigned	Cube five door hatchback debuts	***Pure electric vehicle debuts***	Pathfinder redesigned
	GTR debuts	Z redesigned	Versa redesigned	Titan redesigned
	Murano redesigned			
	Xterra freshened			
	Frontier freshened			
Source: Automotive News, 2008 tables (various) not included: Indian, Chinese, Korean, Malaysian and other Asian or South American brands, and limited volume or emerging brands				

Table F-4: Japanese brands -- Subaru, Subaru, Suzuki, Toyota/Lexus/Scion

New vehicle product development plans				
	2009	2010	2011	2012
Subaru				
Subaru	Forester redesigned	Outback, Legacy redesigned		Impreza freshened
	Impreza WRX freshened			Tribeca redesigned
				Sports car debuts
Suzuki				
Suzuki	Equator pickup debuts	Midsized Kizashi 3 sedan debuts	Swift debuts	
	Grand Vitara freshened		Grand Vitara redesigned	
Toyota/Lexus/Scion				
Lexus		IS coupe/convertible debuts	GS redesigned	ES redesigned
		LS reskinned	LF1 sports car debuts	
		RX redesigned	***Dedicated hybrid model debuts***	
Toyota	Yaris five door hatchback debuts	***Prius redesigned***		Yaris redesigned
	Venza crossover debuts	Camry freshened		Camry redesigned
		4Runner restyled, reengineered		Avalon redesigned
		Sienna redesigned		Possible sports coupe
				RAV4 redesigned
Scion		IC redesigned		
Source: Automotive News, 2008 tables (various) not included: Indian, Chinese, Korean, Malaysian and other Asian or South American brands, and limited volume or emerging brands				

Table F-5: European brands – Alfa Romeo, Aston Martin, Audi, Bentley, BMW, Bugatti, Ferrari, Jaguar

New vehicle product development plans				
	2009	2010	2011	2012
European brands				
Alfa Romeo				
Alfa Romeo		8C Spider debuts	Possible large sedan, coupé	
			C Xover debuts (or 2012)	
Aston Martin				
Aston Martin		Rapide debuts		
Audi				
Audi	A7 sedan debuts	A8 restyled, reengineered	A5 freshened	A4 freshened
	R8 convertible	Small Q3 crossover debuts	A6 redesigned	
	Q5 midsize crossover debuts		TT redesigned (or 2012)	
Bentley				
Bentley	GTC freshening		Arnage redesigned	Possible Azure convertible debuts
BMW				
BMW	Z4 redesigned	3 series redesigned	5 series redesigned	6 series redesigned
	X4 crossover debuts	CS sedan debuts (or 2011)		X6 freshened
		Small X1 crossover debuts		
		X3 redesigned		
Bugatti				
Bugatti	Veyron 16.4 targa debuts			
Ferrari				
Ferrari	F430 redesigned	Limited edition car debuts (or 2011)	612 Scaglietti redesigned	
Jaguar				
Jaguar		Possible XE convertible, coupe		Possible XK redesigned
		XJ restyled, reengineered		
Source: Automotive News, 2008 tables (various) not included: Indian, Chinese, Korean, Malaysian and other Asian or South American brands, and limited volume or emerging brands				

Table F-6: European brands – Lagonda, Lamborghini, Land Rover, Maserati, Mercedes-Benz, Mini, Porsche

New vehicle product development plans				
	2009	2010	2011	2012
Lagonda				
Lagonda			Sporty sedan debuts	Luxury sedan debuts
Lamborghini				
Lamborghini			Possible sedan debuts	Murcielago redesigned
Land Rover				
Land Rover			LRX SUV debuts	LR3 restyled, reengineered
			Range Rover redesigned	
Maserati				
Maserati	GranTurismo Cabriolet debuts		Possible small coupe, sedan	
Mercedes-Benz				
Mercedes-Benz	E class redesigned	CLS reskinned	B class debuts	SLK redesigned
	S class freshening	CLK convertible redesigned	C class freshening	
	CLK coupe redesigned	Gullwing sports car debuts	CL freshening	
	Small GLK SUV debuts	R class restyling		
		GL freshening		
Mini				
Mini		Cooper freshening		
		Crossover debuts		
Porsche				
Porsche	Panamera sedan debuts	Boxster restyled		
		Cayman restyled		
		Cayenne redesigned		
Source: Automotive News, 2008 tables (various) not included: Indian, Chinese, Korean, Malaysian and other Asian or South American brands, and limited volume or emerging brands				

Table F-7: European brands – Rolls-Royce, Saab, Volkswagen, Volvo

New vehicle product development plans				
	2009	2010	2011	2012
Rolls-Royce				
Rolls-Royce	Smaller sedan debuts			
Saab				
Saab	9-4X debuts (or 2010)	9-5 redesigned	Possible 9-1 hatchback	
			9-3 restyled, reengineered	
Volkswagen				
Volkswagen	Rabbit redesigned	Jetta sedan redesigned	New Beetle redesigned	Jetta Sportwagen redesigned
	Passat freshening	Eos freshening (or 2011)	Midsized sedan debuts	Passat redesigned
		Tourag redesigned (or 2011)	Luxury sedan debuts (or 2012)	
			Possible sports car	
Volvo				
Volvo	XC60 debuts	S60 redesigned	V50 redesigned	
	C70 reskinned		XC50 debuts	
	XC90 reskinned			
Source: Automotive News, 2008 tables (various) not included: Indian, Chinese, Korean, Malaysian and other Asian or South American brands, and limited volume or emerging brands				

Glossary	
Freshened	Sheet metal untouched, changes may include new grill, front and/or rear fascia, headlights and tail light modules
Reskinned	Minor changes to overall sheet-metal, may include new hood, front and/or rear fenders
Restyled	Extensive changes to exterior and interior
Reengineered	Platform and components receive an extensive makeover to reduce noise, vibration and harshness. Improvements made in ride, handling, braking and steering, and in some cases safety
Redesigned	New platform, new interior and exterior, but engine and transmission could be carried over
Debuts or replacement	Entirely new vehicle
Hybrid or electric debuts	New hybrid or electric vehicle

Appendix G – Web-sites for Phase 2 research

The following summarizes selected websites that were reviewed to obtain and supplement contact information for Phase 2 interviews:

Automobile and/or light truck repair and service

GM, Ford, Chrysler Dealerships

- http://apps.gm.ca/app/GMCanada/DealerLocatorSearch.do?nav=0&cta=blank&lang=en
- http://www.ford.ca/app/fo/en/shopping_tools/dealers.do
- http://www.chrysler.ca/en/

Toyota, Honda, Nissan, KIA, Hyundai, other Dealerships

- http://www.toyota.ca/cgi-bin/WebObjects/WWW.woa/17/wo/PDR5dwBBDitmAYSbgiBhAM/0.9?fmg%2fdealers%2findex%2ehtml
- http://honda.ca/HondaCA2006/Dealers/default.htm?L=E
- http://www.nissan.ca/buying/dealers/en/index.html
- http://www.kia.ca/dealers
- http://www.hyundaicanada.com/Pages/shoppingtools/step1_locatedealer.aspx

Major automotive and aftermarket retail chains (e.g. Canadian Tire, Midas, etc.)

- http://www.canadiantire.ca/storelocator/store_locator.jsp?CTC_STORE_SEARCH%3C%3EshowCities=false&CTC_STORE_SEARCH%3C%3EshowResults=false&CTC_STORE_SEARCH%3C%3EprovinceList=&CTC_STORE_SEARCH%3C%3Etype=store&CTC_STORE_SEARCH%3C%3Epostal_cd=L1X1W3&CTC_STORE_SEARCH%3C%3EbackupType=store&FOLDER%3C%3Efolder_id=1408474396672077&bmForm=form_store_locator&bmFormID=1234902293306&bmSubmit=find_stores&bmUID=1234902293306&bmHash=e75ce2c45da20f896e4ae677ac093964353f957f
- http://www.midas.ca/

Independents

- http://www.bestbuyautoparts.ca/site/jobbers/locator.asp
- http://www.autosense.ca/stores.php

Collision repair (any type of vehicle)

- http://www.ciia.com/provinces/ontario/autobodyrep.html

Medium and/or heavy truck repair and service

- http://www.peterbilt.com/findadealer.aspx
- http://129.33.208.17/site_layout/dealers/locator-it.asp
- http://www.hinocanada.com/dealers_en.html

Truck Fleets

- http://members.ontruck.org/source/members/custOTACarrier.cfm

Parts warehousing and provisioning

- http://hddc.on.ca/index.php?option=com_alphacontent&section=4&cat=15&Itemid=35

Appendix H -- Interview Guide for Employer Research

Convergence Management Consultants Ltd.
CARS Technology Advancements Project
Interview Guide - Employers

Name of respondent:

Company/Organization:

Telephone number:

Date/Time: Interview duration (minutes):

Type of business:
[ ] automobile and/or light truck repair and service
[ ] collision repair (any type of vehicle)
[ ] medium and/or heavy truck repair and service
[ ] parts warehousing and provisioning

Province/region:
[ ] BC
[ ] Alberta
[ ] Saskatchewan
[ ] Manitoba
[ ] Ontario
[ ] Quebec
[ ] New Brunswick
[ ] Newfoundland and Labrador
[ ] Nova Scotia
[ ] Prince Edward Island

Introduction

Good morning/afternoon, Mr./Ms. _______. My name is _________. I am calling from Convergence Management Consultants Ltd., a management consulting firm based in Thornhill, Ontario. Our firm is working with the Canadian Automotive Repair and Service (CARS) Council and industry stakeholders to assess how new vehicle technologies will impact repair and service, collision repair and parts occupations so that preparations can be made to address HR issues such as skills and training to help firms like yours. This is a major assignment which is strongly supported by the industry. My purpose in calling you is to benefit from your guidance and understand your views regarding new technology impacts on the people who work for you. Our conversation will take about 15 minutes. Is now a good time to discuss this? (If not, when would you like me to call you? -- *record when to call, and call then*)

Discussion

Product technologies

1. Now I will read you a series of technological changes that may result in the need for knowledge and skills upgrading. For each one, please tell me if this technological change will require considerable, some or no knowledge and skills upgrading over the next three years? READ LIST, ROTATE

	None	Some	Consid. amount	NA	DK / refused
A) Internal combustion gasoline engines?					
B) Diesel engines?					
C) Advanced braking and body control systems?					
D) Emissions controls?					
E) Drive train and transmissions?					
F) Hybrid electric vehicles?					
G) Light weight and new materials?					
H) Onboard electronics?					
I) Telematics systems?					
J) Tires, wheels and related technologies?					
K) Diagnostics?					
L) Glass?					
M) Airbags?					
N) Frame and metal construction?					
O) Other - please specify__________________					
P) Other - please specify__________________					

Business Innovation Technologies

2. Do you plan to invest in new [INSERT SYSTEM NAME] in the next three years? IF YES, ASK And how much will you spend on [INSERT SYSTEM NAME] in the next three years? CODE RESPONSE, ROTATE

	None	Less than $50,000	$50,000 to $100,000	More than $100,000	NA	DK / refused
A) Jobber Management Systems						
B) Fleet Management Systems						
C) Body Shop Management Systems						
D) Systems integration services						
E) Customer Relationship Management Systems						
F) Warehouse Management Systems						
G) GPS vehicle and fleet tracking systems						
H) Online systems for customers to track vehicle repairs and make appointments over the Internet						
I) Online procurement/purchasing						
J) Diagnostic systems and equipment						
K) Radio-frequency and other specialized handheld devices						
L) Specialized repair/service and collision tools, equipment and rooms						
M) Other: Please specify___________________						
N) Other: Please specify___________________						

Barriers and Constraints

3. To what degree are you concerned with each of the following potential barriers and or constraints to your company effectively adapting to the new vehicle technologies being introduced and to your company effectively implementing new business technologies over the next 3 to 5 years?
Please answer using a scale where 1 is of no concern, 2 is of some concern, 3 is of significant concern, 4 is not applicable and 5 is don't know.
[ ] Sourcing appropriate training for employees
[ ] Cost of employee training
[ ] Cost of obtaining equipment and facilities for new vehicle technologies
[ ] Cost of obtaining software and equipment for new business technologies
[ ] Ability to provide appropriate on-the-job skills development
[ ] Recruiting sufficient numbers of appropriately qualified people
[ ] Keeping sufficient numbers of qualified people
[ ] Health of our economy and the automotive industry

Occupational Impacts

4. Which occupations do you expect will need most new knowledge and/or skills upgrading in your business over the next 3 to 5 years? *Please answer using a scale where 1 is no different knowledge/enhanced skills required, 2 is some different knowledge/enhanced skills required, 3 is considerable amount of different knowledge/enhanced skills required, 4 is not applicable and 5 is don't know.*

Automotive Service Repair Shops

1 Automotive service technician
2 Alignment and brake technician
3 Automotive machine shop technician
4 Automotive electronic accessory technician
5 Rim and tire technician
6 Fuel and electrical/electronics technician
7 Transmission technician
8 Owner/operator -- vehicle repair and service
9 Service manager
10 Service advisor

Collision Repair Shops

11 Auto body and collision damage repair technician
12 Owner/operator -- collision repair
13 Collision repair manager
14 Collision repair advisor
15 Estimator
16 Automotive glass technician
17 Automotive paint technician

Truck/Transport/Heavy Duty Repair Shops

18 Truck/trailer service technician
19 Truck coach
20 Heavy-duty collision repair technician
21 Owner/operator -- heavy-duty vehicle repair and service

Parts Wholesalers

22 Parts manager
23 Parts counter person
24 Parts sales consultant
25 Parts delivery driver
26 Automotive recycler
27 Owner/operator - parts wholesaler)

Training and Other Remediation

5. For the occupations just mentioned, will the main focus for technology training be on new vehicle technologies or new business systems and software?
   [ ] New vehicle technologies
   [ ] New business systems and software
   [ ] Neither
   [ ] Both
   [ ] Don't know / refused

6. Where will you get training for the occupations you just mentioned? *(Record all that apply) READ LIST, CIRCLE ALL THAT APPLY*
   [ ] On-the-job training, such as training provided informally on the job
   [ ] In-house training, such as formal classes provided at the worksite
   [ ] Manufacturer-provided training at the worksite
   [ ] Manufacturer-funded training at an educational institution
   [ ] Short course, that is a weekend or week-long course
   [ ] Full-time course at an educational or training institution
   [ ] Apprenticeship
   [ ] Temporary training programs offered by colleges
   [ ] After-hours continuing education course
   [ ] Interactive distance learning such as satellite courses
   [ ] E-learning or online training
   [ ] None / I do not provide training
   [ ] Don't know / refused

7. In summary, what human resource challenges does your company face as a result of new vehicle technologies and new business systems and software over the next 3 to 5 years?

   ____
   ____
   ____

8. Do you think businesses involved in vehicle repair and service, collision repair and aftermarket parts would benefit from the identification and sharing of best practices in managing these human resource challenges? Why/why not?

   ____
   ____
   ____

9. Do you think that senior business leaders, owners and managers of businesses such as yours should be working together to develop a shared approach to resolving human resource issues that will be affected by new vehicle and business systems and software? Why/why not?

   ____
   ____
   ____

10. Does the current state of the Canadian economy affect your human resources and business technology plans – and, if so, how?

____
____
____

Concluding Comments

Do you have any other observations or comments to provide at this time?

____
____
____
____
____

On behalf of CARS, we would like to thank you very much for your participation in this important engagement. Thank you for taking the time to provide your views and opinions. If after the end of this discussion you have any questions or suggestions, please don't hesitate to contact our Project Director, Ian Gordon. He can be reached at 905-881-7463. This study is being done as part of an overall assignment to consider human resource skills and training issues in the automotive aftermarket. If you would be willing to complete an online survey in this regard, please visit www.carssurvey.ca. Thanks again.

convergence management consultants ltd.

Appendix I -- Interview Guide for Employee Research

Convergence Management Consultants Ltd.
CARS Technology Advancements Project
Interview Guide - Employees

Name of respondent:

Company/Organization:

Telephone number:

Date/Time: Interview duration (minutes):

Type of business:
[ ] automobile and/or light truck repair and service
[ ] collision repair (any type of vehicle)
[ ] medium and/or heavy truck repair and service
[ ] parts warehousing and provisioning

Province/region:
[ ] Atlantic provinces
[ ] Québec
[ ] Ontario
[ ] Western provinces

Apprentice: [ ] Yes or [ ] No. If yes, what level?

Occupation:

Automotive Service Repair Shops
[ ] Automotive service technician
[ ] Alignment and brake technician
[ ] Automotive machine shop technician
[ ] Automotive electronic accessory technician
[ ] Rim and tire technician
[ ] Fuel and electrical/electronics technician
[ ] Transmission technician
[ ] Service advisor
[ ] Auto body and collision damage repair technician

Collision Repair Shops
[ ] Collision repair manager
[ ] Collision repair advisor
[ ] Estimator
[ ] Automotive glass technician
[ ] Automotive paint technician

Truck/Transport/Heavy Duty Repair Shops
[ ] Truck/trailer service technician
[ ] Truck coach
[ ] Heavy-duty collision repair technician

Parts Wholesalers
[ ] Parts counter person
[ ] Parts sales consultant
[ ] Parts delivery driver
[ ] Automotive recycler

Introduction

Good morning/afternoon, Mr./Ms. _______. I am calling from Convergence Management Consultants Ltd., a management consulting firm based in Thornhill, Ontario. Our firm is working with the Canadian Automotive Repair and Service (CARS) Council and industry stakeholders to identify new vehicle and business technologies that will affect automotive aftermarket occupations over the next 3 to 5 years. This is a major study which is strongly supported by the industry. My purpose in calling you is to benefit from your guidance and to understand your views regarding how technology is impacting people who work with you. Our conversation will take about 15 minutes. Is now a good time to discuss this? (If not, when would you like me to call you? -- *record when to call, and call then*)

Discussion

Before we start, please would you help me understand your occupation or role in your firm *(Record this information in the above area for demographic information).* Is there any other information you would like to know about the project?

Product technologies

1. Do you think that you will need new knowledge or enhanced skills to do your job when it comes to the new vehicle technologies that will be introduced into vehicles over the next three years?

   Yes ....[ ]
   No ....[ ]
   Don't know / refused ....[ ]

2. (If answer is "no" to previous question) Why did you answer as you did?

   ____
   ____
   ____
   ____

3. When thinking about <u>new vehicle technologies</u>, please tell me if you will require considerable, some or no knowledge or skills upgrading for [INSERT TECHNOLOGY] over the next three years?

	None	Some	Consid. amount	NA	DK / refused
A) Internal combustion gasoline engines?					
B) Diesel engines					
C) Advanced braking and body control systems?					
D) Emissions controls?					
E) Drive train and transmissions?					
F) Hybrid electric vehicles?					
G) Light weight and new materials?					
H) Onboard electronics?					
I) Telematics systems?					
J) Tires, wheels and related technologies?					
K) Diagnostics?					
L) Glass?					
M) Airbags?					
N) Frame and metal construction?					
O) Other - please specify__________________					
P) Other - please specify__________________					

Business Innovation Technologies

4. When thinking about business systems and software, please tell me if you will require considerable, some or no knowledge or skills upgrading for [INSERT SYSTEM NAME] over the next three years.

		None	Some	Consid. amount	NA	DK / refused
O)	Jobber Management Systems					
P)	Fleet Management Systems					
Q)	Body Shop Management Systems					
R)	Systems integration services					
S)	Customer Relationship Management Systems					
T)	Warehouse Management Systems					
U)	GPS vehicle and fleet tracking systems					
V)	Online systems for customers to track vehicle repairs and make appointments over the Internet					
W)	Online procurement/purchasing					
X)	Diagnostic systems and equipment					
Y)	Radio-frequency and other specialized handheld devices					
Z)	Specialized repair/service and collision tools, equipment and rooms					
AA)	Other: Please specify___________________					
BB)	Other: Please specify___________________					

Preparedness

5. Thinking about the new vehicle technologies mentioned before, is there anything in your workplace that will limit your ability to learn what you need to know? *Please answer using a scale where 1 is not a significant factor limiting your ability to learn about the new technologies, 2 is a somewhat limiting factor, 3 is very significant limiting factor, 4 is not applicable and 5 is don't know.*
   [ ] Getting appropriate training
   [ ] The cost of employee training
   [ ] Getting time off for training
   [ ] Getting training on-the-job for skills development
   [ ] Having the right equipment and facilities for the technologies
   [ ] Knowing how to use a computer effectively
   [ ] Other: (please specify) _______________________

6. Thinking about new business systems and software that your company might use over the next 3 years, is there anything in your workplace that will limit your ability to learn what you need to know? *Please answer using a scale where 1 is not a significant factor limiting your ability to deal with the new technologies, 2 is a somewhat limiting factor, 3 is very significant limiting factor, 4 is not applicable and 5 is don't know.*
   [ ] Getting appropriate training
   [ ] The cost of employee training
   [ ] Getting time off for training
   [ ] Getting training on-the-job for skills development
   [ ] Having the right equipment and facilities for the technologies

[ ] Knowing how to use a computer effectively
[ ] Other: (please specify) ______________________

Training and Other Remediation

7. If you were going to participate in training related to your job, in which formats would you like to receive training? CIRCLE ALL THAT APPLY And would that be for new vehicle skills training or for business systems and software skills training or for both?

	New vehicle skills training	Business systems and software skills training	Both	Not required	Don't know/refused
On-the-job training					
In-house training, such as formal classes provided at the worksite					
Manufacturer-provided training					
Manufacturer-funded training at an educational institution					
Short course, such as a weekend or week-long course					
Full-time course at an educational or training institution					
Temporary training programs offered by colleges					
After-hours continuing education course					
Interactive distance learning such as satellite courses but not e-learning					
E-learning or online training					

Concluding Comments

Do you have any other observations or comments to provide at this time?

___

___

___

___

Thank you for taking the time to meet and providing your views and opinions. If after the end of this discussion you have any questions or suggestions, please don't hesitate to contact our Project Director for this study. His name is Ian Gordon and he can be reached at 905-881-7463. This study is being done as part of an overall assignment to consider human resource skills and training issues in the automotive aftermarket. If you would be willing to complete an online survey in this regard, please visit www.carssurvey.ca. Thanks again.

Appendix J -- Interview Respondents - Employers

The following lists the companies for which employers who were interviewed for the Phase 2 research work:

1. Land Rover of Newfoundland
2. NAPA Auto Parts, Parrsboro, NS
3. Flag Chevrolet Oldsmobile Ltd., Surrey, BC
4. Dawson Enterprises Ltd., Saint Andrews, MB
5. O'Regan Kia, Halifax, NS
6. Ponoka Chevrolet Oldsmobile, Ponoka, AB
7. Great Plains Ford Ltd., Weyburn, SK
8. Pongoski Enterprises Ltd., Portage la Prairie, MB
9. Graham Auto Parts, Bristol, NB
10. Shaw Body Shop, Calgary, AB
11. Jeff's Collision, Rossland, BC
12. Atlantic Mazda, Moncton, NB
13. Gustafson's Kia, Prince George, BC
14. Subaru of Calgary, Calgary, AB
15. A & H Body & Paint Shop, Bow Island, AB
16. NAPA Auto Parts, Vernon, BC
17. Summerside Hino, Summerside, PE
18. Peterbilt Manitoba Ltd., Winnipeg, MB
19. Lounsbury Truck Centre, Moncton, NB
20. G & M Chevrolet Oldsmobile Ltd., Edmundston, NB
21. Fleet Brake Parts & Service Co. Ltd., Calgary, AB
22. Canadian Tire, Glace Bay, NS
23. Harvest Honda, Steinbach, MB
24. Canadian Tire, Richmond, BC
25. Magic's Auto Parts, Brooks, AB
26. Halifax Chrysler Dodge, Halifax, NS
27. Clarkes Auto Centre Ltd., Summerside, PE
28. Crotty's A Plus Auto Services, St. John's, NL
29. Smith & Watt Ltd., Barrington Passage, NS
30. Fredericton Discount Tire, Fredericton, NB
31. Dalziel's Auto Body Ltd., Charlottetown, PE
32. St. Mary's Ford Sales Ltd., Mount Forest, ON
33. Town & Country Honda Ltd., Hanover, ON
34. Cambridge Chrysler Dodge Jeep, Cambridge, ON
35. International Auto Refinishing, Windsor, ON
36. Foreign Car Parts, London, ON
37. Cambridge Chrysler Dodge Jeep, Cambridge, ON
38. Cambridge Centre Honda, Cambridge, ON
39. Westgate Honda, London, ON
40. Peterbilt Waterloo, Waterloo, ON
41. Carquest Auto Parts, Brantford, ON
42. Storey Automotive AutoPlace, Chatham, ON
43. Dettmer Tire & Auto Service, Guelph, ON
44. Jones Motors, Monkton, ON
45. Len's Automotive & Performance, Jarvis, ON
46. Automobiles Saturn Isuzu, Chicoutimi, QC
47. Daniel Pare Dodge Chrysler Inc., Saint Malachie, QC
48. GN Transports, Concord, ON

49. Canadian Tire Magasin Associe, Shawinigan, QC
50. Nissan Gabriel, St. Laurent, QC
51. Arto Auto Repair Inc., Montreal, QC
52. Hyundai Amos, Amos, QC
53. Carrosseries DM Enr (Les), Saint Romuald, QC
54. Pie IX Dodge Chrysler, Montreal, QC
55. Ovale Lincoln Mercury Inc., Montreal, QC
56. Pieces D'auto St. Etienne, St. Etienne de Lauzon, QC
57. Marlin Service Station, Rawdon, QC
58. Carrosserie Lajoie SENC, Sorel Tracy, QC
59. UAP Associes Pieces d'Autos, Saint Catherine, QC
60. CRS Express Inc., Saint-Georges, QC
61. Gaevan Hino Quebec, Quebec, QC
62. Canadian Tire, Toronto, ON
63. Labrador Motors, Labrador City, NL
64. Alignement Jullen Normand, Saint Felicien, QC
65. Dearborn Ford, Kamloops, BC
66. Brian McLean Chev-Olds, Courtenay, BC

Appendix K -- Employee Research – Responding Companies

The following lists the companies for which employees who were interviewed for the Phase 2 research work:

1. Acadia Suzuki Subaru, Québec, QC
2. Amherst Toyota Ltd, Amherst, NS
3. Auto Machinery & General Supply, Fredericton, NB
4. Automobiles Mauger Ford Mercury, Gaspe, QC
5. Benson Hino Kingston, Kingston, ON
6. Burnside Fleet Service, Halifax, NS
7. Canadian American Trans. (CAT) Inc., Coteau-du-Lac, QC
8. Camions Excellence Peterbilt, Laval, QC
9. Campbell River Honda Country, Campbell River, BC
10. Canadian Tire, Lethbridge, AB
11. Canadian Tire, Montreal, QC
12. Canadian Tire, Roberval, QC
13. Canadian Tire, Saint John, NB
14. Canadian Tire, Saint Thomas, ON
15. Community Chev Olds Pontiac, Brooks, AB
16. Debosselage Df Inc, Dolbeau-Mistassini, QC
17. F & J Collision Service, Windsor, ON
18. Fountain Tire, Campbell River, BC
19. Garage L'Ami de L'Auto Enr, Dolbeau-Mistassini, QC
20. Garage Rene Therrien, St-Philémon, QC
21. Hal Wright Chev Olds, Owen Sound, ON
22. Hino Central, Edmonton, AB
23. Jeff's Collision, Rossland, BC
24. Kenmount Ford Sales Ltd, Sydney, NS
25. Lakeshore Auto Parts Ltd, Etobicoke, ON
26. Len's Automotive & Performance, Jarvis, ON
27. Maritime CARSTAR Collision, New Minas, NS
28. Metro Auto Clinic Ltd, Moncton, NB
29. Motorcity Saturn, Whitby, ON
30. Motrux Inc Truck Fleets, Delta, BC
31. Mountain Hyundai, Hamilton, ON
32. Napa Auto Parts, Woodstock, NB
33. Oakwood Tansport, Ingersoll, ON
34. Parker's Auto Body & Paint Ltd, Victoria, BC
35. Peterbilt Brandon, MB
36. Peterbilt New Brunswick, Fredericton, NB
37. Pettigrew's Garage, Plattsville, ON
38. Pieces D'Auto Cgr Enr, Québec, QC
39. Seaboard Tire Service, Port Hawkesbury, NS
40. Sparrow's Auto Svc Ltd, Eckville, AB
41. Upham's CARSTAR Collision, Truro, NS
42. Vernon Chrysler Dodge Ltd, Vernon, BC
43. Woody's Auto, River Ryan, NS