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COMPREHENSIVE ANALYSIS OF OPEN INNOVATION PRACTICES IN THE EUROPEAN CAR INDUSTRY

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Remark
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SUMMARY

The automobile industry has entered an innovation race. Uncertain technological trends, long development cycles, highly capital intensive product development, saturated markets, and environmental and safety regulations have subjected the sector to major transformations. The technological and organizational innovations related to these transformations necessitate research that can enhance our understanding of the characteristics of the new systems and extrapolate the implications for companies as well as for the wider economy. Is the industry ready to change and accelerate its adaptability and pace of innovation? This report investigates the applicability of the Open Innovation concept to a mature capital-intensive asset-based industry, which is preparing for a radical technological discontinuity - the European automobile industry. The findings identify key obstacles to the adoption of the OI model in the car industry and signal the importance of intermediaries and large incumbents for driving OI practices as well as the need of new competencies to be developed by all players.

1. INTRODUCTION

With huge development costs, long development cycles and fierce global competition, the car industry is a traditionally closed industry. Costs must be contained, and yet customers in nearly saturated markets still desire new, cutting-edge products. Moreover, significant amounts of resources have been spent in recent years on lowering emissions and on the development of environmentally-friendly vehicles. The transition to such vehicles requires a radical and costly technological and organisational shift in automobile operations.

Under growing pressures from increasingly demanding customers, safety and environmental regulations worldwide, the automotive sector has entered an innovation race. Sustained competitive advantage increasingly depends on the ability to improve and accelerate innovation output continuously (Fallah and Lechler, 2008). Innovation has become largely dependent on the ability to monitor all the latest market and technological developments and integrate various complex technologies. Is the car industry ready to embrace a different approach to innovation? This question is critical for an industry preparing for a radical technological shift.

Working across seven European countries, the ProSeSC project, Producer Services for European Sustainability & Competitiveness, aims at examining the practices that assist the upgrading of the car industry and the role of Knowledge Intensive Producer Services (KIPS) in these processes. The project encompasses a range of actions involving active collaboration with SMEs, universities, research centres, support agencies and others. The research behind this report probes more deeply into that experience. ProSeSC is supported by the European Commission’s INTERREG IVC programme (see www.prosesc.org).
2. BACKGROUND

2.1. Open Innovation

The Open Innovation (OI) model has become popular through providing a different perspective on how companies can create and profit from innovation (Chesbrough, 2006, Gassmann, 2006). OI is defined as ‘the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and to expand the markets for external use of innovation’ (Chesbrough et al., 2006, p.1). Outbound knowledge flows are defined as unused technologies that can be sold or licensed to organizations with better suited for their commercialization business models (Chesbrough and Crowther, 2006). Hence, in contrast to the traditional model where innovation is internally generated and marketed, the OI model recommends utilization of both internal and external sources of ideas.

The basic assumption behind the OI model is that even large enterprises can no longer possess all the capabilities and resources to generate innovation by themselves and need to capitalize on external knowledge. Indeed, in the car industry the increasing complexity of cars as products reflects the growing number of technical fields that provide new opportunities for problem-solving. The growing importance of deep specialized knowledge in these fields necessitates an upsurge of R&D investment and organisational capabilities that allow absorption and integration of external knowledge.

However, integrative competencies are not as strongly associated with particular areas of technological knowledge but, rather, relate to application-specific knowledge and adaptability to environmental changes, e.g. emergence of new technologies. Hence, for large organisations such as OEMs the adoption of the OI model necessitates organisational innovation and adoption of structures that allow for optimal combination of internal competencies and external knowledge, leading to continuous innovation. Are OEMs willing to change and embrace OI?

Moreover, what is the role of SMEs in the OI model? It has been argued that SMEs can reap greater benefits from OI than their larger counterparts because external collaboration can offset the limitations of internal resources and competencies (Lichtenthaler, 2008). Technological change tends to reinforce vertical disintegration through reducing the minimum efficient scale thus making it possible for SMEs and entrepreneurs to drive technological innovation (Langlois, 2003). SMEs and start-ups can build a strong regime of appropriability in the early stages of the technology life cycle through establishing deep and complex technology knowledge base, generally unrelated to the knowledge bases of the large players, and a combination of patents (Christensen, 2006).

It has been argued that SMEs should be proactive and take advantage of OI by making this technology base attractive to incumbents through systematic documentation of the technology developments and communication, and engage in cooperation with incumbents to create functional solutions and test market potential (ibid.) or sell the technology to complete its commercialisation (O’Connor, 2006). Thus, one way or another, SMEs are bound to become involved with large incumbents (Christensen et al., 2005). However, do SMEs possess the managerial
and organisational capabilities to secure rents from technological knowledge when collaborating with large incumbents?

In sum, the OI perspective suggests that SMEs deliver innovative ideas and technologies, which large enterprises integrate in product architecture in exchange for complementary assets (Christensen, 2006). While SMEs concentrate on exploration and perhaps some experimentation, large incumbents step into the final stage and take over experimentation and exploitation, instituting repeatable processes such as manufacturing, delivery and customer contact and support (O’Connor, 2006). Such symbiotic relationship can compensate for the cumbersome structures of large enterprises as well as for the resource shortages of SMEs and entrepreneurs.

Last but not least, the OI model is highly dependent upon intermediate markets where entrepreneurs supply new discoveries and highly specialised technological capabilities, possibly in collaboration with research institutions, to large companies, like OEMs, who in turn provide integrative capabilities and complementary assets for large scale commercialisation of innovation, and transform technologies into application-specific use. Thus the OI model highlights the prominence of market-supporting institutions in promoting technological entrepreneurship as well as the importance of multiple ties among organisations and various types of institutions, e.g. universities, research centres, government and regional institutions (Simard and West, 2006). It is important to explore to what extent intermediate markets and institutions facilitate interorganisational interactions in the car industry.

2.2. Open Innovation in the Car Industry

The evidence to support the OI concept is taken almost exclusively from evidence in the context of high-paced industries, such as computers, software industry and pharmaceuticals (e.g. Chesbrough, 2003, West and Gallagher, 2006, Gardet and Fraiha, 2012). Whether the OI concept can be applied in lower tech or more mature industries, remains an open question. Mature industries display very different characteristics in terms of types of innovation, handling of intellectual property rights (IP), patterns of innovation diffusion, risk management as well as strategies for exploiting innovation. Hence it is important to examine whether the OI model is appropriate in the car industry setting.

As in many other industries, in the 1980s, the car industry witnessed a move from the prevalent central-R&D-lab model towards a more distributed R&D model through supplier involvement in new product development. While this may be seen as a move towards OI, suppliers were still working under strict guidelines and specifications provided by OEMs. Although specifications vary in the level of detail (Ge and Fujimoto, 2006), their prescriptive nature make it problematic to see the resulting output as purposive knowledge inflows intended to accelerate internal innovation in OEMs. OEMs still maintained powerful central laboratories while experimenting with ways of coordinating R&D at different levels (Tidd et al., 2005). The move in the 80s has been branded ‘a dismal failure’ by industry practitioners and resulted in transferring the design control and product validation back to OEMs in the 90’s.
The only previous study examining OI in the car industry (Ili et al., 2010) is focused on the German car industry. Building on Gassmann (2006), the authors demonstrate that the car industry displays all the relevant properties suggesting that the OI model would be appropriate, i.e. it is highly globalised, technology intensive, characterised by high levels of technology fusion and open to identifying and implementing new business models. Yet, the industry tends to the closed innovation paradigm. The one idiosyncrasy that does not fit the model is the low level of knowledge leveraging.

Hence, the question that arises is whether OEMs possess the capabilities needed to for the adoption of the OI model. For mature traditional companies like car manufacturers, OI is a marked departure from previous vertically integrated ‘industrial’ models. Have they developed the integrative competencies needed to explore opportunities emerging from technological breakthroughs outside of the firm, to coordinate and benefit from external developments?

2.3. Objectives

Against this background, this comprehensive report aims to explore the applicability of the OI model to a mature industry – the European car industry - in the light of the radical technological discontinuity taking place in the sector.

More specifically, we aim to investigate:
- How flows of knowledge circulate between the different industry players;
- How intermediate markets and institutions facilitate interorganisational interactions.

3. Research Design

This report is grounded in the data collected via thirty semi-structured, open-ended, in-depth conversational interviews. The use of interviews allowed the discussion to lead into potentially relevant areas, which may not have been considered prior to the interview. This flexibility allowed for full use of the respondents’ individual industry experiences and background.

The respondents were selected through purposeful sampling. Each of the PROSESC project partners in the seven participating European countries - Germany, Hungary, Italy, Romania, Slovenia, Spain, and the UK - was asked to provide contacts with individuals who represented one of the following groups: OEMs, Tier 1suppliers, SMEs, regional authorities, cluster management, regional universities or research institutes involved with the automotive industry, and regional support agencies. This approach ensured the research problem was approached in a rounded and multi-faceted way.

The interviewees were encouraged to develop their views around the open-ended questions. The interviews captured a broad picture of the automobile industry and the processes taking place in the sector because most of the respondents had occupied different positions or worked in different companies in the industry over a number of years.
The data was analysed with NVivo9 data analysis computer package. The extracted themes were illustrated with quotations.

4. FINDINGS

4.1. Knowledge Flows

In the context of OI, the existence, intensity and direction of the knowledge flows circulating between the industry players indicate whether and to what extent OI practices are employed. We distinguish three types of purposive knowledge flows, namely between (i) OEMs/Tier 1s and knowledge institutions, (ii) OEMs/Tier 1s and SMEs, and (iii) SMEs and knowledge institutions. We have found that problems and barriers exist at all levels.

The most extensive knowledge flows can be observed between OEMs and Tier 1 suppliers who tend to work very closely. In addition, a relatively good relationship between OEMs and knowledge institutions exist in some of the partner settings, including ‘involvement of students into production for training purposes’ (R25) and ‘contribution to research development’ (R16). However, the knowledge exchange is typically constrained to this kind of collaboration. In some of the partner countries even this kind of exchange is limited.

OEMs work more actively with research institutes and outsource R&D, ‘or rather D’ (R17). They use a twofold mixed approach, which ensures that internal capabilities are maintained. Research institutes work to strict specifications, ‘tactically replacing internal departments’ (R17). The key considerations behind the use of research centres by OEMs are cost, time to market, diversity of knowledge and speed of technology advance. The latter has implications not only for time-to-market but also for the training of the OEMs’ employees.

The key barriers to the use of external knowledge by OEMs are the capital intensity of the industry, the related cost and risk considerations, the lack of efficient organisational interface with external sources of knowledge, and the general resistance to external ideas.

‘You have to trust in others’ knowledge, that is a learning process. You need to change the mindsets of the guys doing the actual R&D within the company to see that they add value if they make use of external knowledge.’ R16

All in all, our data strongly indicate that both incoming and outgoing knowledge flows of OEMs are interrupted and strictly controlled.

SMEs, on the other hand, do not take full advantage of the opportunities to tap into external scientific and technological knowledge to the benefit of their innovation efforts and are rarely proactive despite the opportunities provided by the regional clusters. This could be attributed to internal resource limitations that affect the deployment of externally sourced technology and knowledge as well as to appropriability issues.

‘The SMEs do not want to let outsiders in. They are anxious that other companies might get hold of their knowledge. This is not easy for them. The
OEMs have the resources to protect their knowledge, and they can differentiate the things they do with universities and the things they do themselves. They make some specific research topics with universities, but the inside knowledge that is very sensitive, they do not let out.’ R13

The challenge of inefficient use of external knowledge by SMEs persists across national boundaries and can be observed even in the most developed and successful clusters. In addition, a negative perception of universities as having a different agenda, approach to knowledge generation and project management, further obstructs the development of working relationships between SMEs and knowledge-generating institutions.

‘Only few SMEs work with universities. It is not easy for SMEs to work with research centres and universities because usually they do not have so much resources, skilled people and also financial resources.’ R2

‘There is a lot of openness in companies to work with universities. But, unfortunately, the universities do not have the necessary resources to be able to contribute, or to do what the companies need. In order to do development or research, you need a lot of quite expensive equipment.’ R25

On the other hand, opportunities are emerging and spaces are opening up for innovative SMEs in the new segments around environmentally friendly vehicles, e.g. IT, electronics, software and mobility services, telematics, car entertainment, as well as the development of relevant infrastructure. While the car industry is still closed in its traditional segments, some OI practices can be observed in these emerging segments, which display all the signs of an emerging industry, e.g. lack of dominant design, low rate of market penetration, and focus on technology and design, etc. It is in these segments where inflows of knowledge from other industries can be observed as well as a healthy exchange of knowledge between different types of industry players.

4.2. **INTERMEDIARIES**

In the context of OI, intermediate market-supporting institutions can promote innovation and entrepreneurship through reducing coordinating costs, increasing the scope for secure IP, and developing ties among the various players. They are the critical drivers of enhanced effectiveness in technological markets.

Although there were differences in the level of development, we have observed attempts to establish intermediate market-supporting institutions across all the countries in our study. Cluster networks are themselves key intermediaries, often specialized in innovation management and supporting SMEs in getting support from public institutions and identifying possible partners to share technologies.

‘We do common marketing and push innovation and research. We work consistently on upgrading R&D competencies and buy equipment for our technology centres, which the companies use together. We support SMEs with training that is not available but is needed, especially resource management, project management, quality management.’ R6
However, the key role of intermediaries in the OI model is linking highly specialised suppliers of technology and technological capabilities with the OEMs and Tier 1s that possess the integrative capabilities and complementary assets needed for large scale commercialisation. The examples of the well-developed regional clusters illustrate the importance of close interaction and exchange between SMEs and the large players. The absence of OEMs and Tier 1 suppliers typically has negative impact upon the achievements. In the clusters where healthily-funded intermediaries have assisted the establishment of robust multiple links between the players, SMEs demonstrate marked improvement in technological and managerial capabilities.

‘The cluster could be a solution because you have to find the trust at some level. You need to have a number of companies willing to say “that is how it could work, and our bundle will act as a partner to Daimler, and this is who will do the job, but if he fails we are going to jump in and save the game.” It is all about trust and the intermediary organizations could plant the seed of this trust, feed it, water it and try to be the gardener of it. They can ensure that all the frictions that exist in the networks are managed.’ R17

Different types of intermediaries have emerged to serve the technology markets. Some provide managerial support, link enterprises according to their needs, and coordinate the innovation efforts, e.g. clusters, while others link universities to enterprises, fundamental research to applied research, and become directly involved with the innovation processes, e.g. research centres.

5. DISCUSSION AND CONCLUSIONS

The definition of OI suggests that the readiness of an industry for OI can be assessed by examining the purposive inflows and outflows of knowledge that circulate between the players. Our study strongly indicates that knowledge flows in the car industry are, although to a different degree, largely disrupted. In the traditional segments, the direct incoming knowledge flows of car manufacturers are limited mainly to large suppliers and research institutes. In the better developed clusters, limited in scope relationships with universities are present but direct knowledge exchange with SMEs are rarity in all settings. Outgoing knowledge flows are completely severed.

OEMs have the technological competencies to evaluate and integrate breakthroughs emerging outside of the firm. However they lack the organisational capabilities to select, coordinate and benefit from unplanned external developments. The key problems obstructing the inbound knowledge flows from SMEs are credibility and risk aversion grounded in the capital intensity of the industry, resistance to external ideas and coordination costs. Moreover, the cultural and organisational barriers to OI identified by Ili et al. (2010) in the German car industry - ‘not-invented-here’ syndrome, lack of appropriate processes, and top-down integration – do apply to the national settings in our study. Last but not least, we have identified a problem of accessibility caused by the lack of efficient communication interface between OEMs and the rest of the industry.

The large Tier 1 suppliers appear to be most open – not only they actively scan and select external ideas and knowledge both upwards from the OEMs and downwards
from the SMEs, but they also attempt to maximise the exploitation of their own innovations by offering them to other industries.

SMEs, on the other hand, find potential knowledge exchanges with other players difficult and risky. The paths for taking advantage of OI and making their technology base attractive to incumbents boil down to two: via the large Tier 1 suppliers or via the regional clusters. When SMEs do engage in collaborative work with large incumbents, they typically lack the managerial and organisational capabilities to secure rents from their technological knowledge. Cluster membership offers better chances of benefiting from own innovations. All in all, while SMEs may reap greater benefits from OI than their large enterprises (Lichtenthaler, 2008) in dynamic, knowledge-based, labour-intensive industries like the software industry, in mature capital-intensive asset-based industries like the car industry, they have limited options.

Previous studies have argued that SMEs can counteract the liability of size and enhance their ability to innovate by engaging in OI practices (e.g. Lichtenthaler, 2008, O'Regan and Kling, 2011). However, our analysis suggests that SMEs in the car industry, although reported to be open to external knowledge, are slow to engage in OI practices and do not take a full advantage of the opportunities to tap into external knowledge. The key barriers are IP issues and resource limitations. Appropriability issues erect communication barriers and necessitate new competences in the car industry, e.g. efficient management of intellectual property rights and expertise to evaluate the potential of external technologies. Knowledge flows between SMEs and knowledge-generating institutions are also obstructed by resource limitations as well as differences in management style and priorities.

All in all, the findings show that the car industry is still a closed industry in a pressing need of cultural change if it is to accelerate innovation rate and adaptability. At present, the sector uses mainly its own direct environment as a trigger for innovation: the handling of IP is defence-oriented (Ili et al., 2010), while the most important drivers of innovation are legislation and regulations, followed by customer demand. However, expected technological shifts are giving rise to OI practices in the emerging segments, where SMEs incubate radical innovations. While large enterprises are proficient in managing existing markets, SMEs act as engines of radical innovation because they do not suffer the bureaucracy of incumbents and can be flexible in structuring appropriate business models. The new sustainable mobility paradigm opens up niches for SMEs to identify new kinds of needs and satisfy these through innovative adaptation of deep specialised knowledge, including from cross-industry linkages.

Ultimately, the intensity and quality of participation and knowledge exchange are contingent upon the beliefs and drive of the individuals involved. The problems of accessibility, communication and disrupted knowledge flows can be only resolved if appropriate mindset exists. New competencies need to be developed by all players to achieve and manage the optimal combinations of internal competencies and external knowledge. Last but not least, the study highlights the importance of intermediaries and large incumbents for driving network development and OI practices.
This report identifies key obstacles to the wider adoption of the OI model in the car industry and demonstrates that the OI model, although very attractive, may not be equally applicable to all industry settings. The dependency of the model on IP management and intermediate markets deserve more attention from policy makers.

REFERENCES


Appendix: Description of the respondents

<table>
<thead>
<tr>
<th>Respondents’ job title, education &amp; experience</th>
<th>Organisation</th>
</tr>
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<tbody>
<tr>
<td>1. Professor, and Founder and Manager</td>
<td>SME, spin-off of a cluster member university</td>
</tr>
<tr>
<td>2. Technical coordinator</td>
<td>Intermediary providing foreign buyers with support in outsourcing activities through linking them with suppliers, selected on the strength of their technical, qualitative and logistic capabilities. The member companies are together potentially able to manufacture a vehicle from the drawing board to mass production</td>
</tr>
<tr>
<td>3. [Dr] Head of the Secretariat of the regional financial institution; an Engineer, Ph.D. in Economics and the Management of Technology</td>
<td>The regional financial institution is the bank of the regional government devoted to policy operations. The institution takes care of the car sector with specific instruments.</td>
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<tr>
<td>4. [Dr] researcher in material engineering, working on power sources</td>
<td>University - a cluster member</td>
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<tr>
<td>5. Founder and General Manager</td>
<td>An engineering SME (40 staff), focused on R&amp;D in the field of Electronics. The company provides highly specialised engineering services in different sectors: automotive, railway and military.</td>
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<tr>
<td>6. Managing Director of a regional automotive cluster</td>
<td>The cluster is a business interest association of automotive industry suppliers.</td>
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<tr>
<td>7. HVEC cluster manager, and project manager and partner</td>
<td>An engineering SME (micro – under 10 staff) originally providing services in the field of CAD/CAE, dedicated as a supplier partner to support engineering activities in development of vehicles mostly in designing of passenger cars; offers services in BIW design and simulation. The cluster deals with national and international R&amp;D projects in the vehicle sector, from bicycles up to buses and trucks</td>
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<tr>
<td>8. [Dr] Partner; an engineer and an entrepreneur for about 15 years</td>
<td>An SME (40 staff) developing innovative technical development and background services; construction of prototypes of alternative and hybrid vehicle models, preparations for manufacturing, series production</td>
</tr>
<tr>
<td>9. Innovation Manager</td>
<td>Regional innovation agency</td>
</tr>
<tr>
<td>10. Project and PR manager in the Regional Knowledge Centre for Vehicle Industry,</td>
<td>University - a cluster member</td>
</tr>
<tr>
<td>11. Manager</td>
<td>A large supplier providing a broad range of services to the</td>
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<tr>
<td></td>
<td>Automotive industry in mechanical engineering</td>
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<tr>
<td>12.</td>
<td>Project Manager in the Competence Centre for Mobility Technologies</td>
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<tr>
<td>13.</td>
<td>[Dr] a researcher and Project Manager</td>
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<tr>
<td>14.</td>
<td>Project Manager for development projects; mechanical engineer; 10 years experience in the current consulting company, 10 years in another company providing engineering services to the automotive industry</td>
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<tr>
<td>15.</td>
<td>Manager Infrastructure Development for Fuel-Cell and Battery-Electric Vehicles; Previously 'started in the production of condenser powertrain, then worked on hybrid vehicles in the development centre in Michigan, US, then worked on software development for production vehicle which is now sold in US'</td>
</tr>
<tr>
<td>16.</td>
<td>[Dr] Cluster manager for two organizations</td>
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<tr>
<td>17.</td>
<td>[Dr] Project Manager; background in mechanical engineering and software services for the automotive industry, experience with the Regional Economic European Cooperation</td>
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<td>18.</td>
<td>Head of Powertrain Engineering and Advanced Propulsion; 28 years experience in the current company; background in automotive test and development particularly powertrain emissions and fuel consumption.</td>
</tr>
<tr>
<td>19.</td>
<td>Founder and Managing Director; 41 years experience in the industry, started at 16 on a mechanical apprenticeship, worked for Lotus for 19 years managing a project team with more than 36 people, introducing 8 engines, which have resulted in 8 million cars in and around Europe and America.</td>
</tr>
<tr>
<td>20.</td>
<td>Technical Director; also working as a consultant on some automotive based programs; technical lead on a major EV infrastructure development project; formerly Chief Electrical Engineer at Lotus for a period of 18 years; in the automotive business for a period of 32 years; also worked on some energy storage projects; Chair</td>
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<td>No.</td>
<td>Position/Role</td>
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<tr>
<td>21</td>
<td>Director of Mergers and Acquisitions</td>
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<td>22</td>
<td>Manager Environmental Strategy; worked for another major car manufacturer in a variety of roles in Europe and around the world for 21 years</td>
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<tr>
<td>23</td>
<td>Professor, specialist in the programming and operation of CNC machine tools</td>
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<td>24</td>
<td>Process Improvement Consultant; 16 years experience in the automotive industry (multinational corporation environment) working as process engineer, production manager, plant manager. Participated in the cluster establishment and development.</td>
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<tr>
<td>25</td>
<td>General Manager</td>
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<td>26</td>
<td>Project Consultant and Project Coordinator</td>
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<td>27</td>
<td>General Manager</td>
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<td>28</td>
<td>Coordinator</td>
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<tr>
<td>29</td>
<td>Director of the Research Department at Automotive Technological Centre</td>
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<tr>
<td>30</td>
<td>Partner and COO in an SME, many years of experience in the automobile industry</td>
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