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**An Empirical Study of the
Partnership Network Structure of
Automakers under CASE**

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ENTRENOVA, Split, Croatia, 2020

Introduction

- The purpose of this study
 - is to empirically analyse the effects of radical technological change on the network structure of corporate partnerships.
- This study focuses on
 - the automotive industry, which is currently facing dramatic technological change, known as CASE (Connected, Autonomous, Shared & Services, and Electric)
- The research question
 - whether radical innovation is likely to be created by integrated inter-organisational relationships or by decentralised inter-organisational relationships.
- As an analysis method
 - the characteristics of the network structure of each automobile manufacturer and their relationship with their degree of CASE will be analysed based on the compiled database using the method of social network analysis.

Previous research

1. Relationships between organisations in the automotive industry
 - In the traditional automotive industry, a closed and strong partnership network structure with a specific group of companies has been selected.
 - On the other hand, in the IT industry, a network structure of a relatively open and ad hoc weak partnership has been selected.
 - With the development of CASE, it is predicted that the automobile product structure will resemble that of IT products (Iansiti and Lakhani, 2017).
2. Network Theory and Innovative Technology Evolution
 - According to Granovetter (2005), more novel information flows to individuals through weak ties rather than strong ties.
 - The structural holes' strength lies in the widespread dissemination of new, formal, and heterogeneous knowledge, and it is easily linked to radical innovation (Burt, 2004).
 - On the other hand, without a highly cohesive network, it would be difficult to realize new technologies (Coleman, 1988; Gargiulo, et al, 2009).
3. Platform or Integration
 - The horizontal specialization promotes innovation, for example in platform leadership (Gawer and Cusumano, 2002).
 - Innovative technological change is brought about by integrated inter-organizational relationships, for example in the modularity trap (Chesbrough and Kusunoki, 2001).

Research hypothesis

- H1. With the development of CASE, the network of automaker partnerships will expand.
- H2. With the development of CASE, the structural holes in automaker partnerships will increase.
- H3. With the development of CASE, the partnership network of automakers will not be widened. (Alternative hypothesis)
- H4. With the development of CASE, automakers will expand their platform-type partnership network.
- H5. With the development of CASE, non-automaker suppliers will expand their platform-type partnership network.
- H6. Even if CASE progresses, the industrial structure will remain integrated. (Alternative hypothesis)

Research method (Data)

- Data on the partnerships were obtained from FactSet's Supply Chain Relationships.
- The number of companies available was 106 for automakers and 901 for all, including partners.
- The types of partnerships were mainly Research Collaboration, Joint Venture, licensing, etc.
- The Industry category was used to measure the extent to which automakers are collaborating with partner companies on CASE.
 - The ratio of partners with the following Industry categories (*) to all partners was used as a proxy variable for the degree of cooperation with partners regarding CASE.
(Hereinafter, this value is referred to as the “CASE ratio”).
 - (*) Packaged Software, Electrical Products, Internet Software/Services, Telecommunications Equipment, Electric Utilities, Broadcasting, Information Technology services, Semiconductors, Electronics/Appliances, Electronic Equipment/Instruments, Electronic Production Equipment, Major Telecommunications, Electronic Components, Internet Retail, Alternative Power Generation, Wireless Telecommunications, Computer Processing Hardware, Data Processing Services, Computer Communications, Electronics Distributors, Specialty Telecommunications, Cable/Satellite TV, Computer Peripherals

Research method (Analysis)

- Various network indices that quantify the characteristics of the network structure of each automobile manufacturer were extracted, and the relevance of each variable to CASE was verified by correlation analysis with CASE ratio.
- The network indices used to test each hypothesis are as follows.
 - For Hypothesis 1, the size of the network is based on the size of the ego network of each car manufacturer.
 - For the structural hole in Hypothesis 2, Constraint was used.
 - Constraint is an index that indicates the degree of constraint of the network.
 - The smaller the value of constraint, the larger the structural hole, indicating that the company is effectively cooperating with various companies.
 - For the platform of Hypothesis 4, we used broker and ego betweenness
 - These are indices indicating the mediation of a certain node, and indicate the ratio of mediating the connection between other nodes on the network.
 - For Hypothesis 5, density was used.
 - This index indicates the degree to which each node on the network is connected to each other.
 - The network analysis was performed using UCInet ver. 6.6.

Results

- Table 1 illustrates the results of the correlation analysis between the network indices of all automakers and the CASE ratio.

Network index	Correlation coefficient	Related hypothesis (alternative hypothesis)
Size	.348*	Hypothesis 1(3)
Constraint	-.390*	Hypothesis 2(3)
Broker	.245	Hypothesis 4(6)
EgoBetween	.233	Hypothesis 4(6)
Density	-.241	Hypothesis 5(6)

Discussion

- From the results of the correlation analysis on the trends of all automakers, the more companies progressing to CASE, the wider and more diversified their partnerships.
- On the other hand, horizontal specialisation and platformisation were not correlated with the progress of CASE.
 - Currently, numerous automakers are expanding their R&D activities by investing proactively in the new CASE domain while maintaining vehicles that are based on existing gasoline engines and maintaining a vertically integrated supply chain.
 - These results support Hypotheses 1 and 2, and reject Hypothesis 3, an alternative hypothesis.
 - Also, the results of the correlation analysis seem to support Hypothesis 6, which is an alternative hypothesis, with Hypotheses 4 and 5 being rejected.

Discussion (Cont.)

- The current overall trend seems to indicate a situation that differs from experiences of the computer industry in the past.
- The question then arises as to whether the inter-organisational relationship will change in the automotive industry even if CASE progresses.
- As one possibility, a vertically integrated organisational relationship may be maintained.
- Or, as another possibility, even if the current inter-organisational relationship is vertically integrated, it may be because technology development for CASE is in the early stages of the life cycle.
 - In other words, a scenario is conceivable in which, as development progresses in the future, many technologies mature, and various technical standards are established, and the inter-organisational relationships will become specialised horizontally.

Conclusion

- The purpose of this study
 - was to empirically explore the impact of technological innovation on network structure between organisations in the automotive industry.
- As a methodology
 - A database on the network structure of partnerships by automakers around the world was created and analysed using network analysis techniques.
- As a result
 - In response to technological changes called CASE, automakers have increased the size and diversity of their networks.
- As a limitation of this research
 - CASE is still in progress, and the structure of the corporate inter-organisational network may further change in response to future technological changes.
- As a remaining issue,
 - continuous investigation is subsequently needed.



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Thank you!