Visualization Research and Analysis of Top Management Team Characteristics in Engineering Projects

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Abstract. In the process of project management, the project manager has a huge responsibility. The project manager determines the success of an engineering project. The project manager is a member of the executive team, so it is necessary to study the characteristics of the executive team. Scholars have produced a series of research results on the top management team characteristics. This paper uses Citespace.5.3 to analyze the characteristics of top management teams in the Web of Science database, and analyzes the research status of top team characteristics from the perspectives of the number of countries, representative scholars, geographical distribution of authors and cited authors. The cluster analysis is carried out for high-frequency keywords, and the research hotspots, theoretical basis and research direction of the top management team are compiled. The article focus on the top 10 citation bursts, and provides suggestions for future research.

1. Introduction
With the rapid development of urbanization, people's demand for convenience and home has made the construction industry flourish. The project manager plays an important role in the project. In today's era of rapid dissemination and development of Internet information, only one person's knowledge can no longer adapt to the changes of the times, and various construction companies face enormous challenges. The reality puts higher demands on managers, and the challenge is more dependent on the collective wisdom of the executive team in the project process. Analysis of the current status of top management team characteristics has not been applied to the analysis of visualization software. Therefore, this article uses Citesease.5.3. software to sort out the latest research findings and research progress on the characteristics of the top management team, and provides ideas and directions for future research.

2. Data sources and research methods
The data comes from the web of science database, enter keyword as top management team characteristics, select 2008-2018 in time, and select Web of Science Core Collection to retrieve 316 records, and use the visualization tool citesease to data. Perform a visual analysis. In order to ensure the rationality of the data, the paper will eliminate the data of 2019. The purpose is to analyze the research status of top management team from representative authors, high-author author papers, etc. From the high-frequency keyword cluster analysis, the research hotspots are discovered, and the evolution of context is highlighted.
3. Research analysis

3.1 Geographical distribution

According to the statistics of the authors of Top Management Team Characteristics literature, the data shows that the largest number of publications in the 10 years is USA, the number of publications reached 112, followed by SPAIN, and the number of publications reached 30, while China did not.

| Num | Freq | Centrality | Author            |
|-----|------|------------|-------------------|
| 1   | 112  | 1.06       | USA               |
| 2   | 30   | 0.1        | SPAIN             |
| 3   | 29   | 0.09       | PEOPLES R CHINA   |
| 4   | 27   | 0.14       | ENGLAND           |
| 5   | 25   | 0.19       | GERMANY           |
| 6   | 21   | 0          | TAIWAN            |
| 7   | 17   | 0.21       | NETHERLANDS       |
| 8   | 13   | 0.05       | SWITZERLAND       |
| 9   | 12   | 0.01       | CANADA            |
| 10  | 11   | 0.01       | ITALY             |

3.2 Authors of the top 20 posts

It can be found from Table 2 that most of the high-yielding authors are less than or equal to three. 14 of the top 20 authors published 3, and the rest published 2, the network is more dispersed, generally less than 2 people, indicating that the research scholars of the executive team characteristics are influenced by the work background or geography, and the cross-team and interdisciplinary cooperation is less. Future research can be developed in the direction of cross-team and interdisciplinary cooperation.

| Num | Author            | Freq | Num | Author            | Freq |
|-----|-------------------|------|-----|-------------------|------|
| 1   | KOSTY MP          | 3    | 11  | HYLTON H          | 3    |
| 2   | SCHENKEL C        | 3    | 12  | ROSENZWEIG M      | 3    |
| 3   | VOGEL W           | 3    | 13  | PICKARD TA        | 3    |
| 4   | SMITH N           | 3    | 14  | HANLEY A          | 3    |
| 5   | LYNCH C           | 3    | 15  | CHEN SM           | 2    |
| 6   | WILLIAMS SF       | 3    | 16  | KELLERMANNNS FW   | 2    |
| 7   | BRUINOOGGE SS     | 3    | 17  | MOON J            | 2    |
| 8   | WESTIN SN         | 3    | 18  | LEE WS            | 2    |
| 9   | TETZLAFF E        | 3    | 19  | NARANJO-GIL D     | 2    |
| 10  | GARRETT-MAYER E   | 3    | 20  | HACK A            | 2    |
3.3 Highly cited authors
Through the analysis of cited authors, it was found that among the extracted documents, the highest citation rate was published by Hambrick in 2008, and the number of citations reached 201 times. Carpenter and Finkelstein have also been cited more than 100 times. Therefore, it can be inferred that in the research of the top management team, a deep understanding of the articles of highly cited authors is needed.

Table 3. Statistics on the number of the first twenty authors.

| Num | Author          | Year | Freq | Num | Author   | Year | Freq |
|-----|-----------------|------|------|-----|----------|------|------|
| 1   | Hambrick DC     | 2008 | 201  | 11  | Kor YY   | 2009 | 52   |
| 2   | Carpenter MA    | 2008 | 127  | 12  | Daily CM | 2009 | 51   |
| 3   | Finkelstein S   | 2008 | 124  | 13  | Amason AC| 2008 | 51   |
| 4   | Wiersema MF     | 2008 | 94   | 14  | Zahra SA | 2008 | 50   |
| 5   | Bantel KA       | 2008 | 93   | 15  | Tihanyi L| 2009 | 48   |
| 6   | Eisenhardt KM   | 2009 | 84   | 16  | Boeker W | 2008 | 44   |
| 7   | Pfeffer J       | 2008 | 65   | 17  | Barker VL| 2008 | 43   |
| 8   | Miller D        | 2008 | 64   | 18  | Hillman AJ| 2009 | 42   |
| 9   | Hitt MA         | 2008 | 58   | 19  | Herrmann P| 2009 | 41   |
| 10  | March JG        | 2010 | 52   | 20  | Smith KG | 2009 | 39   |

4. Research hotspot analysis
Analysis by keyword clustering can find a hot spot and the latest research frontier in the research field. The keywords of the literature can reflect the core of the literature. Therefore, the keyword frequency analysis method can be used to observe the high and low distribution of the literature keywords to explore the development direction and research hotspots of the field.

4.1 High frequency theme
According to the keyword clustering analysis, it was found that the top ranked frequency was Top Management Team, the frequency of occurrence was 126 times, the centrality was 0.09, and the ranking of second, third, fourth, fifth were Firm Performance reached 90 times, Upper Echelon and Performance appeared 76 times in parallel, and Moderating Role appeared 48 times.

4.2 Theoretical basis
In Table 4, the most widely used literature on the characteristics of the executive team is Hambrick and Mason [1], based on the bounded rational hypothesis and cognitive psychology, the upper echelon, which is considered to be the epitome of the executive team. The cognitive foundation and values of the executive team will influence the strategic decisions of the company and thus the performance of the company. Secondly, there are entrepreneurial theory [2], human capital theory, social exchange theory, socialization theory and information decision theory [3] as the theoretical basis of supporting research.

4.3 Research on the characteristics of senior management team
Based on the results of keyword clustering analysis, table 4 and figure 1, it can be found that the research on the top management team characteristics can be roughly divided into three categories. (1) Subdivide the characteristics of the top management team, which can be divided into diversity and heterogeneity. (2) Study its firm performance, performance, financial performance, innovation and other organizational output results. (3) Study the impact of the top team characteristics on decision-making, including the impact of decision making, strategic change, corporate governance, strategic
decision making and other major decisions. It also includes research on the operational mechanisms between the top teams and firm performance, moderating role or model.

Table 4. Top management team characteristics high frequency keywords.

| Num | Keyword                  | Centrality | Freq | Num | Keyword                  | Centrality | Freq |
|-----|--------------------------|------------|------|-----|--------------------------|------------|------|
| 1   | top management team      | 0.09       | 129  | 11  | team                     | 0.02       | 26   |
| 2   | firm performance         | 0.07       | 90   | 12  | strategy                 | 0.04       | 26   |
| 3   | upper echelon            | 0.24       | 76   | 13  | strategic change         | 0.08       | 26   |
| 4   | performance              | 0.21       | 76   | 14  | management               | 0.06       | 24   |
| 5   | moderating role          | 0.12       | 48   | 15  | organization             | 0.05       | 23   |
| 6   | diversity                | 0.04       | 39   | 16  | firm                     | 0.05       | 21   |
| 7   | top management           | 0.03       | 38   | 17  | financial performance    | 0.09       | 20   |
| 8   | corporate governance     | 0.13       | 36   | 18  | heterogeneity            | 0.11       | 19   |
| 9   | decision making          | 0.06       | 35   | 19  | model                    | 0.05       | 19   |
| 10  | innovation               | 0.02       | 28   | 20  | strategic decision making| 0.05       | 19   |

Figure 1. Top team characteristics keyword common word map.

5. Evolutionary trends
Exploratory word detection can identify keywords that suddenly increase in frequency during a certain period of time. It is helpful to grasp the evolutionary trend of research in this field by combing the emergent words in different periods. In this article, we use Keyword as the node, select Citation Burst in the visualization, and then use View to get the top ten prominent words, as shown in figure 2.
At the first stage, from 2008 to 2013, the word environment / diversification / diversity / ownership structure / strategic change / strategic change making / organization / outcome / entrepreneurship emerged, which means that the research of the senior management team is more concerned by scholars. On the impact of organizational ownership, changes in strategic decisions, and other major organizational issues, on the other hand, they are more concerned about their impact on company performance. At the second stage, from 2015 to 2016, Management Team Characteristics emerged. In addition, the entrepreneurship is still a hot spot.

### Conclusions and recommendations

The top management team plays a very important role in the project management. It is responsible for determining the organizational goals, formulating strategies to achieve the stated goals, supervising and interpreting the external environment and making decisions on issues affecting the entire organization, and determining the future development and performance of the company. The above analysis shows the overall situation of employee innovation behavior research. From the research status quo, there are still some shortcomings on the characteristics of the senior management team in the research. Therefore, future research can be further improved from the following aspects:

- **Exploring the outcome variables of executive team characteristics**, focusing on corporate innovation performance and social performance. Although there have been many studies on corporate performance, in the era of increasing innovation, research on innovation performance is more necessary.

- **Focus on the dynamic environment.** In the latest research, it can be found that research on the characteristics of top management teams is more concerned with environmental impacts. The environment makes the executive team's heterogeneity characteristics more obvious. In the future, the characteristics of the senior management team will pay more attention to the characteristics of the dynamic executive team members affected by the times, in addition to the static characteristics of homogenization.

- **Exploring the detailed research on the characteristics of the top management team.** Many scholars have studied in detail the demographic characteristics of top management team homogeneity and heterogeneity, but conflicts, communication, coordination, power distribution and behavioral integration among members of the top team's operational characteristics. At present, there are still relatively few studies, and research can be strengthened in the future.
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