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Scenarios of Developing Platform Businesses Using Open Innovation and Designing Fuzzy Experiments Approach

Reza Amerisiyahooei[1] **Masoumeh Hosseinzadeh Shahri**[2]

[1-] Postdoctoral Researcher, Department of Management, Faculty of Social Sciences and Economics, Al-Zahra University, Tehran, Iran. (Corresponding author) Email: rezaamerisiyahooei@gmail.com.
[2-] Associate Professor, Department of management, Faculty of Social Sciences and Economics, Alzahra University, Tehran, Iran. Email: mhshahri@alzahra.ac.ir.

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Abstract:

Innovation in developing platform businesses is very significant nowadays due to the importance of businesses and their role in economy. As businesses will use in future the collective wisdom and extra-organizational knowledge, applying open innovation in the businesses seems to be a must. The expert participants of the research are twelve specialists and managers of platform businesses. Reviewing the theoretical foundations, four factors were extracted from the opinions of experts: attraction capacity, networking and network management, knowledge and technical capacity, and collaboration capability. Taguchi experiment design method was used for determining the role of the factors. Four levels is defined for each factor (between 0 and 0.25 for level 1, between 0.25 and 0.50 for level 2, between 0.50 and 0.75 for level 3, and between 0.75 and 1 for level 4). Using Qualitek software sixteen scenarios extracted.

For determining the optimal scenario, questionnaire and fuzzy Taguchi experiments were used. The results showed that the appropriate level of platform development indicators using open innovation should be at the fourth level (0.75-1) for all four factors. That is, all four factors impact drastically the development of platform businesses. Moreover, the results of variance analysis showed that the importance of the factors in the development of the platform are, respectively, knowledge and technical capacity (42.70% of participation), attraction capacity (24.37%) and networking and network management (21.09%), and collaboration capability (6.84%).

Introduction

Platform is a kind of business model that generates values through facilitating the communication between two or more interdependent groups that usually include service providers and service recipients (Osterwalder & Pigneur, 2010). Platforms have central role in competitive environments and their position in the

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global economy is so high, but to date, the developmental concepts of platform businesses have not been seriously investigated (Bonina et al., 2021). Therefore, to determine a framework for platform business development (PBD henceforth) it is necessary to find the requirements. Considering that platforms are technology-based, a development requirement for platform businesses to be modern, is taking an open innovation approach. Open innovation on platforms makes business sustainable (Kim & Yoo, 2019), plays an important role in creating values (Chesbrough et al., 2018), and improves the performance. Applying open innovation is among the fundamental strategies in platform businesses. It is defined a distributed process that is based on targeted knowledge and managed beyond the boundaries of an organization (Zhu et al., 2019). The boundaries between companies and the environment are permeable in open innovation model; therefore, the characteristic provides the ground for the entry and exit of knowledge through diverse channels in different stages of the innovation process (Ibarra et al., 2015). Moreover, it is noteworthy that the main reason for using open innovation is its capability in creating an ecosystem in which businesses can cocreate faster (Chesbrough & Crowther, 2006). Considering the mentioned issues, it is so evident that open innovation system is necessary for the development of platforms. Also, a prerequisite for the system to be effective is a specific scenario. Therefore, this research focuses on formulating development scenarios of platforms through using open innovation. The scenarios would help depicting the right scenario for achieving a specific position. The final goal is helping platform businesses to apply the inward and outward flows of technical knowledge in an effective manner and to boost the speed of domestic process of innovation and expand the market for the external use of innovations.

Theoretical Foundations

Platform development

Platforms create values in a method different from traditional businesses. Platform businesses have different value systems and emphasize controlling resources for organizing and focusing on customer values against ecosystem values (Alstyne et al., 2016). Parker et al. (2016) believe that platform is a new business model that uses technology to make connections between people, organizations, and resources in an interactive atmosphere and creates, then, great values through the interactions. Hagiu and Wright (2015) define platform a technology-based space that facilitates the interaction and exchange between two or more groups of distinctive and interdependent customers so that the activities of a group create and enhances value for other groups. Considering the high speed of development of different technologies in the recent years (Tauscher & Laudien, 2017) many business researchers believe that appropriate competitive position would be possible only through applying suitable business development models; a model that creates value from business (Dmitriev et al., 2014) and

creates, at the end, more values and benefits for the business. This issue will definitely relies on the creativity and innovation of new processes and methods.

Open Innovation

Open innovation as a constructed concept was coined and introduced for the first time in 2003 by Chesbrough, to define the networked nature of innovation mechanisms, though later definitions emphasize that the main feature of innovation is the ability of organizations in managing knowledge (Huggins et al., 2020).

It is a paradigm (Stanislawski & Lisowska, 2015) that believes that companies can use and should use suitably the internal and external ideas and paths to the market (Chesbrough & Garman, 2009). Open innovation is defined as revealing and making more permeable the boundaries between organizations and their external environments (Keupp & Gassmann, 2009). Now, open innovation for enhancing business development and competitive power of domestic and foreign markets is a must (Zhang & Zeng, 2009). Open innovation is increasingly become a key factor business, especially platform businesses because of its features and has attracted the attention of many knowledge-based businesses (Hilbolling et al., 2020).

Method

Considering the problem and the purposes, the following steps were taken to do the applied research:

1. Identifying factors of PBD through open innovation

Four factors of PBD through using open innovation were extracted from the complete review of the theoretical foundations and related literature as well as the opinions of four academic experts (Table 1).

Table 1. Factors of developing platform business using open innovation

Factor	Definition	Source
Attraction capacity	The ability of identifying the value of new external information, attracting using it to achieve the goals of platform business	(Van Lancker et al., 2019) (Lyu et al., 2019), (Ibrahimov, 2018) (De Oliveira et al., 2017) (Cheng et al., 2016) (Michelini et al., 2015) (Brunswicker & Ehrenmann, 2013) (Mu & Di Benedetto, 2012) (Hafkesbrink & Schroll, 2010) (Chiaroni et al., 2010) (Chesbrough, 2006)
Networking and network management	The ability of making effective and productive relationships for influencing platform business and its management, improvement, and maintenance	
Knowledge and technical capacity	The ability related to specific areas of expertise in different subject areas of platform businesses	
Collaboration capability	The ability of integrating and leveraging factors of business to make capacity and capability in platform business	

2. Formulating scenarios of platform development

When factors and levels defined according to Taguchi's orthogonal array table, scenarios were formulated and a questionnaire was constructed. The questionnaire included different order of levels of factors in every scenario. Qualitek software, which is an operational software for designing Taguchi experiments, was utilized. Four experts confirmed the validity of the questionnaire.

3. Determining the population and sample of experts and collecting data

The expert population was determined to analyze the development scenarios of platform businesses. The population included experts of platform and open innovation, managers having work experience in platform businesses who have at least master's degree in a relevant areas related to business. Purposeful sampling and snowball technique were used. Twelve experts answered the questionnaires.

4. Determining the main impacts and the share of every factor in developing platform businesses

The data collected through designing fuzzy experiments were analysed by Qualitek software. The output is presented in the form of the contribution of every factor in developing of platform business using open innovation.

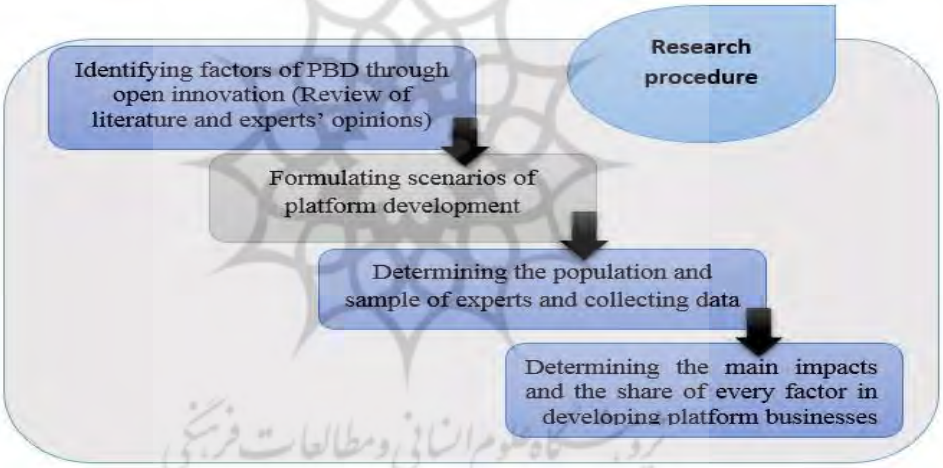

Figure 1. Research procedure

Results

Taguchi method is a design method. It works based on experiments and is used to save costs and time. Taguchi method optimizes the performance of a system through ordering parameters and decreasing the sensitivity of performance (Baharudin et al., 2012). One can use the method to change the controllable input factors and see their impacts on the output parameters (Antony, 2014). Using the opinions of experts and based on quartiles, four levels for every factor was determined: level 1 between 0 and 0.25, level 2 between 0.25 and 0.50, level 3

between 0.50 and 0.75, level 4 between 0.75 and 1. As can be seen four four-level factors for designing Taguchi experiments was determined (Table 2).

Table 2. Factors and levels for designing Taguchi experiments

No. of factor	Factors extracted from reviewed literature and interviews	L1	L2	L3	L4
1	Attraction capacity	0 - 0.25	0.25 - 0.50	0.50 - 0.75	0.75 - 1
2	Networking and network management	0 - 0.25	0.25 - 0.50	0.50 - 0.75	0.75 - 1
3	Knowledge and technical capacity	0 - 0.25	0.25 - 0.50	0.50 - 0.75	0.75 – 1
4	Collaboration capability	0 - 0.25	0.25 - 0.50	0.50 - 0.75	0.75 – 1

Factors and the number of their levels were entered into Qualitek software. Table 3 shows the output and formulated scenarios using the Taguchi experiment method.

Table 3. Results of the design of Taguchi L_{16}

Scenario	Attraction capacity	Networking and network management	Knowledge and technical capacity	Collaboration capability
1	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
2	0 - 0.25	0.25 - 0.50	0.25 - 0.50	0.25 - 0.50
3	0 - 0.25	0.50 - 0.75	0.50 - 0.75	0.50 - 0.75
4	0 - 0.25	0.75 - 1	0.75 - 1	0.75 - 1
5	0.25 - 0.50	0 - 0.25	0.25 - 0.50	0.50 - 0.75
6	0.25 - 0.50	0.25 - 0.50	0 - 0.25	0.75 - 1
7	0.25 - 0.50	0.50 - 0.75	0.75 - 1	0 - 0.25
8	0.25 - 0.50	0.75 - 1	0.50 - 0.75	0.25 - 0.50
9	0.50 - 0.75	0 - 0.25	0.50 - 0.75	0.75 - 1
10	0.50 - 0.75	0.25 - 0.50	0.75 - 1	0.50 - 0.75
11	0.50 - 0.75	0.50 - 0.75	0 - 0.25	0.25 - 0.50
12	0.50 - 0.75	0.75 - 1	0.25 - 0.50	0 - 0.25
13	0.75 - 1	0 - 0.25	0.75 - 1	0.25 - 0.50
14	0.75 - 1	0.25 - 0.50	0.50 - 0.75	0 - 0.25
15	0.75 - 1	0.50 - 0.75	0.25 - 0.50	0.75 - 1
16	0.75 - 1	0.75 - 1	0 - 0.25	0.50 - 0.75

The output of Taguchi experiments (Qualitek software) shows that 16 scenarios with four selected factors can help developing platform business. A questionnaire was then constructed to choose the best scenario. The questionnaire was distributed among 12 members of the population. They were asked to evaluate all depicted scenarios considering the five-item scale (from very low to very high) as the result of the scenario. Since the results of the second step are experts' perspectives (nominal variables), to convert them into fuzzy numbers, the Likert scale was used (Table 4). The fuzzy method is so effectively used for creating empirical knowledge by considering uncertainty (Wang, 1997).

Table 4. Triangular fuzzy numbers of Likert scale

Nominal variable	Triangular fuzzy number
Very low	(۰, ۰ ۱, ۰ ۳)
Low	(۰ ۱, ۰ ۳, ۰ ۵)
Normal	(۰ ۳, ۰ ۵, ۰ ۷)
High	(۰ ۵, ۰ ۷, ۰ ۹)
Very high	(۰ ۷, ۰ ۹, ۱)

Defuzzification was performed in the next step to enter the numeric information of experts' opinions about the scenarios into the software. Defuzzification is a process that transforms a fuzzy set into numeric data. Such methods as the mean of maxima, the center of gravity, the center of means, and the midpoint of an area are usually used for defuzzification, but the center of gravity is the most common method (Roychowdhury & Pedrycz, 2001). This study uses the center of gravity according to the following equation:

$$A = \frac{(a + 4 * b + c)}{6}$$

When the data were analyzed, the values of the main impacts were measured. The main impact of each factor at level L is the sum of responses at that level divided by the number of responses. Table 5 includes the main impacts of factors at different levels.

Table 5. The main impacts of factors of platform development in different levels

Factor	L1	L2	L3	L4	LMax - LMin
Attraction capacity	-8.257	-6.519	-5.156	-4.327	3.93
Networking and network management	-8.278	-6.113	-5.291	-4.622	3.656
Knowledge and technical capacity	-9.137	-6.246	-4.893	-4.028	5.109
Collaboration capability	-7.186	-6.532	-5.390	-5.195	1.991

One can say according to Table 5 that value LMax - LMin for knowledge and technical capacity (5.109) is higher than the value for other factors of PDB using open innovation. So, this factor is the most effective one in development of platforms. Moreover, since Max response is considered better in this research, the appropriate level for every factor of platform development will be the level in which the main impact value is higher. According to Table 5, the appropriate level in platform development indicators for the factors "attracting capacity", "networking and network management", "knowledge and technical capacity", and "collaboration capability" is level 4 (0.75-1).

Moreover, a significant capability of the method is the ability of determining the contribution of every factor. This capability that is achieved through the ANOVA for experiment data helps decision makers to rank factors based on their significance (Yao & Chi, 2013). Therefore, Table 6 shows the results of variance

analysis, that is, the percentage of participation of every platform development factor.

Table 6. Results of variance analysis

Factor	Degrees of freedom	Sum of squares	Variance	Test statistics	Net sum	Participation (%)
Attraction capacity	3	34.814	11.604	25.335	33.44	24.37
Networking and network management	3	40.311	10.103	22.058	28.937	21.09
Knowledge and technical capacity	3	59.964	19.988	43.637	58.59	42.70
Collaboration capability	3	10.748	3.582	7.821	9.374	6.84
Other factors/error	3	1.373	0.427			5
Total	15	137.213				100

Table 6 shows that "knowledge and technical capacity" (having 42.70% of participation) is the most important factor and "collaboration ability" (having 6.84% of participation) is the least important factor in platform development. Figure 2 shows the contribution of the factors. Moreover, the error values show that there are some factors that impact the results but have not been considered in the experiments. This value can be due to conflicting answers of experts on determining the results of every experiment. Very small error (about 5%) can be neglected and confirms the reliability of the results of weighting. In this research, about 5% of the contribution belongs to the error factor. As the number is small (about five percent) it can be ignored.

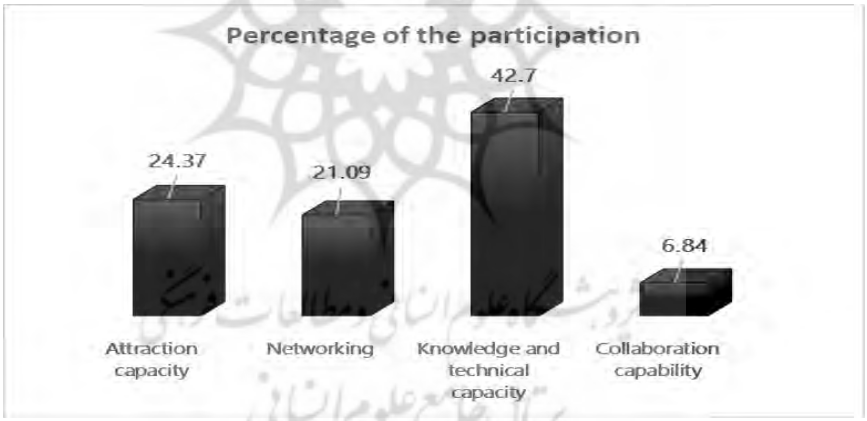

Figure 2. The percentage of the participation of all factors

Discussion and Conclusion

This applied study tried to provide platform business development scenarios using open innovation. A combination of Taguchi method and fuzzy approach were used to consider the ambiguity related to experts' opinions. After reviewing

the theoretical foundations and experts' confirmation, four factors "attracting capacity", "networking and network management", "knowledge and technical capacity", collaboration ability" were determined as the most effective factors in platform development using open innovation. In the next step, to determine the optimal scenario based on the experts' opinions, four levels were considered for every factor and entered into Qualitek software. The output that included 16 scenarios was used to construct a questionnaire. The questionnaires were distributed among the experts. Then, the obtained nominal data were converted into fuzzy numbers and then defuzzified using the centre of gravity and entered as a definite numbers into Qualitek software. Data analysis showed that the appropriate level in platform business development indicators in all main factors is level 4 (0.75-1). Owners of platform businesses can take appropriate levels of this research and also use their own existing resources to have optimal development of platform businesses. Regarding the participation percentage of the factors, one can say that "knowledge and technical capacity" (having 42.70% participation) is the most important factor, followed by "attraction capacity" and "networking and network management", as the second and third important factors. Factor "participatory ability" (having 6.84% participation) is least important factor in the platform development.

It is noteworthy that since managing open innovation for developing platform businesses requires such issues as sharing rare and so valuable resources, facilitating joint learning initiatives, managers' professional and specialized qualifications, developing intra- and extra-organizational networking and collaboration capabilities, making coherent databases, and developing the ability of considering business a part of ecosystems, the designed model of this research can help platform-business owners' decision-making regarding innovation based on open model. The study can also help managers achieve the goals of platform business development by taking the most appropriate managerial levers and combining them.

Four factors were selected. Future studies can do qualitative investigations using in-depth interviews to identify exactly the factors with different levels. Moreover, such issues as the size and type of platform businesses, the existing-life of platform businesses, and their period of life cycle are the factors that impact on determining the factors. Among the suggestions of this study are studying the participation of service providers and service recipients of platform businesses and designing a fuzzy expert system for choosing the best open innovation process using factors impacting on developing platform businesses.

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سناریوهای توسعه کسب‌وکارهای پلتفرمی با استفاده از رویکرد نوآوری باز و طراحی آزمایشات فازی

چکیده:

امروزه با توجه به اهمیت کسب و کارهای پلتفرمی و نقش اقتصادی آن‌ها، نیاز به نوآوری‌ها در راستای توسعه کسب و کارهای پلتفرمی بسیار احساس می‌گردد و از آنجایی که روند آتی کسب و کارها به سمت بهره‌گیری از خرد جمعی و دانش برون سازمانی می‌باشد، بکارگیری نوآوری باز در این کسب و کارها به یک ضرورت تبدیل شده است. خبرگان پژوهش شامل دوازده نفر از متخصصان و مدیران کسب و کارهای پلتفرمی است. پس از بررسی مبانی نظری، از بین عوامل مختلف چهار عامل (ظرفیت جذب، شبکه‌سازی و مدیریت شبکه، ظرفیت دانشی و فنی، توانمندی مشارکتی) با نظرات خبرگان مشخص شدند. برای تعیین نقش این چهار عامل از روش طراحی آزمایشات تاگوچی استفاده که برای هر عامل چهار سطح (سطح اول بین ۰ تا ۰,۲۵، سطح دوم بین ۰,۲۵ تا ۰,۵۰، سطح سوم بین ۰,۵۰ تا ۰,۷۵ و سطح چهارم بین ۰,۷۵ تا ۱) تعریف و با نرم افزار کوالتیک شانزده سناریو استخراج که راستای تعیین سناریوی مطلوب از پرسشنامه و رویکرد طراحی آزمایشات تاگوچی فازی استفاده گردید. نتایج پژوهش نشان می‌دهد که سطح مناسب شاخص‌های توسعه پلتفرم با بکارگیری نوآوری باز بایستی در هر چهار عامل، در سطح چهارم (۱– ۰,۷۵) باشد، بدین معنی که هر چهار عامل تاثیر زیادی بر توسعه کسب و کارهای پلتفرمی دارند. در ضمن نتایج حاصل از تحلیل واریانس نشان می‌دهد که عامل ظرفیت دانشی و فنی با ۴۲,۷۰ درصد مشارکت، ظرفیت جذب با ۲۴,۳۷ درصد، شبکه‌سازی و مدیریت شبکه ۲۱,۰۹ و توانمندی مشارکتی با ۶,۸۴ درصد مشارکت به ترتیب دارای اهمیت در توسعه پلتفرم می باشند.

کلمات کلیدی: توسعه کسب و کار پلتفرمی، طراحی آزمایشات فازی، ظرفیت جذب، شبکه‌سازی و مدیریت شبکه، ظرفیت دانش و فنی، توانمندی مشارکتی.