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Model for Creating New Knowledge under Budget Constraints

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Abstract

Under the influence of global competition, innovative products and services of certain enterprises have eliminated many of the conventional industries in a very short time. To cope with the stiff global competition, enterprises must keep on innovating products and services to stay ahead of the competitors. However, the consecutive innovations must rely on knowledge creation, especially, high-technology products. Thus, knowledge creation is a vital activity for an enterprise to thrive in the competition, and it can be achieved via teamwork and collective learning. However, the way the enterprise selects the perfect team for knowledge creation is the key to success. This study proposes a mathematical model for enterprises to select the best team by evaluating the team's performance of knowledge creation. Three variables are used in the models, i.e. knowledge complexity, knowledge correlation, and knowledge level. Via the model, the time needed and the amount of knowledge gained for each member after the knowledge creation can be obtained, and the processes continue until the creation of the target knowledge is achieved. The results of the cases show that the proposed model can help enterprises select the best possible candidates to form a team for knowledge creation.

JEL classification numbers: C61, M10.
Keywords: Knowledge management, Mathematical programming, Knowledge complexity, Knowledge level, Knowledge correlation.

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1. Introduction

The source of enterprise competitiveness is the constant innovation under the influence of competition to keep providing competitive products or services to the market (Sokoh and Okolie, 2021). Even when the enterprise produces new products, competitors soon launch new marketing strategies, causing the profit of the enterprise to plummet. Therefore, enterprises must continuously release new products during the growth period of the existing products to sustain its competitiveness in the market. Thus, it is clear only by incorporating innovation consecutively can an enterprise sustain its competitive advantages. Mohajan (2017) concluded that firms should concentrate on seeking entrepreneurial solutions and developing effective knowledge management systems to survive in turbulent times (Mohajan, 2017).

Knowledge is the result of human understanding and learning in various activities (Nonaka and Takeuchi, 1995). Before the innovation of new products, enterprises must create new knowledge, specifically, to develop the core knowledge of revolutionary products. Knowledge includes explicit knowledge and implicit knowledge. Explicit knowledge is mostly present in the form of numerals and data in the files, allowing ease of transfer. However, implicit knowledge exists in the human brain, figuratively. Therefore, the transfer of implicit knowledge is obviously much more difficult.

According to the survey of the Delphi Group, approximately 42% of the enterprise knowledge resides in the brain of the employee in the form of implicit knowledge, another 58% of which is the explicit knowledge recorded on paper documentation, computer files, or other computerized knowledge (Chang and Lin, 2015). Four steps of knowledge creation are suggested by the knowledge spiral theory (Al-Attar and Shaalan, 2016): the first stage is the sharing and communication of the implicit knowledge between the members (Socialization); the second stage is the expression of the implicit knowledge through various means, thus converting the implicit knowledge into explicit knowledge (Externalization); the third stage is the incorporation of the externalized explicit knowledge and the existing knowledge through IT technology, forming a larger knowledge system (Combination); and the final stage is the individual learning process of each member for the new knowledge of this knowledge system, and the transformation of the explicit knowledge into the implicit knowledge of the member (Internalization). By repeating the aforementioned process, the knowledge of the enterprise can be expanded and deepened. Simply put, knowledge creation is a dynamic process, and the knowledge spiral theory will be repeated constantly to expand the knowledge system.

The product of the enterprise usually involves several different fields of knowledge; therefore, knowledge creation is best performed when executed with a team. By sharing personal experience and knowledge between the individual members, and in turn, via the means of integration and verification, the knowledge body of the enterprise can be expanded. In other words, by utilizing the theory of knowledge spiral, the personal knowledge of each member can be transferred to the team. The core knowledge of the enterprise can be developed with the impact of the different knowledge on each other.

The enterprise hopes to create the target knowledge internally, and by doing so, a certain level of compatibility would exist, making it easier to apply the said knowledge internally in the enterprise. What is required of the enterprise is only the knowledge creation process from the existing knowledge to the target knowledge. The knowledge can be divided into knowledge complexity, knowledge level, and knowledge correlation (Korposh et al., 2011; Wei et al., 2009). The knowledge complexity is the equivalent of the difficulties of the knowledge – the harder the difficulties, the higher the knowledge complexity will be. For instance, the knowledge complexity of building a space rocket is higher than that of building a ship. The knowledge level represents the level of specialization of the knowledge - the higher the levels are, the more specialized the knowledge is. For example, the technological knowledge of a senior engineer is more specialized than that of an engineering assistant.

Knowledge correlation is the difference between the target knowledge and the existing team knowledge - the larger the difference is, the more difficult it is to accomplish. For instance, the knowledge correlation between the knowledge of riding a bicycle and piloting an airplane is low; therefore, an extremely long period is needed to accomplish the latter activity. This study presumes knowledge is accumulative. Therefore, by utilizing the theory of knowledge spiral, it is believed that knowledge complexity, knowledge level, and knowledge correlation can be gradually improved, accumulated, and created with teamwork. The present study proposes a mathematical model, with which the impact of teamwork on knowledge complexity, knowledge level, and knowledge correlation can be evaluated. The time needed to achieve the target knowledge can also be acquired.

This study intends to achieve the following objectives:

(1) The amount of knowledge improved of each member following the creation of new knowledge.

(2) Find the most efficient member from each team to establish a new team to create new knowledge.

(3) After considering the salary of the members, select the best team by inspecting the CCP (Cost to Complete) value of each member when the knowledge creation is complete.

(4) After considering the limited funding, select the best team by inspecting the CCP value of each member when the knowledge creation is finished.

(5) A sensitivity analysis indicating the impact of the parameter value setting on the results.

The abovementioned CCP is defined as the cost-effectiveness of the finished work, wherein CCP = Cost to Complete, and the "Cost to Complete" are defined as the cost needed for completing the task (Trivedi and Srivastava, 2022). In the present study, “Cost to Complete” represents the needed cost to complete the target knowledge for each member.

2. Literature Review

Paschek (2018) believed that innovation includes the creation of new products, new manufacturing technology, new markets, sources of raw material supply, and new types of arrangement (Paschek et al., 2018). The main factors for the economic development of a nation are capital, labor, and technological development (Venkitachalama and Willmott, 2017). It is further suggested by Robert that the impact of technological development is higher than that of capital (Tseng and Lee, 2014). Technology is the driver of the growth of the economy, but innovation is the key to the sustainable development of an enterprise (Richardt et al., 2022). The core competitiveness of an enterprise comprises the core operation capability and the core knowledge capability, and knowledge creation is the drive of the innovative capability of an enterprise. The consecutive innovation of an enterprise comprises management innovation, technological innovation, and market innovation. If an enterprise possesses knowledge creation capability, the new knowledge that was created internally can be fully developed following the strategic objective or the innovative product of the enterprise, thus making the compatibility between the development results and the enterprise very high. By creating knowledge internally, the enterprise members can be much more united, and by utilizing the organization's overall effort, the long-term action for the sustainable development of the enterprise can be planned. In response to the competition, by utilizing the effort of the members of the enterprise from around the world to accelerate the development process, the enterprise can develop new knowledge 24 hours a day.

To thrive under intense competition, enterprises must innovate continuously to enable sustainable development. The innovation process of the enterprise includes the creation of new knowledge, the transferring of the knowledge in the organization, and last but not least, the application of the new knowledge to the product, system, and service of the enterprise.

The creation of knowledge mostly consists of the following two means:

(a) Learning the accumulated experience from predecessors and utilizing the learned experience.

(b) Creating new knowledge by solving the encountered real-life problems.

The aforementioned two means are usually used reciprocally to create new knowledge (Baronian, 2022). The path to knowledge creation consists of the permutation and combination of different knowledge (Chang and Lin, 2015). Knowledge combination is further divided into the progressive transformation and the breakthrough transformation. Progressive transformation is the integration of technology and academic knowledge theory from different fields (modified or incremented step-wisely) to create new knowledge. Progressive transformation also means the mutual knowledge exchange between employees with different knowledge or technique, and the fusion with original knowledge to achieve new knowledge (e.g. the combination of computer and telephone becomes a smartphone), to solve emerging issues. Generally, the occurrence of progressive knowledge creation is more common, however, the influence of which is less dominant. Most of the new knowledge created by the enterprise is progressive transformation. For instance, the expert system applied in the fields of engineering, education, medicine, business, military, and the like is the newly created knowledge by teams using the means of progressive transformation. An expert system must be collaboratively developed by teams of specialists, knowledge engineers, IT engineers, and the like. Chen et al. claimed an expert system is a computer program with intelligence, which can solve problems requiring a high degree of specialist intelligence with knowledge and deduction (Chen et al., 2022). Merriam-Webster's definition of an expert system is a computer program system that can imitate the reasoning of a human specialist (Webster, 2017). Breakthrough knowledge creation is a discovery and invention, the occurrence of which is low, however, the influence of which is much more dominant whenever it occurs. The occurrence of this also kicks the development of many new fields of knowledge and new products into motion, for instance, when Einstein proposed the mass-energy relation, $E=MC^2$, in his paper published in 1905, it resulted in the development of nuclear energy (Gonzalez and Martins, 2014). Alternatively, the Theory of Relativity was also applied in Global Positioning Systems (GPS) (Zhao et al., 2022), which guide countless satellites, boats, airplanes, and automobiles. Tan et al. (2017) devised a predicting model for knowledge management effect on manufacturing performance via neural network (Tan and Wong, 2017). Lee and Wong (2017) presented the development of a KMPM (KM project management) system using a fuzzy logic methodology specifically for the SME sector (Lee and Wong, 2017).

The knowledge created via teamwork can be transferred into explicit and implicit knowledge of each member and the organization. The exchange of knowledge between the members and the discussion between peers can increase the amount of new knowledge (Huang et al., 2007). The process of decision-making includes deciding various viable alternatives, evaluating the various options, and finally selecting the most promising option to execute. By utilizing Simon’s theory, this study imitates the choice of various team candidates, to analyze whether the amount of knowledge created by different teams is met with the target knowledge when using the model, and to analyze the time needed to accomplish the task. To analyze is to provide the decision maker with different choices, to decrease the risk and increase the competitiveness of the enterprise.

3. Model formulation

It is assumed that knowledge can be measured in the dimensions of level, complexity, and correlation. The knowledge of these three dimensions can be created and accumulated, as shown in Figure 1. Enterprise knowledge can gradually transform from existing knowledge to target knowledge.

Assume target knowledge consists of the values of the three dimensions, including complexity B^*, level D^*, and correlation κ^*; The enterprise organized j teams, $j=1, 2 \dots m$, each team consists of i members, $i= 1, 2, \dots n$.

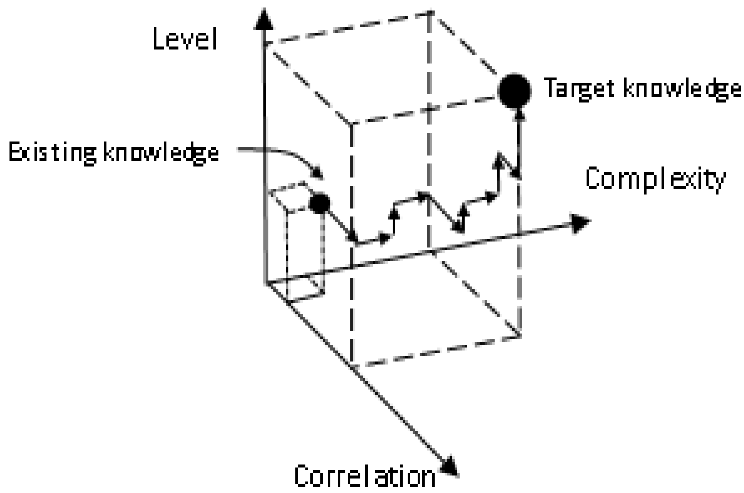

Figure 1: Creation and accumulation of knowledge

Assume the salary of the team members is C_{ji}, the knowledge complexity is B_{ji}, the knowledge level is D_{ji}, and the knowledge correlation is COR_{ji}. The maximum amount of knowledge is $MaxB$, the maximum knowledge level is $MaxD$, the maximum knowledge correlation is 1. Assume the factor for team j to enhance the knowledge complexity is $CorB_j$ and the factor for team *j* to enhance the knowledge level is $CorD_j$. Following knowledge creation via teamwork, the increment of the knowledge complexity and the increment of the knowledge level for member *i* of team *j* are $IncrB_{ji}$ and $IncrD_{ji}$, respectively. After the creation of the new knowledge for team *j*, the likeness with target knowledge has incremented with $Incr\alpha_j$. The time needed to increment the knowledge complexity $IncrB_{ji}$ and the knowledge level $IncrD_{ji}$ for member i of team j are DTB_{ji} and DTD_{ji}, respectively. The total time needed for team *j* to create target knowledge complexity is TXB_j, the total time for team *j* to create target knowledge level is TXD_j, and the total time for team *j* to create target knowledge is T_j.
The knowledge complexity and correlation originally possessed by each member in team *j* affects the newly created knowledge of each member ($CorB_j$). Similarly, the knowledge level and correlation originally possessed by each member of the team affect the newly created knowledge of each member ($CorD_j$). Therefore, Equations (1) and (2) can be expressed as follows:

$$CorB_j = \mu \sum_{i=1}^{n} B_{ji} * COR_{ji} \tag{1}$$

Wherein μ represents the coefficient of the complexity factor, while n represents the number of members in the team.

$$CorD_j = \beta \sum_{i=1}^{n} D_{ji} * COR_{ji} \tag{2}$$

Wherein β represents the coefficient of the level factor.

The increment of knowledge complexity for each member is $IncrB_{j,}$ and it positively affects the original knowledge complexity of member B_{ji}; the complexity difference with the target knowledge (B_{ji} –B*); and the increment of complexity for the team $CorB_j$, therefore it can be expressed as Equation (3). After the collaboration, the increment of the knowledge level for each member is $IncrD_{ji}$, and it positively affects the original knowledge level for the member D_{ji}; the level difference with the target knowledge ($D_{ji}-D^*$); and the increment of the complexity for the team $CorD_j$, therefore it can be expressed as Equation (4). Similarly, after the collaboration, the knowledge correlation for each member also increased and has an increment of $Incr\kappa_j$, it has an interactive effect with knowledge complexity B_{ji}, knowledge level D_{ji}, and knowledge correlation COR_{ji}, therefore, it can be expressed as Equation (5).

$$IncrB_{ji} = \ln\left(\delta * B_{ji} * e^{\varepsilon*(B_{ji}-B^*)} + e^{CorB_j}\right) \tag{3}$$

Wherein δ represents the factor coefficient, while ε represents the factor coefficient.

$$IncrD_{ji} = \eta * \ln D_{ji} * \ln\left(CorD_j * (\theta + \left(D_{ji} - D^*\right))^3\right) \tag{4}$$

Wherein η indicates the factor coefficient, while θ represents the factor coefficient.

$$Incr\kappa_j = \lambda \sum_{i=1}^{n} B_{ji}^2 * D_{ji} * COR_{ji} \tag{5}$$

Wherein λ represents the correlation factor coefficient.

Following the knowledge creation, the time needed for the knowledge complexity of each member to increase is DTB_{ji}, and it positively impacts the increment of the knowledge level $IncrD_{ji}$, the increment of the knowledge complexity $IncrB_{ji}$; and it negatively affects the knowledge correlation COR_{ji} and the knowledge complexity of itself B_{ji}; therefore, the higher the knowledge complexity is, the faster it is, and the aforementioned can be expressed as Equation (6). Similarly, the time needed for the knowledge level of each member to increase is DTD_{ji}, and it positively impacts the increment of the knowledge level $IncrD_{ji}$; and negatively affects the knowledge correlation COR_{ji} and the knowledge level of itself D_{ji};

therefore, the higher the knowledge correlation is, the faster it is, and the aforementioned can be expressed as Equation (7).

$$\mathrm{DTB}_{ji} = \gamma * (\varpi * IncrB_{ji}{}^{2} + IncrB_{ji} + 1)/(COR_{ji} * B_{ji}) \quad (6)$$

Wherein γ represents the factor coefficient, and ϖ represents the factor coefficient.

$$\mathrm{DTD}_{ji} = \xi * (\phi * Incr\_D_{ji}^{2} + IncrD_{ji} + 1)/(COR_{ji} * D_{ji}) \quad (7)$$

Wherein ξ represents the factor coefficient, and ϕ represents the factor coefficient.

The time needed for the team to increase its knowledge complexity TXB_j is the sum of the time required to increase the knowledge complexity for each member, therefore can be expressed as Equation (8). The time needed for the team to increase its knowledge level is the sum of the time required to increase the knowledge level for each member, which therefore can be expressed as Equation (9).

$$TXB_j = TXB_j + DTB_{ji} \quad (8)$$

$$TXD_j = TXD_j + DTD_{ji} \quad (9)$$

Therefore, the new knowledge complexity B_{ji} for each member is the sum of the increment of the knowledge complexity and the original knowledge complexity (see Equation 10). The new knowledge level D_{ji} for each member is the sum of the increment of the knowledge level and the original knowledge level (see Equation 11). The new knowledge correlation COR_{ji} for each member is the sum of the increment of the knowledge correlation and the original knowledge correlation (see Equation 12).

$$B_{ji} = \min\{MaxB, \; B_{ji} + IncrB_{ji}\} \quad (10)$$

$$D_{ji} = \min\{MaxD, \; D_{ji} + IncrD_{ji}\} \quad (11)$$

$$COR_{ji} = \min\{1, \; COR_{ji} + Incr\kappa_j\} \quad (12)$$

To determine whether the creation of target knowledge of team j is finished, the following requirements must be met: the knowledge complexity for any of the members is larger than or equal to $MaxB$, and the knowledge level is larger than or equal to $MaxD$, and the knowledge correlation equals 1. If the created knowledge is insufficient, then let the process of knowledge creation recommence. The creation process of new knowledge begins with increased knowledge complexity, knowledge level, and knowledge correlation. The process is repeated until the task is completed. Accumulate the time for complexity creation TXB_j on a cyclical basis, and accumulate the time for level creation TXD_j on a cyclical basis. The overall time needed, T_j, is the maximum value of the time for the complexity increment and the time for the level increment, see Equation (13).

$$T_j = \max\{TXB_j,\ TXD_j\} \tag{13}$$

Equation (1) to Equation (13) help the enterprise to find the following: (1) the team which can finish the knowledge creation in the least amount of time, (2) k members who are closest to the target knowledge after the knowledge creation, (3) k members with the lowest CCP value after the knowledge creation, and (4) under the constraint of total funding C, k members with the lowest CCP value after the knowledge creation. Please see the following for the respective description.

(1) The team with the least amount of time to finish knowledge creation:
The mathematical programming model is as Equation (14).

$$\text{Min } \sum_{j=1}^{m} x_j T_j \tag{14}$$

st

$\sum_{j=1}^{m} x_j = 1$

x_j=0, 1 for all j

(2) k members who are closest to the target knowledge following the knowledge creation:
The mathematical programming model is as Equation (15).

$$\text{Min } \sum_{j}^{m} \sum_{i}^{n} x_{ji}\, |(B_{ji}, D_{ji},\ 100 * COR_{ji}) - (B^*, D^*, 100 * 1)| \tag{15}$$

st

$\sum_{j}^{m} \sum_{i}^{n} x_{ji} = k$

$x_{j,i}$=0, 1 for all j, i

Wherein k represents the number of members in the knowledge creation team. $|(B_{ji}, D_{ji},\ 100 * COR_{ji}) - (B^*, D^*, 100 * 1)|$ represents the absolute value CC of the level of similarity between the ith member in team *j* and the target knowledge.

(3) k members with the lowest CCP value after the knowledge creation:
The mathematical programming model is as Equation (16).

$$\text{Min } \sum_{j}^{m} \sum_{i}^{n} x_{ji}\, |(B_{ji}, D_{ji},\ 100 * COR_{ji}) - (B^*, D^*, 100 * 1)| / C_{ji} \tag{16}$$

st

$\sum_{j}^{m} \sum_{i}^{n} x_{ji} = k$

x_{ji}=0, 1 for all j, i

wherein k represents the number of members in the knowledge creation team.
$|(B_{ji}, D_{ji},\ 100 * COR_{ji}) - (B^*, D^*, 100 * 1)|/C_{ji}$ represents the level of similarity, CCP value, with the target knowledge for the cost per unit of the ith member in team j.

(4) Under the constraint of total budget C, k members with the lowest CCP value after the knowledge creation:

The mathematical programming model is as Equation (17).

$$\text{Min } \sum_j^m \sum_i^n x_{ji} \, |(B_{ji}, D_{ji},\ 100 * COR_{ji}) - (B^*, D^*, 100 * 1)|/C_{ji} \qquad (17)$$

st

$\sum_j^m \sum_i^n x_{ji} = k$

$\sum_j^m \sum_i^n x_{ji} C_{ji} \leq C$

x_{ji}=0, 1 for all j, i

wherein k represents the number of members in the selected team.
C represents the limit of total budget.
$|(B_{ji}, D_{ji},\ 100 * COR_{ji}) - (B^*, D^*, 100 * 1)|/C_{ji}$ represents the level of similarity, CCP value, with the target knowledge for the cost per unit of the ith member in team j.

4. Case Implementation

To verify the effectiveness of the model proposed in this study, this section illustrates four models for the application process, with the assumption of the complexity B^* =62, the level D^* =59, and the correlation κ^*=1 of the desired target knowledge. $MaxB = MaxD = \theta$ =100, $\gamma = \xi$ =10, δ = 2, ϖ =1.2, ϕ = 0.14, η = 0.12, ε = 0.1, μ = 0.01, β = 0.01, λ = 0.000000526316.

(1) The team with the least amount of time to finish knowledge creation:

Assume three teams, each with five members, are being assigned to carry out the process of knowledge creation, and the original knowledge for each member is listed in Table 1. By utilizing Equation (14), it can be deduced that the time taken by the first team, Team 1, to finish the process of knowledge creation is the shortest, i.e. T_1= 88.40454. Therefore, Team 1 should be chosen to finish the task. The notation of Start and End in Table 1 indicates original and new knowledge.

Table 1: Original and new knowledge for the members

	Team 1					Team 2					Team 3				
Team	1	2	3	*4*	*5*	1	2	3	*4*	5	1	*2*	3	4	*5*
Start_B	22	29	42	*52*	*53*	18	25	33	*49*	35	38	*36*	30	38	*49*
Start_D	36	30	25	*35*	*47*	24	41	45	*37*	50	49	*36*	31	40	*32*
Start_Cor	0.2	0.4	0.6	*0.8*	*0.7*	0.4	0.5	0.4	*0.7*	0.3	0.3	*0.4*	0.3	0.6	*0.5*
cost	39	35	41	*49*	67	34	31	38	48	35	29	28	30	32	40
End_B	27	35	51	*65*	66	23	31	41	65	44	52	49	40	52	70
End_D	54	47	41	*53*	67	46	67	72	62	78	84	68	62	73	63
End_Cor	0.74	0.94	1	*1*	1	0.88	0.98	0.88	1	0.78	1	1	1	1	1
T	T_1= 88.40454					T_2= 93.3607					T_3= 137.0351				

(2) k members who are closest to the target knowledge after the knowledge creation: If it is desired to locate the 5 members closest to the target knowledge when the knowledge creation process is completed from the case (1), by utilizing Equation (15), the mentioned five members are determined as: the third, fourth, fifth member of Team 1; the fourth member of Team 2; and the fifth member of Team 3, respectively. If Team 4 is established with the aforementioned five members, Table 2 can be created with the original knowledge of the stated five members. After achieving the target knowledge with the knowledge creation process, it is discovered the time is shortened to T_4=83.29244, which is shorter than T_1=88.40454 of Case 1, further illustrating the fact that utilizing a team with better members can shorten the time for knowledge creation.

Table 2: Knowledge creation of the members closest to the target knowledge

	N(4,1)	N(4,2)	N(4,3)	N(4,4)	N(4,5)
Start_B	42	52	53	49	49
Start_D	25	35	47	37	32
Start_Cor	0.6	0.8	0.7	0.7	0.5
End_B	51.68	64.73	66.08	60.73	60.73
End_D	41.26	53.29	67.25	55.65	49.73
End_Cor	1	1	1	1	1
T	T_4= 83.29244				

(3) k members with the lowest CCP value after the knowledge creation:
By utilizing Equation (16), the 3rd, 4th, and 5th members of Team 1, the 4th member of Team 2, and the 5th member of Team 3 can be selected. The five selected members are the ones with the lowest CCP value, with the total funding=241, and the sum of the CCP value for the five members = 1.106276. This model can be used as a reference for team members' selection when the enterprise is creating new knowledge based on the budget of the company.

(4) Under the constraint of total budget C, k members with the lowest CCP value after the knowledge creation:

Assume the total limit budget is C=230, k with the lowest value=5 members. By utilizing Equation (17), the 4th, and 5th members of Team 1, the 4th member of Team 2, and the 2nd, and 5th member of Team 3 can be selected. The five selected members are with the total cost=228 and the sum of the CCP value for the five members is 1.156286. It has been illustrated to not exceed the limit of the budget constraint of 230, the sum of CCP= 1.156286, which is lower than the sum of CCP value of Case 3, which is 1.106276.

5. Sensitivity Analysis

To discover the impact of the setting of the variables of the model on the results, this section conducts a sensitivity analysis with Team 5. Assume the knowledge correlation of each member is the same, $COR_{5i} = v_p$ i=1, 2, 3, 4, 5; p=1,..,5, as shown in Table 3. The analysis results are as follows: when knowledge correlation v_1 =0.1, the finishing time T(1)= 729.2018; when v_2 =0.3, the finishing time T(2)=199.4447; when v_3 =0.5, the finishing time T(3)= 100.0832; when v_4 =0.7, the finishing time T(4)=77.94943; and when v_5 =0.5, the finishing time T(5)= 70.76378. Thus, it is shown that the correlation between the target knowledge and the existing knowledge impact the finishing time, and reveals an inverse relationship. For example, with the correlation being lower, the finishing time takes longer; with the correlation being higher, the finishing time is shorter. A detailed illustration can be seen in Figure 2.

Table 3: Existing knowledge of the members

	N(5,1)	N(5,2)	N(5,3)	N(5,4)	N(5,5)
Start_B	52	53	49	36	49
Start_D	35	47	37	36	32
COR_{5i}	v_p	v_p	v_p	v_p	v_p

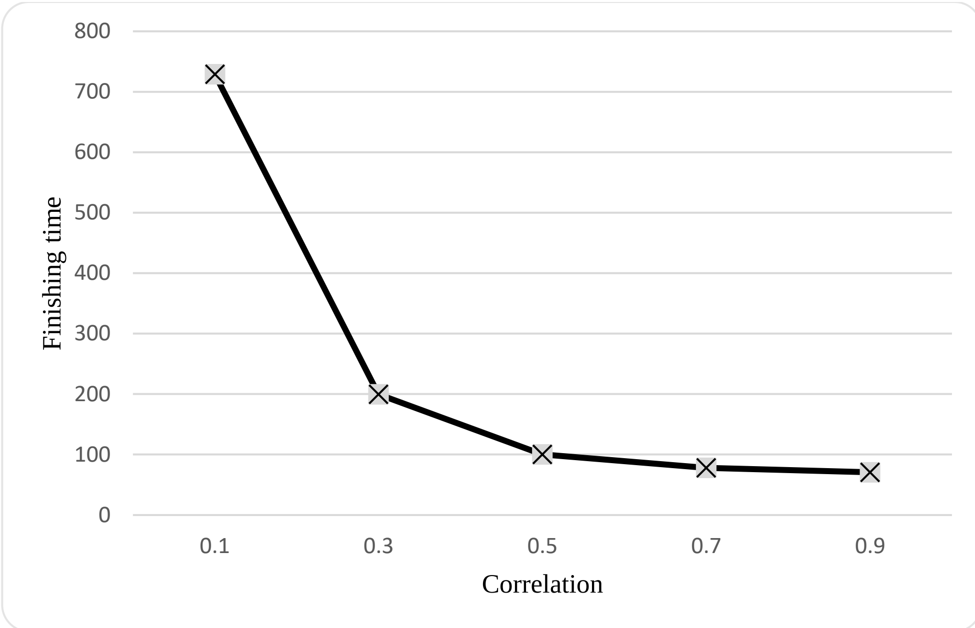

Figure 2: Relationship between correlation and finishing time

6. Conclusions

Stiff global competition forces enterprises to develop innovative means to compete and obtain competitiveness, and one of the proven effective strategies is to deploy knowledge management companywide. The objective of the knowledge management is to create new knowledge via knowledge sharing and learning activities. Previous studies tended to be qualitative oriented and thus, difficult to measure the processes of a knowledge management initiative. This study proposes a mathematical model for knowledge creation, which takes account of the knowledge complexity, knowledge level, and knowledge correlation.

This model can help the enterprise to discover the following in advance:

(1) The time needed for the teams to finish knowledge creation, and also to locate the most efficient team.

(2) The best team to finish knowledge creation under the constraint of total budget.

The model developed in this study is one of few attempts to try to capture the mechanism of knowledge creation, therefore, it can provide enterprises with a new perspective of dealing with competitions.

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