Analysis of HeXie Controllability and HeXie Observability of the Project Team

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Abstract

Based on the frame of HeXie Management Theory, in this article, HeXie-state model of the project team system is studied, two attributes, HeXie controllability and HeXie observability in the HeXie state model, are put forward, and those attributes are analyzed and defined. Judgement rules of those two attributes are described. The HeXie controllability is used to measure the influencing function of the project management activity to the HeXie-state, and the HeXie observability is to measure the initial HeXie-state. To analyze the HeXie controllability and the HeXie observability can estimate the project management risk, compute the influence of management activity to the project team and the project performance, and help to optimize the organization and structure of the project team.

Keywords: HeXie Management Theory, Project management, HeXie-state, HeXie controllability, HeXie observability

1. Introduction

With continual development of information science, the economic form of human society is continually transforming from the commodity economy under the industrial society to the knowledge economy under the information society. This transformation makes the leading activity of the enterprise which gives priority to various innovational activities gradually develop, and the model of enterprise management will essentially change with that. Because most innovational activities of the enterprise are actualized by means of the form of project (Tavares, 2002, p.1-18), so innovational components in activities leded by the enterprise are more, they more need better project management. Though the research to the project process management has initially formed complete system (John, 2005, p.688-704), but the relation between better project management and enterprise performance has not been clear (Kam, 2006). And according to the contingency theory, the project management must match with the environment with high uncertainty (Wang, 2006), so the analysis of the influence of the project management to the performance as viewed from the system is very necessary (Tavares, 2002, p.1-18).

The enterprise can be looked as the system composed by factors which are closely associated and dependent each other (Richard, 1999, p.583-600), and the economic activity, human resource, structure characteristic are the factors to compose this complex system. Some researches thought the coherence, interior matching and interaction degree among these factors are positive correlative (Robert, 1985, p.514-539). The project team is the subsystem of the enterprise system, and the resource, personnel and organizational character of the team are factors of the project team system. The HeXie Management Theory is to utilize the system idea to describe the influence of enterprise management to the enterprise performance (Tang, 2003, p.1485-1487). Base on the HeXie Management Theory, the HeXie degree of the project team, i.e. the response of the project team system to the management, describes whether the team fully exerts member enthusiasm, creationary conditions and environment, and the total HeXie of subsystem activity under member and the team, which can be concretely divided into structure HeXie degree, organizational HeXie degree, interior HeXie degree and exterior HeXie degree (Xi, 2002). These four sorts of HeXie degree constitute the HeXie-state of the vector form. In the implementing process of the project, the project management activity possesses changeable management ability, and the project team system correspondingly produces the changeable response of HeXie-state which is represented as the changeable performance of the project team (Wang, 2007, p.1129-1133 & Wang, 2007, p.117-121). Some researches thought that the relationship among management activity, HeXie degree response and team performance of the project team system can be abstracted as the HeXie-state model (Wang, 2007, p.191-195). In the HeXie-state model, the project management can be described as
the following process. The HeXie-state is the intrinsic attribute of the project team system, and the management (input) arouses the change of the HeXie-state, and the HeXie-state and project management decide the change of the performance (output) together.

In this article, we stress to discuss two attributes, the HeXie controllability and the HeXie observability in the HeXie-state model. The HeXie controllability is used to measure the influencing function of the project management activity to the HeXie state, and the HeXie observability is to measure the initial HeXie state.

2. The HeXie-state model of the project team

This article is based on the hypothesis that when the management ability changes some times, the HeXie degree response of the project team system also changes some times. The HeXie-state model of the project team system thought that the change of HeXie-state induced by the management was the process of differential movement, and the changes of team performance influenced by the management and the HeXie-state was the process of variable transformation (Wang, 2007, p.191-195). The HeXie-state model of the project team system based on the hypothesis is

\[ L_\tau : \frac{d\rho(t)}{dt} = A(t)\rho(t) + B(t)\theta(t), \]

where, (1) the HeXie-state of the project team system at the time of \( t \) \((t \geq t_0, t_0\) is the anticipative HeXie-state, so the project team system exist and make \( L_\tau \) \), where, \( \theta(t) \) is the interior state of the project team system \((\theta(t)=\theta(t_0)\) and \( t\) \), if the time of \( \tau = t - t_0 \) \), and the interior state \( \rho(t) \) is the anticipative HeXie-state, so the HeXie-state is the terminal time of the \( \tau \).

Some researches thought that the project team in the project lifecycle had five stages including establishment, adaptation, standard, effect and dismiss (Wang, 2007, p.117-121). For \( y(t) \), if the time of \( \tau \) and \( \tau \) are in the same stage of the project lifecycle, \( \Delta t = \tau - t \) \), and \( \rho(\tau) \) exists and make \( \rho(t) = \int A(e)\rho(e)de + \int B(e)\theta(e)de = R(t) \), where, \( \rho(\tau) \) is the HeXie-state change anticipated by the manager, \( \rho(t) \) is the anticipative HeXie-state, so the project team system \( L_\tau \) is HeXie controllable in the stage of \( \Delta t \) when the project management is \( \Delta t \).

Based on above HeXie-state model, in this article, we work out following definitions.

Definition 1 (HeXie controllability): Suppose that \( L(T) \), if the time of \( (t \leq t \leq T, T \) is the terminal time of the project, \( \Delta t = t - t \) \) and \( L_\tau \) \((t \in [t, t]\) exist and make \( A(e)\rho(e)de + \int B(e)\theta(e)de = R(t) \), where, \( \rho(t) \) is the HeXie-state change anticipated by the manager, \( \rho(t) \) is the anticipative HeXie-state, so the HeXie-state \( L_\tau \) of the project team system \( L_\tau \) is HeXie controllable in the stage of \( \Delta t \) when the project management is \( \Delta t \).

Some researches thought that the project team in the project lifecycle had five stages including establishment, adaptation, standard, effect and dismiss (Wang, 2007, p.117-121). For \( \rho(\tau) \), if the time of \( \tau \) and \( \tau \) are in the same stage of the project lifecycle, \( \Delta t = \tau - t \) \), and \( \rho(\tau) \) exists and make \( \rho(t) = \int A(e)\rho(e)de + \int B(e)\theta(e)de = R(t) \), where, \( \rho(t) \) is the HeXie-state change anticipated by the manager, \( \rho(\tau) \) is the anticipative HeXie-state, so the project team system \( L_\tau \) is HeXie controllable in the stage of \( \Delta t \).
Definition 2 (HeXie observability): If the time of \( t_1 \) \((t \leq t_1 \leq T, t_0 \) is the initial time of the project and \( T \) is the terminal time of the project, \( \Delta t = t_1 - t \) ) exists and makes \( Y'(t) t \in \left[ t_0, t_1 \right] \) only confirm \( Y(t_0) \)

and \( \mathcal{P}(t_0) = W^{-1}_G(t_1, t_0) \int_{t_0}^{t_1} \left( C(t) \Phi(t, t_0) \right)^T \mathcal{P}(t) d\tau \), where, \( \Phi(t, t_0) = \begin{bmatrix} \phi_{01}(t, t_0) & \phi_{02}(t, t_0) & \phi_{03}(t, t_0) & \phi_{04}(t, t_0) \\ \phi_{12}(t, t_0) & \phi_{12}(t, t_0) & \phi_{23}(t, t_0) & \phi_{24}(t, t_0) \\ \phi_{34}(t, t_0) & \phi_{34}(t, t_0) & \phi_{44}(t, t_0) & \phi_{44}(t, t_0) \end{bmatrix} \) is the state transfer matrix of the project team system, \( \phi_{ij}(t, t_0) \) respectively represent influences of structure HeXie, organizational HeXie, interior HeXie and exterior HeXie at the time of \( t_0 \) to the structure HeXie at the time of \( t \). \( \phi_{ij}(t, t_0) \), \( \phi_{ij}(t, t_0) \), \( \phi_{ij}(t, t_0) \) and \( \phi_{ij}(t, t_0) \) respectively represent influences of structure HeXie, organizational HeXie, interior HeXie and exterior HeXie at the time of \( t_0 \) to the organizational HeXie, interior HeXie and exterior HeXie at the time of \( t \), and \( W_G(t_1, t_0) = \int_{t_0}^{t_1} \left( C(t) \Phi(t, t_0) \right)^T C(t) \Phi(t, t_0) d\tau \), so the project team system \( L_0 \) is HeXie observable in the stage of \( \Delta t \).

Suppose that \( t_0^1, t_1^1, t_2^1, t_3^1 \) and \( t_0^4 \) are respectively initial times of five stages such as establishment, adaptation, standard, effect and dismiss, and if \( t_0^1, t_2^1, t_3^1 \) and \( t_4^1 \) \((t_0^1 \leq t_0^1 \leq t_2^1 \leq t_3^1 \leq t_4^1 \leq t_0, \) \( t_i \) \( i = 0, 1, 2, 3, 4 \) are in the same stage of the project lifecycle, \( \Delta t_i = t_i - t_i^0 \) exist and make \( \mathcal{P}(t_i) \in \left[ t_i^0, t_i \right] \) only confirm \( Y(t_i^0) \) and \( \mathcal{P}(t_i^0) = W^{-1}_G(t_i, t_i^0) \int_{t_i^0}^{t_i} \left( C(\tau) \Phi(\tau, t_i^0) \right)^T \mathcal{P}(\tau) d\tau \), \( \Delta t = \max(\Delta t_i) \), so the project team system \( L_0 \) is HeXie controllable in the stage of \( \Delta t \).

3. Judgment rules of HeXie controllability and HeXie observability

Theorem 1: Suppose that \( Y(t) \) exists in the project team \( L_0 \), and if the time of \( t_1 \) \((t \leq t_1 \leq T, T \) is the terminal time of the project) exists and makes all four sorts of HeXie possess positive influences from the time of \( t \) to the four sorts of HeXie at the time of \( t_1 \) and three coherences possess positive influences to four sorts of HeXie, so the project team \( L_0 \) is HeXie controllable.

First we prove the Lemma 1.

Lemma 1: Suppose that for the project team \( L_0 \), if the time of \( t_1 \) exists and makes the matrix \( W_K(t_1, t) = \int_0^{t_1} \Phi(t_1, \tau) B(\tau) \Phi(t, t_1) B(\tau) d\tau \) is positive definite, so \( L_0 \) is HeXie controllable.

Prove: Suppose that the time of \( t_1 \) exists and makes \( W_K(t_1, t) > 0 \), so \( W_K(t_1, t) \) is positive definite.

Suppose that \( Y(t) \) is the HeXie-state of \( L_0 \) at the time of \( t \), \( \mathcal{P}(\tau) = -\left( \Phi(t_1, \tau) B(\tau) \Phi(t, t_1) B(\tau) \right) d\tau \), so the expression of the solution of system state equation is \( \mathcal{P}(t_1) = \int_0^{t_1} \Phi(t_1, \tau) B(\tau) \mathcal{P}(\tau) d\tau \), so \( \mathcal{P}(t_1) = R + \mathcal{P}(t_0) \). According to the definition, the project team \( L_0 \) is HeXie controllable.

Next, we prove the Theorem 1.

Prove: To prove \( L_0 \) is HeXie controllable, we must prove \( W_K(t_1, t_0) \) is positive definite. Because all four sorts of HeXie possess positive influences from the time of \( t \) to the four sorts of HeXie at the time of \( t_1 \), i.e. \( \phi_{ij}(t, t_0) > 0 \), \( t_0 \leq t \leq t_1 \), \( i, j = 1, 2, 3, 4 \), and since the time of \( t \), all three coherences possess positive influences to four sorts of HeXie, i.e. \( b_{ij}(\tau) > 0 \), so \( \sum_{j=1}^{4} \sum_{i=1}^{4} \phi_{ij}(\tau, t_0) b_{ij}(\tau) > 0 \), \( k = 1, 2, 3, 4 \).

If \( \lambda_i = 2 \sum_{j=1}^{4} \sum_{i=1}^{4} \phi_{ij}(\tau, t_0) b_{ij}(\tau) \), so \( \det(\lambda - \Phi(t_1, \tau) B(\tau) \Phi(t, t_1) B(\tau)) = 0 \), and \( W_K(t_1, t_0) \) is positive definite.

According to Lemma 1, the project team \( L_0 \) is HeXie controllable.
Theorem 2: Suppose that $B(t)$ of the project team $L_s$ is the vector composed by following three parts, (1) the sum of influences of certain HeXie and the coherence of organizational mission and EOL at the time of $\tau$ to four sorts of HeXie at the time of $\tau$ and the time of $t_1$, (2) the sum of influences of certain HeXie and the coherence of HeXie-Topic and EOL at the time of $\tau$ to four sorts of HeXie at the time of $\tau$ and the time of $t_1$, (3) the sum of influences of certain HeXie and the coherence of HeXie and EOL at the time of $\tau$ to four sorts of HeXie at the time of $\tau$ and the time of $t_1$. If the time of $t_1$ exists and makes four vectors cannot transform reciprocally though linear transform, so $L_s$ is HeXie controllable.

Prove: Above four vectors can not transform reciprocally through linear transform, i.e. various vectors are linear independent. Suppose that the matrix $\Phi(t_1,\tau)B(\tau)$ is linear independent in $[t_0,t_1]$, but $L_s$ is not HeXie controllable, so $W_\tau(t_1,t_0)$ is non-positive definite, so for $t_0 > t_0$, the nonzero vector $z\varpi$ certainly exists and makes $z\varpi W_\tau(t_1,t_0)z\varpi = 0 \Rightarrow \int_{t_0}^{t_1} \Phi(t_1,\tau)B(\tau)\Phi(t_1,\tau)B(\tau)^T\varpi d\tau = 0$. Because $A(t)$ and $B(t)$ are successive, so $W_\tau(t_1,t_0)B(\tau) \equiv 0$, $t_0 \leq \tau \leq t_1$, which is ambivalent. So the hypothesis can not come into existence. According to the definition, the project team $L_s$ is HeXie controllable.

In the same way, we can prove Theorem 3: if the time of $t_1$ exists and makes the matrix $C(\tau)\Phi(t_1,\tau)$ is linear independent in $[t_0,t_1]$, so $L_s$ is HeXie observable.

4. Conclusions

Based on the HeXie management theory, in this article, we analyze the HeXie controllability and the HeXie observability of the project team $L_s$. The theorem proved in the article shows that the problem of the HeXie controllability of the project team $L_s$ is only decided by the state keep matrix $A(t)$ and the Management-Distribution-Matrix $B(t)$ of $L_s$, and the problem of the HeXie observability of the project team $L_s$ is only decided by the HeXie-Distribution-Matrix $C(t)$. That indicates that the HeXie controllability and the HeXie observability are the essential attributes of the project team, which are confirmed when the project team is established, and don’t depend on the project management.

In this article, we define the HeXie controllability and the HeXie observability and describe the judgment theorem. The HeXie controllability is used to measure the influencing function of the project management activity to the HeXie state, and the HeXie observability is to measure the initial HeXie state. These two attributes of the project team have important help to optimize the project management and elevate the structure of the project team, and have abroad application space. With the deepening of research, the matching degree of the HeXie-state and the stability of the management activity to the function process of the project team system are the direction for the future study.

References


