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Computer Modeling of Sustainability and Support of Enterprises in Organizational Networks

Sergey Vikharev

Ural Federal University
Office 607, Turgeneva str. 4, Ekaterinburg, Russia, 620075

Abstract

The concept of the networking support and sustainability of enterprises in the structure of organizational network is researched in this article. On the basis of a series of computer experiments the analysis of resources redirection process in the network structure of a large holding company has been carried out, the regularities of the coefficients of sustainability and networking support of enterprises have been detected and dependences of the coefficients of sustainability and networking support from different groups of factors have been shown. The practically applied conditions of feasibility of introducing the enterprise in the structure of a holding company are formulated.

Keywords: generalized stability, ranked vendors, corporate network, critical performance event

1 Intorduction

For carrying out series of computer experiments and defining the coefficients of sustainability and networking support a special computer system has been developed [1—5]. Apply approaches close to papers [6-13]. The results of numerical experiments carried out by means of this system and some important conclusions from these results will be described below.

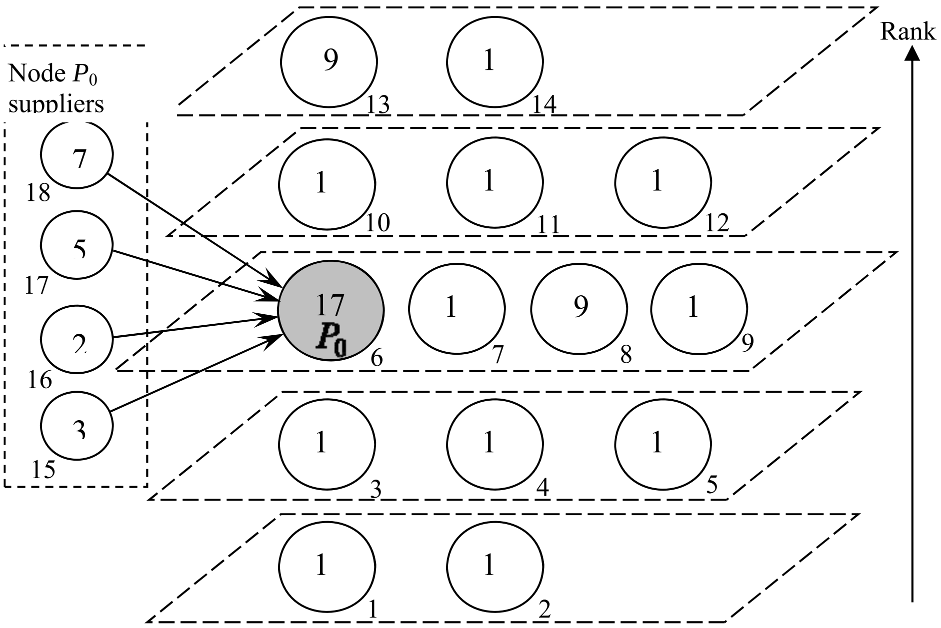

Fig. 1. Experiment 1. The graduated network $\mathbf{G_1}$ with initial data of

The first group of experiments is devoted to calculation the networking support coefficient and studying its dependence on isolated sustainability of the different configurations of organizational networks. At figures 1—3 for clarity the graduated organizational networks are presented as a partition of the enterprises having the same rank to planes, the studied node P_0 is emphasized by grey color. The number inside each node means the volume of required resources for this node; for suppliers these numbers mean volumes of contracted deliveries toward the node P_0. At the bottom of each node its ordinal number is indicated.

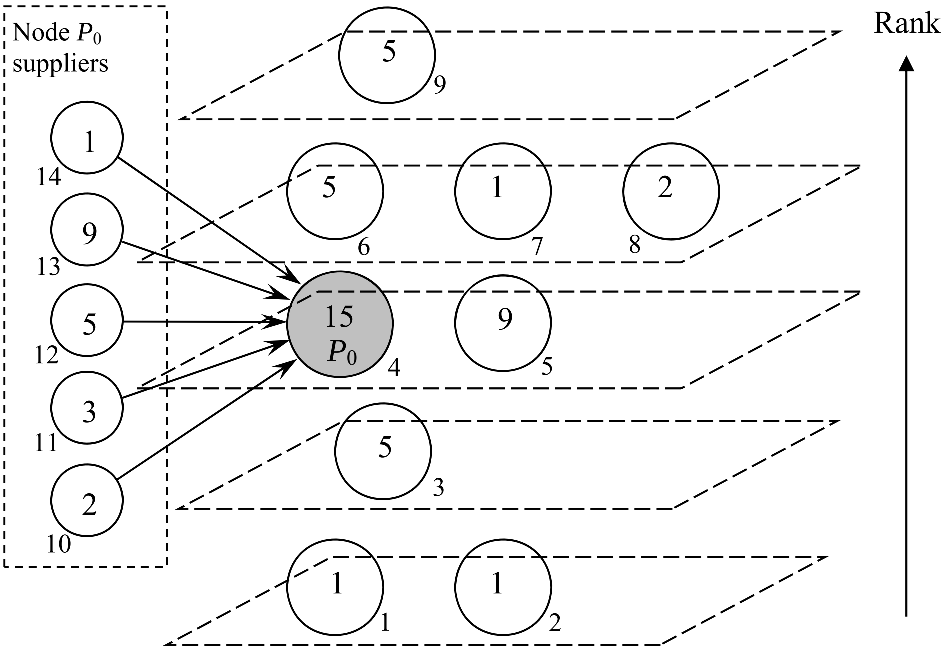

Fig. 2. Experiment 2. The graduated network $\mathbf{G}_3$ with initial data of resources volumes

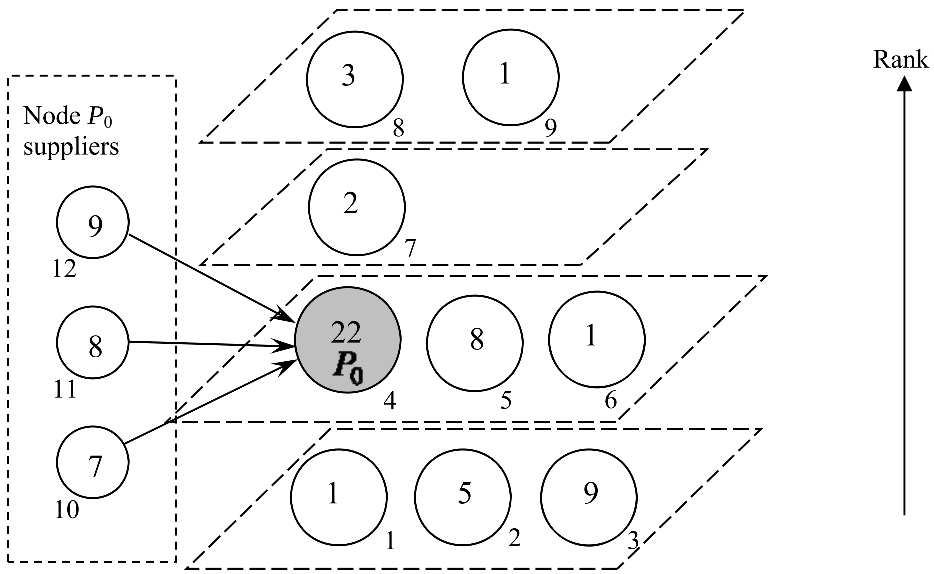

Fig. 3. Experiment 3. The graduated network $\mathbf{G}_2$ with initial data of resources volumes

The coefficients p_j of the isolated sustainability of the network enterprises calculated on the basis of interaction between each enterprise P_j of the network $\mathbf{G}_1$ and groups of their own suppliers (at the figure these groups are not shown in order to

save space), are given in the
Table 1.

Table 1. The isolated sustainability of the nodes of the networks $\mathbf{G}_1$, $\mathbf{G}_2$, $\mathbf{G}_3$

Network $\mathbf{G}_1$		Network $\mathbf{G}_2$		Network $\mathbf{G}_3$	
Node number	p_i	Node number	p_i	Node number	p_i
1	0,88	1	0,79	1	0,88
2	0,69	2	0,79	2	0,69
3	0,8	3	0,79	3	0,8
4	0,98	4 (P_0)	0,79	4 (P_0)	0,965
5	0,88	5	0,79	5	0,7
6 (P_0)	0,529	6	0,79	6	0,88
7	0,7	7	0,79	7	0,9
8	0,8	8	0,79	8	0,8
9	0,86	9	0,79	9	0,86
10	0,79	10	0,79	10	0,92
11	0,87	11	0,79	11	0,99
12	0,8	12	0,79	12	0,8
13	0,86			13	0,88
14	0,7			14	0,6
15	0,99				
16	0,8				
17	0,88				
18	0,76				

2 Results and discussions

The results of computing the coefficients of the networking sustainability of the enterprise P_0 in networks $\mathbf{G}_1$, $\mathbf{G}_2$, $\mathbf{G}_3$ and the networking support coefficients for this enterprise are shown in the Table 2.

Table 2. Results of experiments for the networks $\mathbf{G}_1$, $\mathbf{G}_2$, $\mathbf{G}_3$

Network $\mathbf{G}_1$		Network $\mathbf{G}_2$		Network $\mathbf{G}_3$	
Networking sustainability of the node P_0	Networking support coefficient $\sigma(P_0)$	Networking sustainability of the node P_0	Networking support coefficient $\sigma(P_0)$	Networking sustainability of the node P_0	Networking support coefficient $\sigma(P_0)$
0,806	52,1%	0,82	3,9%	0,612	–36,5%

Let's discuss the obtained results. In the experiment #1 the volume of demand of the considered node P_0 in resources is equal to 17 – the company "has not reinsured" and it has entered into a contract with suppliers on the total volume of possible deliveries which is exactly equal to 17. In this case the isolated sustainability of the node P_0 is extremely low and it is equal to $p_0 = 0{,}529$. Largely due to low intrinsic sustainability of the enterprise P_0, its networking support coefficient is high in the experiment 1 $\sigma(P_0) \approx 52\%$ (the enterprise P_0 becomes more stable on 52% percents due to its inclusion to the organizational network $\mathbf{G}_1$ and therefore its networking sustainability is equal to $p_0^* = 0{,}806$.

Let's note that if in the terms of experiment 1 the demand of the enterprise P_0 were equal to 16, not 17, i.e. the enterprise "reinsured" and entered into a contract with suppliers on the total volume of resources deliveries equal to 17, that exceeds its planned requirements, then the isolated sustainability would be equal to $p_0 = 0{,}72$, the networking sustainability would be equal to $p_0^* = 0{,}878$ and a networking support coefficient would be equal to $\sigma(P_0) \approx 22\%$. It means that increase of the enterprise own sustainability requires additional expenses (entering into additional contracts), slightly alters the stability the enterprise networking sustainability and significantly reduces the networking support coefficient. This observation leads to the important practical conclusion – participation of enterprises with middle indexes of their own sustainability in the structure of the organizational network is the most profitable and natural way of increase their stability and sustainability. Except this, there is almost no sense in isolated increase of own sustainability to the enterprises in the structure of organizational network – increase of stability of the network enterprises can be achieved only by means of complex simultaneous increase of stability of each element on the and/or reorganization of the whole structure in a whole.

In the experiment #2 the initial data were specially selected so the all enterprises of the network G had their own equivalent isolated sustainability $p_j = 0{,}79$, in particular for the node P_0 it was achieved by exceeding the total contract supply volumes by suppliers over the own demand of the P_0 node (fig.4). Nevertheless, the networking sustainability of the node P_0 is higher than its isolated sustainability ($p_0^* = 0{,}82$) and the coefficient of the networking support is low $\sigma(P_0) = 3{,}9\%$. It means that in the case of homogeneity and approximately the same enough stability of all enterprises in the structure of organizational network ("alliance of equals", when there are not any obvious unreliable partners) the organizational structure has an additional positive impact to the stability and sustainability of its members and at the same time it does not burden responsibilities on the network enterprises to support its other members.

Experiment #3 shows a situation when the networking support can be negative. The enterprise P_0 significantly reinsured in the volumes of resources contracted deliveries by its suppliers (quite reliable) and in the result the enterprise has achieved an extremely high isolated sustainability coefficient $p_0 = 0{,}965$ in comparison to quite smooth (in the interval 0,8 ÷ 0,9) indexes of own sustainability of their networking partners (the enterprise P_0 became a leader). Due to its high isolated sustainability the enterprise P_0 rarely enters to critical situations and it is more often compelled (according to the rules of resources redistribution) to support less stable networking partners by their resources and as a result it gets the negative networking support coefficient.

It obvious from the experiments results that the processes of networking interaction [7] in complex positively affect to stability of insufficient sustainable enterprises and at the same time they grade too much superiority of reliable nodes – the organizational network quasi "aligns" the indexes of sustainability and stability of enterprises in its structure.

Let us consider one more important dependence, characterizing the organizational network – dependence of the networking support coefficient on rank of considered node in the fixed graduated organizational network (ceteris paribus to the nodes of considered network). To identify this dependence in order to exclude extraneous factors) it is convenient to use the graduated network $\mathbf{G}_2$ shown in the fig. 4, because all enterprises of this node (regardless of rank) have the same isolated sustainability. Results of numerical experiments by definition the networking sustainability coefficient of enterprises with different ranks in the structure of the network $\mathbf{G}_2$ are shown in the Table 3. The enterprise of the network $\mathbf{G}_2$ having in the fig. 4 the serial number j is denoted as P_j and its networking sustainability coefficient is p_j^* respectively.

Table 3. Networking sustainability and networking support of the nodes with different ranks

node	P_5	P_4	P_3	P_2	P_1
rank	1	2	3	4	5
p_j^*	0,95	0,92	0,82	0,80	0,63
$\sigma(P_j)$	37,4%	24%	3,9%	2,37%	–12,7%

A graph of this dependency is presented at the fig. 4.

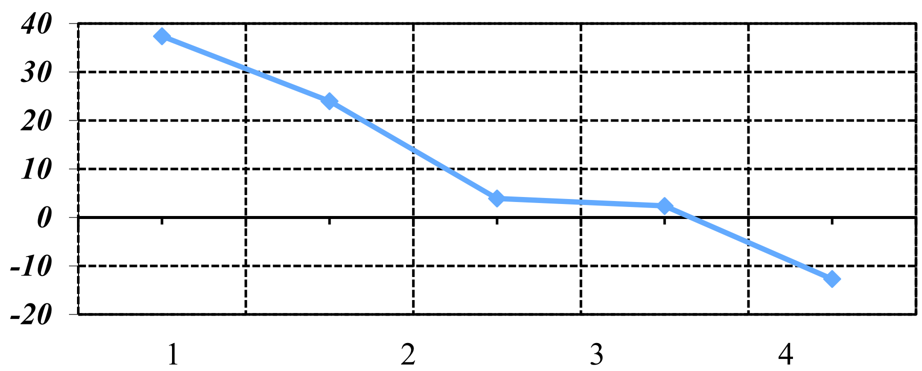

Fig.4. Dependence the networking support

From the results shown in Table 3 it can be concluded in accordance to practical experience of networking interaction – the lower the priority of the node in the graduated organizational structure is, the lower the networking support coefficient of an enterprise is, i.e. the less stabilizing influence and resources help from organizational structure it gets. In terms of interests of company's stability these results mean that the lower its rank is, the less expedient for this enterprise in the organizational network structure is. From a practical point of view for design the organizational structures these results mean the most stable and preferable (acceptable and satisfying most of its enterprises) structure is a structure, where decrease of the networking support coefficient with decreasing ranks of the nodes is fairly slow and the networking support coefficient is positive for the most enterprises of the network. If there is sharp decrease of the nodes networking support coefficient with decreasing of ranks of the nodes then such organizational network will be intended only for providing its "top" and it is principally disadvantageous for the majority of its nodes. A typical example of such unstable networks with a sharp decreasing networking support coefficient of its nodes is a financial pyramid where the networking support coefficients are already negative for the nodes of the third of fourth ranks.

3 Conclusion

There is a general conclusion. If the networking support coefficient $\sigma(P_j)$ of an enterprise P_j in the structure of organizational network is low (or, worse, it is negative) then the enterprise P_j gets a small addition to its sustainability and stability (or even loses). It can be regarded as inexpedient for the enterprise to be in the structure of organizational structure. In the case when the coefficient $\sigma(P_j)$ is low the participation of an enterprise in a networking structure can be caused only by some specific reasons of economic or conjuncture nature. Ceteris paribus, an enterprise P_j with the low networking support coefficient $\sigma(P_j)$ is less interested to be in frames of organizational structure and it is a "prime candidate" to be separated from a network and leave a network structure. In solving problems of transformation and reformation of organizational networks of holding companies such enterprises should first obtain independence and go into free economic and legal space.

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