

CO-ORDINATION PROCESSES: MODELLING AND TAXONOMY

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Abstract. The hierarchy of information units and interactions in managing of Organizational Systems is rather complicated. Interactions between departments of different levels of hierarchy are named "co-ordination" (Mesarovic, Mako, Takahara, 1970). This paper deals with the coordination as the "vertical" informational interfaces between the units called "elementary management cycles" which compose the structure of managing process.

The taxonomy of co-ordination processes presented in this paper is based on the decomposition of information processing at managing in so called the Space of Processes (Gudas, 1991).

Key words: enterprise management, hierarchy of information units, levels of hierarchy, co-ordination in the Space of Processes.

1. Introduction. The structural model of information units and their interactions at managing of Enterprise is needed. The attempts at systemic investigation of information processes hierarchy were made. The computer-aided modelling of those processes needs more detailed framework. Such framework should include the hierarchy of interactions between the data, knowledge and objective items as well as between the departments and technological objects.

The analyse of co-ordination processes made in this paper is based on the information processing model presented in (Gudas, 1989; 1991).

2. The hierarchy of elementary management cycles.

Here we recall the main points discussed in the aforementioned paper (Gudas, 1989, 1991). Suppose that the elementary management cycle (EMC) is the simple step of the managing process. Formally the EMC is complex unit with its own structure. Thus, one EMC can influence another EMC through such its components:

- technology of material-energy processing (P),
- interpretation (IN), which makes up a model I of process P,
- data processing (DP),
- decision making (DM),
- realisation (RE),
- structure of goals (G),
- data structures (D) of model (I),
- knowledge structures (K) of model (I).

The process P is supposed here as the "object of managing" too. Organizational System as hierarchy of EMC is presented in Fig. 1. This is the graphical model of information processing hierarchy in Organizational System decomposed in the Space of Processes.

The processes of aggregation (AG) and generalization (GE) divide the set of the EMC into levels and in this way two different types of EMC hierarchies arise: hierarchy of aggregation and hierarchy of generalization of EMC.

The EMC are noted in Fig. 1 as a points on the activities $r, \dots, r+n$. Every mark, $j, j+1, \dots$ on the axis GE notes the level of generalization of EMC. Each single activity r may be managed by different number of EMC of various levels of generalization. Besides the generalization level of the same activity r may be different on different levels of aggregation as presented in Fig. 1.

Several important features of the such hierarchical system of EMC must be outlined:

1. An interaction between two different EMC in this hierarchy is realised as interface between any components of EMC. Thus, one EMC make influence to another EMC through its components P, IN, DP, DM, RE, G, D and K discussed above.

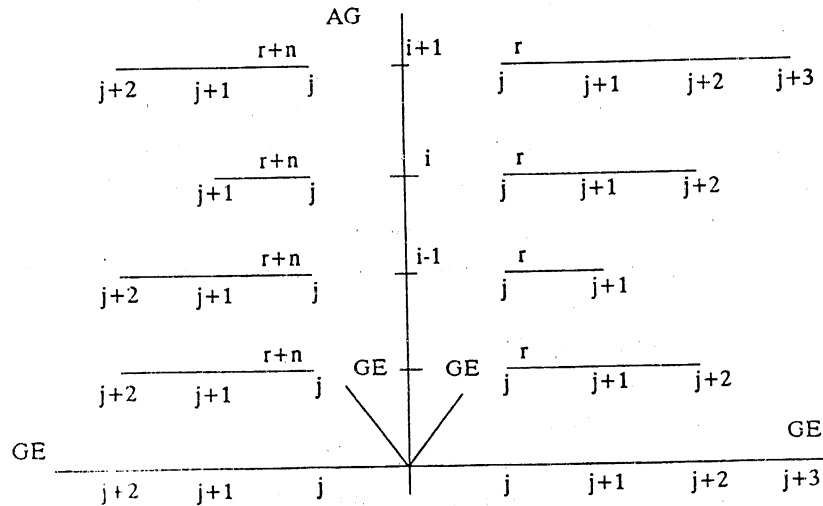


Fig. 1 The hierarchy of EMC as the model of Organizational System managing process.

2. Every component of EMC forms its own hierarchies in directions of the axes AG, GE and T. So, each component of EMC composes the hierarchy of aggregation, the hierarchy of generalization and the hierarchy of time levels.

3. Information used for managing of Organizational System is divided into three diverse components: data structure D, knowledge structure K and structure of objectives G (goals). The analyse of EMC interactions must include the hierarchies of those items as the components of EMC.

The main guideline of this approach to classification of co-ordination is: co-ordination is supposed as the informational interfaces (relations) in the hierarchy of managing processes between the EMC – the units of information processing at managing.

Naturally, a set of EMC is implemented in Organizational System by a set of departments (or other units of administrative system). In general case the correspondence between the EMC and departments may be different:

- a) a single EMC is carried out by one department;
- b) a part of the EMC is carried out by one department, i.e., a set of departments implements one EMC;

c) a few different EMC are implemented by one department.

So, this approach suppose the co-ordination as the hierarchical interactions of the information processes and not as that of administrative units (departments) of Enterprise. From that point of view the co-ordination of departments is the second step of investigation of that problem.

3. Taxonomy of the co-ordination processes. The types of inferences at managing of Enterprise can be separated in accordance with mutual disposition of EMC in Space of Processes. From what has been stated above it can be concluded that for two (or more) EMC are reasonable:

- the type of activity is the same in all EMC,
- the type of activity is various in different EMC,
- the object of managing P is the same in all EMC,
- the object of managing P in different EMC is various,
- all EMC are located in the same period of time t ,
- EMC are from various periods of time.

The classification of situations composed by two (or more) EMC is presented in Table 1:

1 - "the same",

0 - "the different".

This table makes the basis for taxonomy of co-ordination processes in Enterprise.

Table 1. The macrotypes of co-ordination

| Macrotypes of co-ordination | A | B | C | D | F | G | H | L |
|-----------------------------|---|---|---|---|---|---|---|---|
| The activity r | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| The object P | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| The period of time t | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |

It is also fair to outline that the relations between different stages of EMC are not hierarchical. All stages of the single EMC are located on the same level of aggregation and on the same level of generalization hierarchies. They are related in time as the steps of the one single managing process. That can't be classified as co-ordination because interactions between agents of the same EMC are not hierarchical.

4. The co-ordination in the same period of time. Our analysis is centered around the co-ordination of types A, B, C and D – the period of time in those cases is "the same".

A. Co-ordination of the same activity

The managing process in the hierarchy of EMC of the same activity r is classified in Table 1 as cases A and B.

Some types of situation A are reasonable.

1. Two (or more) ESM of different level of generalization are used (Fig. 2) to manage the same object on the same level of aggregation: $EMC(i, j, r)$, $EMC(i, j+1, r), \dots$

Thus, several solutions of the different level of generalization are generated, but only one of them – of the lowest level of generalization hierarchy, will be realised. The coordination of this type can be named "horizontal concretisation" (in Fig. 2. CO is the process of concretisation).

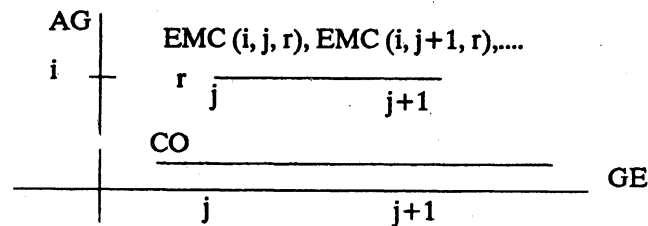


Fig. 2. The co-ordination of the type "horizontal concretisation".

2. The EMC are located in the different levels of aggregation hierarchy, but the level of generalization is the same (Fig. 3): $EMC(i, j, r)$, $EMC(i+1, j, r), \dots$

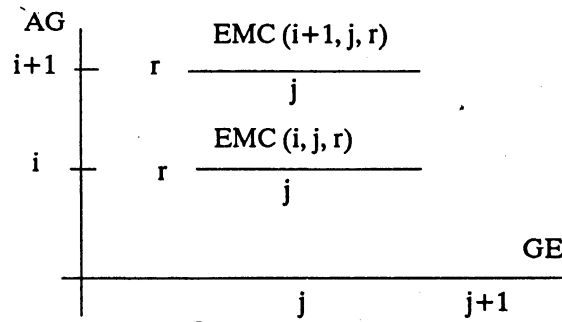


Fig. 3 The co-ordination of the type "detailizing co-ordination".

In this case the elements of the lower EMC became the units of the structure of the stages of the higher level EMC. Consequently, the EMC of higher level can co-ordinate the lower EMC by acting on stages (one or some) of them. The main feature of such vertical coordination is the influence over information of the lower levels of aggregation hierarchy (detailized information). This type of co-ordination can be named "detailizing co-ordination".

3. Two EMC are on the different levels of both aggregation and generalization hierarchies (Fig. 4): $EMC(i, j, r)$, $EMC(i + 1, j + 1, r), \dots$

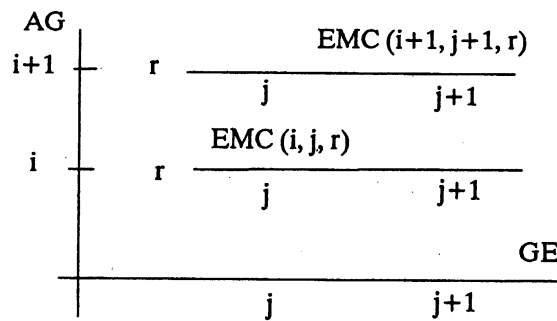


Fig. 4. The two-dimentional co-ordination.

In this case two-dimentional interfaces between EMC and their elements arise: along the AG axis and along the GE axis. Co-

ordination of such type can be named "two-dimensional co-ordination".

B. Co-ordination of the same activity when object of managing differ

The classification of co-ordination is continued now taking into account the technological relations between the objects of managing P.

4. Two or more EMC are located on the same levels of aggregation and generalization, but the objects of managing are different (Fig. 5). Object of managing are in special interdependences as elements of the same Enterprise. Consequently, the additional EMC of the higher level of aggregation is necessary. The object of managing of that higher EMC includes (as the elements of its structure) the objects of the EMC from lower levels. So, the "vertical technological co-ordination" can be separated.

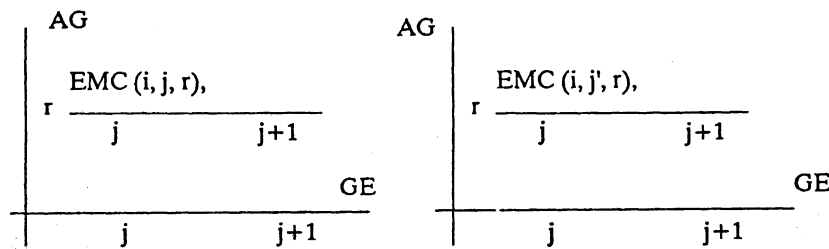


Fig. 5. The vertical technological co-ordination.

5. Two EMC are located on the same level of aggregation and on different level of generalization hierarchies, the objects of managing are interrelated: $EMC(i, j, r), \dots, EMC(i, j', r), \dots$

The actions of these different EMC must be co-ordinate – the solution of adequate level of concretisation (generalization) is necessary. Thus a supplementary EMC of higher level for co-ordination of such type (concretizing-technological) is necessary.

6. Two EMC are on the same level of generalization and on different levels of aggregation hierarchies, the objects of managing are interrelated: $EMC(i, j, r), \dots, EMC(i', j, r), \dots$

In this case adequate level of solution detailisation is necessary. Thus the supplementary EMC of higher level for co-ordination of such type (detailizing-technological) must be included.

7. The levels of aggregation and generalization of two EMC are different, objects of managing are technologically related: EMC $(i, j, r), \dots, EMC (i', j', r), \dots$

This is the general case of mutual disposition of different EMC, and so, the separate type of co-ordination must be implemented.

C. *Co-ordination of different activities*

In cases C and D when activities managed by various EMC are different the situations arises similar to that in case B:

8. ... EMC $(i, j, r), \dots, EMC (i, j, r'), \dots$ (case 4),
9. ... EMC $(i, j, r), \dots, EMC (i, j', r'), \dots$ (case 5),
10. ... EMC $(i, j, r), \dots, EMC (i', j, r'), \dots$ (case 6),
11. ... EMC $(i, j, r), \dots, EMC (i', j', r'), \dots$ (case 7).

In all those situations the EMC of higher level is necessary for co-ordination of activities. Naturally, the content of information processing in situation (8 – 11) is different but nearly about that in cases (4 – 7).

5. Subtypes of co-ordination. Every EMC is the structure and one can conclude that each type of co-ordination is made as the interaction of EMC components mentioned above: P, IN, DP, DM, RE, G, D, K. Thus in this way all types of co-ordination mentioned above can be decomposed into set of subtypes according to the element of the EMC they are interacting.

So, the list of types of co-ordination can be continued in that way:

- co-ordination of EMC as correction of the part of object (real process) must be managed by each EMC of lower level,
- co-ordination as the change-over the model of data processing used in the EMC of lower levels,
- co-ordination as the change-over the rules of realisation used in the EMC of lower levels,

- co-ordination as the change-over the structure of goals in the EMC of lower levels,
- co-ordination as the change-over the data structures in the EMC of lower levels,
- co-ordination as the change-over the knowledge structures in the EMC of lower levels.

6. Practical issues of the taxonomy. The proposed taxonomy may be used as systematic guideline to check-up the internal structure of some activities management. The organizational units of the activities (subdivisions of the Enterprise) and their informational relations compose the hierarchical structure. The content of information flow up and down in such hierarchy can be classified in the terms of proposed taxonomy. In this way the type of co-ordination is identified.

The different type of co-ordination (the style of managing) occurs more or less effective in real situation. So a set of real situations in Enterprise is directly related with the taxonomy of co-ordination and may be used to improve management of some activities.

7. Conclusions. This approach suppose the co-ordination as the hierarchical interaction of the information units – elementary management cycles (EMC). From that point the co-ordination of administrative units of Enterprise is consequence (the second step) based on the results of the first step.

The co-ordination of EMC located on the different levels of aggregation and generalization hierarchies are necessary to obtain the global goal of Organizational System. The co-ordination can be implemented by influence to everyone element of EMC in two different directions: along the axis of aggregation (AG) and along the axis of generalization (GE).

The taxonomy of co-ordination presented in this paper seems to be the frame for identification of present situations in Enterprise and the bases for further investigations in finding effective procedures of managing.

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