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PAPER NO. 1231

# A Coordination Cost Approach to the Strategy-Structure Paradigm

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March 1986

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## ABSTRACT

A model is developed to illustrate that for a diversified firm, the divisional structure is more efficient than the functional structure in terms of coordination costs. This model provides an additional explanation to the thesis that structure follows strategy.

The proposition put forth by Chandler (1962) that structure follows strategy is one of the most important theses in the field of strategy. A corollary to this thesis is that the diversification strategy leads to the multi-divisional structure, rather than the functional structure. Both Williamson (1975) and Thompson (1967) argued that this occurs because the multi-divisional structure is more efficient than the functional structure in managing a diversified firm. They differ in that Williamson believes in the efficiency in allocating capital among diverse businesses and Thompson believes in the efficiency in managing the dependence relations between the firm and its environment. This study provides an additional explanation to this proposition. The major theme of this study is that because the coordination cost of a divisional structure is less than that of a functional structure, a diversified firm adopts a divisional structure. Herein a model is derived to specify the coordination costs of the two kinds of organizational structure.

## THE MODEL

As suggested by Thompson (1967), this study assumes that an organization chooses a structure which minimizes coordination costs. This study also assumes that the coordination cost of an organization is a linear function of the number of necessary links or interactions between the units of the organization. A link represents the interaction between two units of an organization. A link can be horizontal or vertical. By horizontal we mean that two units are at the same level within the organization and by vertical we mean that one unit is

a subordinate of the other. The total number of links of an organization is the sum of the numbers of vertical links and horizontal links. For example, for a 3 unit, two level organization the number of horizontal links is $c(3,2) = 3$. The number of vertical links is the number of subordinates, 3, as shown in Fig. 1.

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Insert Figure 1 about here
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In the aforementioned case, the total number of links is $3 + 3 = 6$.

Let N denote the total number of links of an organization. A formula is derived to calculate the N for a particular type of structure. Consider a three level organization with $n_2$ units at the level 2 and $n_3$ units of each second level unit at the level 3, which is shown in Fig. 2.

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Insert Figure 2 about here
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The number of links of each unit at level 2 is $c(n_3,2) + n_3$. Since the structure has $n_2$ second level units, the total number of links of units below level 2 is $n_2 \times (c(n_3,2) + n_3)$. Similarly, the number of links of the units at level 2 is $c(n_2,2) + n_2$. The sum of the number of links of the units at levels 2 and 3 is

$$N = n_2 \times (c(n_3,2) + n_3) + c(n_2,2) + n_2 \quad \ldots\ldots\ldots\ldots (1)$$

This equation may explain why diversification leads to divisionalization.

Traditional functional structure is comprised of five departments: marketing, finance, personnel, production, and R&D. If a firm diversifies into n different product lines and still keeps functional structure; its structure will be shown in Fig. 3.

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Insert Figure 3 about here

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From equation 1, the total number of links for a functional structure $N_F$ is

$$N_F = 5 \times (c(n,2) + n) + c(5,2) + 5$$

$$= \frac{5}{2} n^2 + \frac{5}{2} n + 15 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

and

$$\frac{dN_F}{dn} = 5n + \frac{5}{2}$$

where $N_F$ is the number of total links of a functional structure.

If the firm adopts a divisional structure, its structure should be that shown in Fig. 4.

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Insert Figure 4 about here

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From equation 1, $N_d$, the total number of links for a divisional structure is

$$N_d = (c(5,2) + 5)xn + c(n,2) + n$$

$$= \frac{n^2}{2} + \frac{31}{2}n \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

and

$$\frac{dN_d}{dn} = n + \frac{31}{2}$$

Comparing equation 2 with equation 3 reveals that as a firm diversifies, the number of its product lines (n) increases, the N of the functional structure increases faster than the N of the divisional structure as shown in derivatives. As a firm diversifies, the coordination cost of a functional structure increases faster than that of a divisional structure. Thus, when n reaches to a certain point, a diversified firm has to adopt the divisional structure in order to reduce its coordination cost. As shown in Fig. 5, when n exceeds 5, it is more costly for functional structures to coordinate than for divisional structures. Thus, it is shown that a firm will adopt a divisional organization structure when it diversifies into more than 5 different businesses.

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Insert Figure 5 about here

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This conclusion does not change if different weights are assigned to horizontal links and vertical links. Let w and 1-w be the weights given to horizontal links and vertical links respectively. According to equation 1,

$$N_F = 5 \times (c(n,2)w + (1-w)n) + c(5,2)w + 5(1-w)$$

$$= \frac{5n^2}{2} w - \frac{15}{2} nw + 5n + 5w + 5 \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

$$\frac{dN_F}{dn} = 5nw - \frac{15}{2} w + 5$$

and

$$N_D = (c(5,2)w + 5(1-w)) \times n + c(n,2)w + n(1-w)$$

$$= \frac{n^2}{2} w + \frac{7}{2} nw + 6n \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

$$\frac{dN_D}{dn} = nw + \frac{7}{2} w + 6$$

Again, the derivatives show that $N_F$ increases faster than does $N_d$. Also, the difference between $N_F$ and $N_D$ is

$$N_F - N_D = (n-5)(2wn-w-1) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

which indicates that when $n = 5$, $N_F$ is equal to $N_D$. Therefore, despite different weights, a firm should adopt the divisional structure when it diversifies into more than five product lines.

This simple model contains general implications for the number of levels a highly diversified firm should have.

## A GENERAL MODEL

To extend equation 1 to a multi-level divisional structure, assume that each unit at the same level has the same number of subordinate units. Let $n_2, n_3, \ldots, n_j$ be the numbers of subordinate units of a unit at levels 1, 2, 3, ..., j-1, therefore,

$$N = ((((c(n_j,2) + n_j)n_{j-1} + c(n_{j-1},2) + n_{j-1})n_{j-2}) \ldots)n_2 \quad \ldots. \quad (7)$$

This formula is used to determine the number of levels that a large diversified firm should have. Consider a firm with 144 divisions. If the firm organizes itself into three levels, the CEO, the group level and the division level, the possible combinations of the number of groups and divisions within a group are (2,72), (3,48), (4,36), (6,24), (8,18), (9,16), (12,12), (16,9), (18,8), (24,6), (36,4), (48,3), (72,2). According to equation 7, the Ns of these structures are as shown in Table 1.

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Insert Table 1 about here
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The desirable three level structures are (16,9), (18,8), (24,6) all of which have a large span at the CEO level. However, the total number of links can be reduced greatly by adding one more level to the structure. For four level organizational structures, we may use equation 7 to calculate N. Ns for some possible structures are given in Table 2.

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Insert Table 2 about here
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Observe from Table 2 that Ns do not change greatly with different structure. However, Ns of four level structures, with an average of 490, are significantly less than Ns of three level structures, with an average of 800 (see Table 1). Thus, a large, highly diversified firm, such as General Electric, can greatly reduce its coordination costs by adding one more hierarchy to its organizational structure.

By adding one more level, one could show that the marginal rate of return declines. The N of a five level structure, (4, 4, 3, 3),

is calculated in Table 2. This N is smaller than Ns of four level structures but not significantly. This comparison illustrates the simple rule of diminishing marginal rate of return.

## Conclusion

In this paper, it is indicated that (i) there are economic incentives for diversified firms to adopt divisional structures and (ii) modifying hierarchical structure reduces coordination costs. In addition to bounded rationality and uncertainties in transactions, increasing coordination costs may force a firm to transform itself from a functional structure to a divisional structure.

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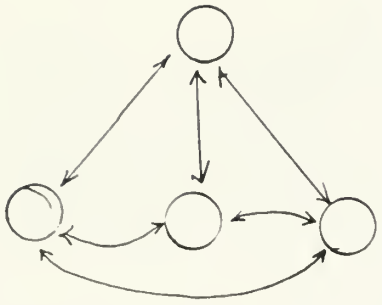


FIGURE 1

A Two Level, Three Unit Structure

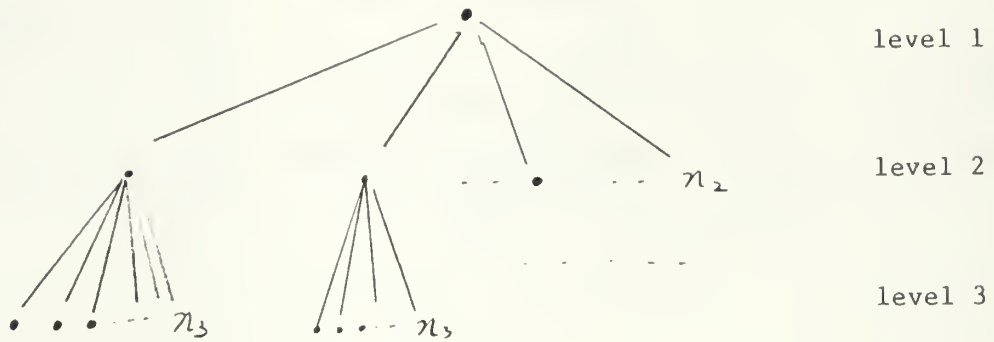


FIGURE 2

A Three Level Organization

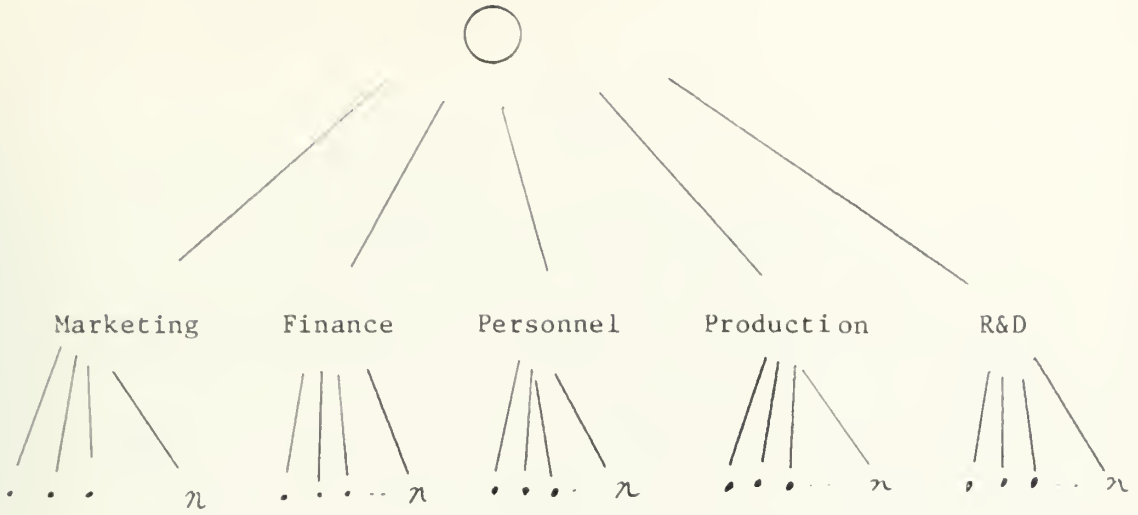


FIGURE 3

A Functional Structure with n Product Lines

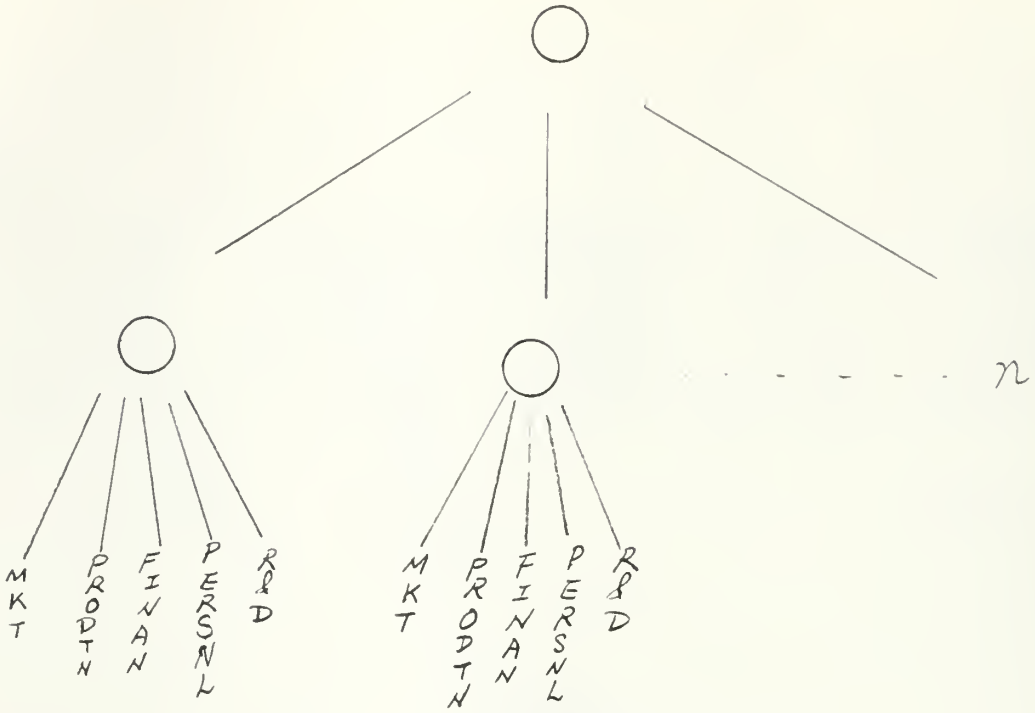


FIGURE 4

A Divisional Structure

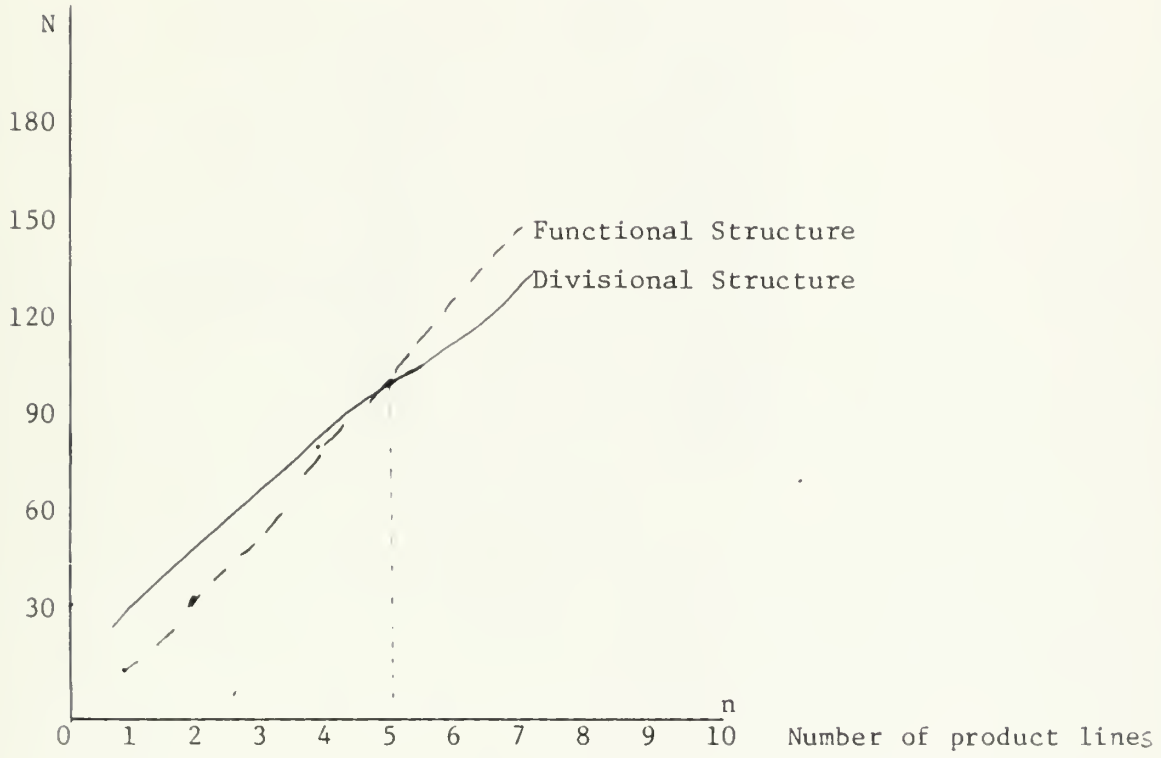


FIGURE 5

Number of Links and Number of Product Lines

TABLE 1

Number of Links of a Three Level, 144 Division Firm

| Structure $(n_2, n_3)$ | N | |
|---|---|---|
| (2,72) | 5,260 | |
| (3,48) | 3,534 | |
| (4,36) | 2,674 | |
| (6,24) | 1, 821 | |
| (8,18) | 1,404 | |
| (9,16) | 1,265 | |
| (12,12) | 1,000 | |
| (16,9) | 840 | Desirable structures |
| (18,8) | 801 | |
| (24,6) | 780 | |
| (36,4) | 882 | |
| (48,3) | 1,464 | |

TABLE 2

Number of Links of a Four Level, 144 Division Firm

| Structure $(n_2, n_3, n_4)$ | N |
|---|---|
| 6, 6, 4 | 301 |
| 8, 6, 3 | 484 |
| 9, 4, 4 | 486 |
| 12, 4, 3 | 474 |
| 16, 3, 3 | 504 |
| $(n_2, n_3, n_4, n_5)$ | |
| 4, 4, 3, 3 | 430 |