Effectiveness vs. Efficiency in Managing a Large, Distributed EM Network

by

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I. Introduction:

A search of the literature over the last three years revealed little information on the determinants of cost for electronic mail (EM) networks of whatever size and little guidance offered organizations on how to manage their EM network costs. This paper aims to partially fill both gaps. It should prove particularly useful to current or future implementors of EM networks using HP DeskManager (HP Desk), Hewlett-Packard's (HP) EM product based on the HP 3000 line of computers.

HP's internal HP Desk network is the source of the data presented and discussed in this paper. Implementation of this network began early in 1982. The data itself was gathered in the Spring of 1987. As of July 1987, HP's internal HP Desk network had over 63,300 users registered in the network's global directory. The network connected 536 HP 3000's in the United States and 32 other countries. Average volume per month through the network was

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calculated to be 24 billion bytes, or approximately 4 million pages (with an average page estimated to contain 4,000 bytes).

The HP EM network is designed as a _tiered_ network with different levels of service and delivery times. Average delivery time anywhere in the world is seven hours using normal service and one hour using urgent service. Local delivery time is usually in minutes. Table 1 summarizes the major facts about the network as of July 1987.

Data was published in a Spring 1987 issue of the San Francisco Examiner newspaper regarding the number of subscribers of the major public EM networks in the United States. Using that data, HP's EM network would rank between the seventh and eighth largest public EM networks in the U.S. in terms of registered users.

More information regarding the origin and development of HP's EM network is contained in an article in the September 1986 issue of the HP Journal.[2]

II. Organization of This Paper:

This paper begins by analyzing the nature and determinant of costs in large, distributed EM networks, such as HP's. Next, it examines how such costs and the factors affecting them could vary in comparison with smaller networks or with non-distributed networks. The first two sections of the paper lead to the next section, where recommendations are made regarding cost management for EM

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2. "Implementing a Worldwide Electronic Mail System," Luis Hurtado-Sanchez, Amy Tada Mueller, _et_. _al_., _Hewlett-Packard_ _Journal_, September 1986, pp. 30-48.

networks. Lastly, cost comparisons are made with other alternative methods of communication, both electronic and not.

III. Nature and Determinants of Large, Distributed EM Network Costs:

Total costs of operating HP's EM network were calculated to be approximately $ 3.7 million per month ($ 44.4 million per year). This equals $ 58 per month per registered user. (See Tables 2 and 3.) All costs presented in this study are current costs, that is to say, they are the costs of currently running the network. They reflect no purchase or acquisition costs.

There are three major components to the HP EM network costs: 1) current operating costs; 2) human resources costs; and 3) data communications costs.

Current operating costs make up 80.2 percent of total costs. Under the current operating costs heading are the costs associated with running the HP 3000's on which HP Desk itself runs. These costs include depreciation, service and support, operations, occupancy, and the like. A standard operating cost was calculated for each HP 3000 series model in use in the network. This cost was then applied to all the HP 3000's in the network dedicated to running HP Desk. For those HP 3000's not dedicated to running HP Desk, a percentage of the standard operating cost was applied; this percentage was the equivalent of the percentage of each HP 3000's resources calculated to be devoted to HP Desk. Current operating costs of the network do not include the cost of personal computers (PC's) and terminals used to access the network. There are two main reasons for not doing so. First, many, even most, of the PC's and terminals are fully depreciated or were fully expensed when acquired. (Costs included in

this study are current costs, not reflecting purchase or acquisition costs.) Second, the PC's and terminals accessing the network were originally procured to do other tasks, such as using other EDP systems, doing office automation, and so on. Thus, their contribution to the current operating costs of the network was taken to be minimal.

Human resources costs make up 12.1 percent of total costs. These costs are the costs associated with the people who support the software and train and support users internally. They are called local messaging coordinators (LMC's) and are located at major entities (manufacturing divisions or sales regions) throughout HP. Human resources costs include salaries, benefits, travel, training, occupancy, and the like. (Thanks are due the LMC's for their time and effort in gathering all the data used in the cost study.)

Data communications costs make up 7.7 percent of total HP Desk network costs. These are the costs of transmitting the data between (not within) entities through HP's private data communications network. Data communications costs for EM within an entity were taken to be minimal, since such a network is used by many applications and for many purposes, of which EM is only one. Also, no billing or similar measurement mechanism existed to estimate the local networking costs due to EM. HP's inter-entity data communications costs are probably low compared with those of other organizations, since HP moves its EM through its own private data communications network. This network consists of a combination of leased point-to-point lines and switchable X.25 circuits. The rate used to calculate data communications costs is $ 35 per megabyte, a weighted average of U.S. and international costs.

As far as volume itself is concerned, only <u>inter-entity</u> volume was actually measured. Experience shows that intra-entity volume is approximately <u>twice</u> inter-entity volume. Thus, total volume is calculated to be three times the measured inter-entity volume.

The cost per page can be calculated from the data given in terms of monthly volume and total cost. The average cost per page is $ .61. However, HP Desk possesses several features which allow a single copy of a message transmitted through the network to serve several users. Since the average number of recipients per message is 2.075 (based on a sample), the average cost per page per recipient is $ .29. (See Table 4.)

Regarding HP's EM network costs and how they compare with what HP's customers might experience, it is true that HP obtains its hardware and software internally cheaper than customers. However, as noted previously, the computed EM network costs are <u>current</u> costs and do not include purchase or acquisition costs. They do include an average estimated depreciation for the HP 3000's. Other costs, such as salaries and benefits for the LMC's, occupancy, and leased lines, may be the same as, higher, or lower for HP than for its customers. An analysis of the data leads us to conclude that a customer's comparable EM network costs, computed under similar assumptions, would be higher than HP's by no more than 15 % and in many cases might be the same or lower.

Table 5 summarizes the results of regression analyses conducted on several variables to determine predictive relationships between several independent variables (number of users per entity, number of computers per entity, number of users per computer, outgoing volume, and others) and several dependent cost

variables. A stepwise (up) procedure was conducted to select the best fit predictive model with the least number of independent variables.

The major conclusions to be drawn from the regression analyses are that at the level of an entity (manufacturing division or sales region):

1. HP Desk network current operating costs are driven largely by the number of users and the number of computers.

2. HP Desk human resources costs are also driven largely by the number of users and the number of computers.

3. But, the number of computers which belong to the network is largely driven by the number of users.

IV. How Costs Might Differ in Other Types of EM Networks:

The analysis in the previous section of this paper was conducted largely in absolute terms, from data for a very specific kind of network, since HP's internal EM network is both <u>large</u> (536 HP 3000's, accessed by approximately 30,000 PC's and 30,000 terminals) and <u>distributed</u> (the HP 3000's are situated in the United States and 32 other countries). The question arises of how the data and therefore the analysis would differ for different kinds of EM networks, or in different kinds of organizations from HP. This section will speculate on these issues.

First, consider smaller networks. We believe that for smaller but still distributed networks, the total costs would be comparatively smaller. The

percentage distribution of costs into the three different categories considered would be similar. However, human resources costs would be a larger percentage of total costs because of the fixed overhead associated with administering HP Desk on each HP 3000. Such overhead does not decrease proportionately as the size of the network is reduced. Although total costs would be smaller for smaller networks, we believe they would not decrease sufficiently to allow for an even larger decrease in volume. Thus, we would expect <u>unit</u> costs to be <u>higher</u> for the smaller, distributed networks.

For equal-sized but centralized networks, the costs might be larger or smaller, both in total and on a per unit basis. The <u>distribution</u> of costs, however, would certainly be different. The total computer resources needed would be smaller due to sharing system overhead among a greater number of users on larger computers. How many fewer computers would make up the network depends on the economies of scale effected by consolidation. Fewer computers would also lead to smaller costs for human resources to support the network and its users. However, data communications costs would be higher, perhaps much higher, as users would have to access the computers from remote sites. How much higher would depend on several factors, including how far users would be from the computers they would have to access and the costs of the network they would use to access the computers. Centralized networks may also have other, not easily quantified costs, such as less control by end-using organizations and less integration, if users must use EM on a computer other than their home computer (the one on which they usually do the bulk of their daily work).

To summarize, centralized networks would have lower operating and human resources costs than decentralized networks. However, decentralized networks would have lower data communications costs and probably greater integration and control by the using organization, leading to greater productivity. The challenge for any organization is to arrive at that optimum point where these considerations balance each other. For example, in HP's EM network, approximately 50 % of the HP 3000's have HP Desk installed on them. Thus, even though HP's network is highly decentralized, it is not as totally decentralized as it might theoretically be.

V. Recommendations on Managing EM Network Costs:

Before making recommendations on management of EM network costs, the data collected needs to be analyzed in more detail. Table 6 breaks down the data by looking at monthly per registered user costs within categories defined by the number of registered users which use a given HP 3000 as their home computer.

At first glance, the data suggests that the way to reduce EM network costs is to put as many users on an HP 3000 as possible. However, the analysis so far does not take into account the intensity with which certain users may be using the EM network. For a more refined analysis, a measure of the intensity of use of EM on an entity-wide basis was defined:

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Avg. disc space/user/entity      Avg. outgoing vol./user/entity

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HP-wide avg. disc space/user     HP-wide avg. outgoing vol./user
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Table 7 displays four different kinds of normalized data within categories defined by intensity of use. Average cost per user per month goes down with an increasing number of users per computer. However, once the average cost per user per month is divided by the intensity of use, the normalized average cost per user per month goes down with decreasing number of users per computer.

The data thus really indicates that the key cost management decision to be made is balancing the allocation of resources to meet the varying usage patterns. Thus, organizations with high intensity of usage should insure that users are making proper use of EM. In terms of cost management, they should aim for low unit costs. Organizations with low intensity of usage should examine whether their policies and procedures are keeping usage, and thus, effectiveness, artificially low. In terms of cost management, they should aim for low total costs. Both types of organizations should implement some kind of billing system, at least to educate users. Billing should be usage-based and structured around the resources in shortest supply.

VI. Comparisons with Alternatives:

Although the data gathered on the costs of HP's EM network is both informative and useful on its own, it is even more so when it is compared to similarly

gathered costs for alternative forms of mailing and communications, both electronic and not.

Table 8 presents comparative cost data for several alternatives to HP's EM network. Table 9 presents comparative delivery times data for the same alternatives.

The inter-office mail, HP Desk network, and FAX costs are based on data internal to HP. So are the Comgrams costs (Comgrams was an earlier, TELEX-like messaging system broadly in use within HP.) Public E-Mail networks referred to are two large public electronic mail networks within the United States. Express Mail includes the average cost of the service and an allocation of HP's internal costs in handling it.

VII. Conclusions:

From Tables 8 and 9, it can be concluded that an HP Desk network comes closest to being the ideal means for normal and urgent communications, when both cost and speed of alternatives are considered, for short to medium length transmissions. For deferrable communications, when a delivery delay of several days is permissible, regular mailing channels (inter-office mail and the postal service) are both cheaper than EM. For very long communications, paper mailings may be preferable in terms of cost and convenience to the receiver (after all, who reads a 50-page newsletter online?). However, EM may prove more convenient to the sender for long communications.

Several challenges lie ahead in managing HP's internal HP Desk network over the next few years. HP's EM network is now well established. It has proven to be a competitive advantage from the standpoint of sheer communications cost and speed. It is used to send not only messages but also documents, graphics, spreadsheets, source code, object code, newsletters, almost anything which can be encoded electronically. It is used to manage projects across entities, across time zones, across the world. In effect, it has become the personal information distribution system of HP, no longer just a messaging system.

Opportunities await to turn HP's EM network into an even greater competitive advantage from the standpoint of other business considerations. One such opportunity lies in promoting greater integration between EDP applications and the EM network, adding to its current role as the personal information distribution system of HP. Another opportunity lies in hooking up HP's EM network with similar networks that HP customers and suppliers enjoy. This interlinking of EM networks would result in greater responsiveness to issues and faster problem resolution. There is also the challenge of ever increasing volume caused by increased demands on the network stemming from increased use of EM, greater user sophistication, and technology evolution. In particular, the network will have to change to meet the future challenge of increasing message size brought about by such technologies as desktop publishing, image processing, and digitized voice.

Arching over the mission to satisfy users' needs and the desire to take advantage of new opportunities and challenges is the mandate to reconcile cost and service considerations to provide HP with an EM network which is

simultaneously effective and efficient. In the world of electronic mail networking, there is only one law: Follow up, fine tune, forever.

TABLE 1   HP's HP Desk Network
July 1987

SCOPE
- 33 Countries
- 536 HP 3000's
- 63,386 Registered HP Desk Users

VOLUME
- 24 billion characters/month
- (6 million pages/month)

DELIVERY

Avg	Range	
10 sec	0-5 min	Within an HP 3000
30 min	0-2 hr	Within a location
1 hr	0-2 hr	Between locations (urgent)
7 hr	0-12 hr	Between locations (normal)

TABLE 2
Mid – 1987 HP's HP Desk Network Costs

Current Operating Costs
{ Hardware Depreciation Service Operations

80.2%

Datacomm 7.7%

Human Resources 12.1%

Total Costs $3.7 Million per Month

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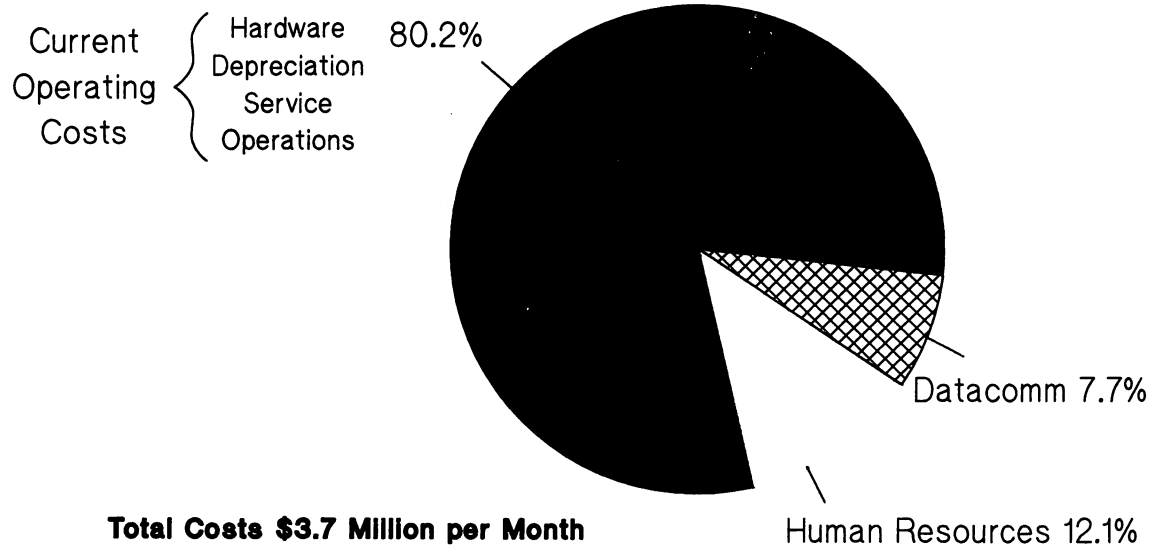
TABLE 3

Mid – 1987 HP's HP Desk Network Costs
Average Cost per User

Total HP Desk Costs	3.7	($M/month)
# of Registered Users	63,386 *	
Average Cost per User	58	($/month)

*Registered in HP global directory

AVGPU

TABLE 4

Mid – 1987 HP's HP Desk Network Costs
Average Cost per Page

Total volume (per address)	24,168	(Mbytes/mo)
Total volume (per recipient) [1]	50,149	(Mbytes/mo)
Total cost	3.7	($M/mo)
Cost per page (per address) [2]	.61	($)
Cost per page (per recipient) [2]	.29	($)

[1] estimated 2.075 recipients per address based on sample
[2] assumed 4000 bytes per page

AVGPP

TABLE 5
Mid – 1987 HP's HP Desk Network Costs
Cost Regression Analyses

$Y = a + bX_1 + cX_2$	R^2	a	b/std err	c/std err
Y = Operating costs ($K/mo) X_1 = # of users X_2 = # of computers	.78	−3.9	.012/.004	4.72/.44
Y = Human resources time (100 = one person) X_1 = # of users X_2 = # of computers	.60	36.6	.059/.008	2.05/1.00
Y = # of computers X_1 = # of users	.50	1.4	.006/.0006	

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TABLE 6

Mid − 1987 HP's HP Desk Network Costs

Cost Analysis by Users per Computer

# Users per Comp	Avg $ per User per Month
20 − 50	107
51 − 100	62
101 − 200	40
201 − 300	30
300+	22

TABLE 7

Mid – 1987 HP's HP Desk Network Costs

HP Desk Cost Analysis by Intensity of Use

Intensity of Use (Avg = 2.00)	Avg # Users per Comp	Avg $ per User per Month	Avg $ per User per Month/ Intensity
0.00 – 1.00	258	34	47
1.01 – 2.00	143	49	35
2.01 – 3.00	98	75	29
3.01 – 9.49	77	130	29

TABLE 9

Mid -- 1987 HP's HP Desk Network Costs
Comparison with Other Alternatives
($ Cost per Page per Recipient)

System	2 Pages	10 Pages	Delivery
HP Interoffice Mail	.10	.50	1–5 days US, 5–10 days Intl
US Postal Service	.44	.88	1–3 days US, 3–10 days Intl
HP's HP Desk Network	.58	2.90	1 hr urgent, 7 hrs normal
Comgrams	.76	3.80	1–3 days
Public E–Mail Net #1	1.60	4.80	Varies
Public E–Mail Net #2	2.00	6.00	Varies
FAX	3.20	9.68	Varies
Express Mail	10.00	10.00	Overnight

Note: Does not include costs associated with message preparation

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