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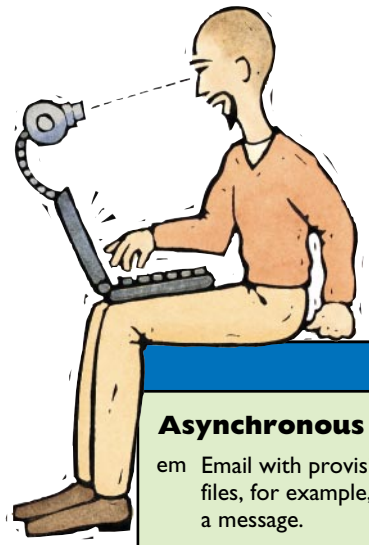
Low-Cost Estimation of Travel Trade-offs

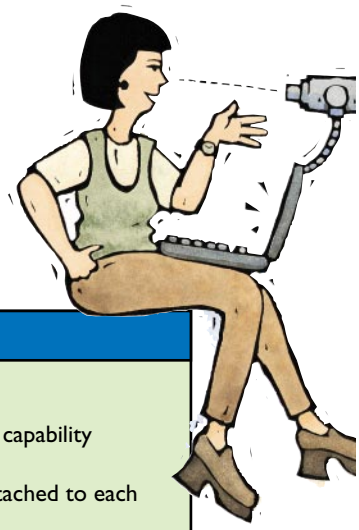
We have seen a dramatic reduction in the cost of communication during the last 20 years as the transmission capacity of fiber has increased ten-fold every four years since the mid-1970s [3]. Improved technology and the substitution of optical for electronic components, for example in optical amplification and optical frequency-division multiplexing, assure accelerating progress for many years.

There has also been accelerating investment in communication infrastructure. Between 1994 and 1995, the world added over 45 million new telephone lines, a 7% growth rate; telecommunication equipment trade rose by $10 billion (21%), and telecommunication service revenues rose by $90 billion (17.6%) [4]. Growth rates are highest in poor nations, though the absolute numbers are much smaller. Earlier in this century, we built roads; now we are building telecommunication links.

These infrastructure investments encourage investment in complementary information processing technology by businesses and other organizations, and there is some evidence this is resulting in increased productivity [1].

While communication cost is





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Communication Alternatives

Asynchronous

em Email with provision for text, and attaching data files, for example, a spreadsheet, as part of a message.

ev Email with the addition of voice messages (a combination of your email and voice mail systems).

de Email with the addition written and drawn material (like FAX).

ve Email with the addition of video messages and "documents".

ln Lotus Notes. A system of easy-to-use electronic discussions and databases on various topics.

Synchronous

tp Telephone with conference call capability

vp Video phone. A small-screen attached to each telephone.

cr Video conference room. Conference rooms at places of work and business centers where you can conduct a video meeting between any two points.

dc Desktop conference. Two or more computers can be linked for a conference. Windows on the screen can show the faces of the conferees, what they are writing, and the results of program execution (for example a spreadsheet).

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falling and infrastructure is expanding, transportation cost is rising. Increased competition and improved engineering have reduced some travel costs in recent years, but others have risen. In the long run, depletion of non-renewable fuels and political pressure to internalize environmental costs will result in higher cost of travel.

Economic theory and common sense tell us that if the relative costs of two supplementary factors of production change, there will be a marginal shift from utilization of one to the other. The extent of the shift will be determined by the relative cost changes and marginal productivity of the factors. This is the most conservative scenario. Some technical innovation, for example the deployment of clocks and watches, telegraphy, or electric light, has resulted in more dramatic, non-linear shifts. While I suspect that digital communication technology will in fact result in non-linear changes, this column is concerned only with a conservative, linear estimate of its effect.

Table 2. Expected Time and Direct Cost Savings as a Result of the Substitution of Communication for Travel

Title	Comm Alt	Time Saved (Hrs.)	Direct Cost
Director of marketing	cr	9.0	$670.00
VP/general council	cr	13.0	$1,619.00
Cost analyst (finance)	vp dc ln de	5.0 5.0 4.0 1.0	
Advertising and dealer association manager	cr vp	21.0 1.5	$2,050.00
Treasurer	cr dc vp	0.5 2.5 38.0	$150.00 $25.00 $3,060.00
District parts and service manager	cr dc ve vp tp	1.5 8.0 2.0 2.0 1.0	$100.00 $300.00 $100.00 $100.00 $100.00
Programmer/analyst	c em vp dc ln	4.5 0.3 0.1 0.1 2.2	$409.50 $15.00 $2.50 $1.25 $103.75
Senior human resources analyst	cr vp tp	1.5 1.5 1.5	$7.00 $7.00 $7.00
Tax administrator	ln	2.0	$40.00
Senior systems analyst	dc ve cr vp de ln em	8.5 3.0 3.5 2.0 0.5 11.0 1.0	$1,450.00 $290.00 $460.00 $210.00 $920.00 $100.00
Parts planning and price analysis manager	dc	48.0	$4,693.00
Totals		206.2	$16,990.00

Low-Cost Study

This study was designed to estimate the impact of the travel-transportation shift in a single organization using a very simple, low-cost methodology. The method was kept simple by design. While extensive studies may yield accurate and precise information, there is a place for simple studies. We have taken this minimalist approach to LAN [6] and expert system shell [7] benchmarking with some success. If the results of a simple study correlate well with a more complex study, the simpler study will be a more economical decision-making aid. (For a comparison of [6] with a more complex benchmark, see [2].) Even if the results do not correlate perfectly, the simple study may provide sufficient information for a decision that is satisfactory as opposed to optimal.

Table 3. Titles of Subjects Who Would not Have Substituted Communication for Travel

Senior technical communication administrator
President and CEO
Human resources manager
Employee relations and employment administrator
Warranty analyst
Operations support analyst (information systems)
Manager of distribution planning
Payroll specialist

Table 4. Portable Communication as a Percent of Desktop

Mode	Time Saved (Hrs.)	Direct Cost
Portable	17.5	$2,210.00
Overall	206.2	$16,990.00
Portable percent	8.5%	13.0%

Table 5. Estimated Savings by Type of Technology

Communication Technology	Time Saved (Hrs.)	Direct Cost
synchronous		
desktop video conferencing	72.1	$6,469.25
video conference room	54.5	$5,465.50
video phone	50.1	$3,370.00
conference calling	2.5	$107.00
total synchronous	179.2	$15,421.25
asynchronous		
Notes – like conferencing	19.2	$1,063.75
video email	5.0	$390.00
email + text/data files	1.3	$115.00
email + draw (like FAX)	1.5	
total asynchronous	27.0	$1,569.75
total	206.2	$16,990.00
percent synchronous	86.9%	90.8%

The study was conducted at the headquarters of the U.S. distributor for a major international corporation. There were 19 participants, including executives, managers, and operating personnel.

During a three-week period, they recorded information on their travel out of the headquarters building. The general methodology was to observe actual behavior, in the spirit of the pioneering work of Mintzberg [5]. Since Mintzberg was making fine-grained observations and shaping his study as he gathered observations, he used trained observers who "shadowed" the subjects. Shadowing was not needed in our case because we focused on only one aspect of behavior, travel, and trips were relatively infrequent and easily identified. The subjects recorded their trips in a fixed-format diary.

The subjects were given a list of hypothetical communication alternatives (see Table 1) and instructed in the nature of each of these using readings, video tapes of systems, and discussion. They were told to assume that they and everyone they worked with (internally or externally) had access to the alternative communication technologies, and that the technologies were secure and easy to use. For each trip they made, they were asked to decide if they could have avoided travel by using one of the communication alternatives. For each trip that could have been avoided using communication, they were asked:

- Which communication alternative they would have used
- Whether it would be used from their office or a wireless, portable computer
- The amount of their time it would save
- The amount of direct cost would it would save.

Results

Table 2 shows an estimated savings of 206 hours and $16,990 from this group during a three-week period. Eight subjects reported that all of their travel would be necessary regardless of available communication technology. This results in an estimated savings of 3.6 hours and $298 per person per week if we consider all 19 employees, and 6.2 hours and $515 if we consider only the 11 who would have substituted communication for transportation.

Table 3 lists the titles of people who made no trips that could have been substituted with communication during the three weeks. Some of these did not travel at all, and others, notably the president traveled, but believed the travel would have been necessary regardless of communication alternatives. Personality as well as position is a factor here.

Table 4 shows the communication modes that would be used by the subjects. The majority of the choices involve synchronous communications, but it should be

recalled that this study focuses on communication substituted for travel, and presumably asynchronous communication would be widely used in other cases. Table 5 shows that the majority of the time and cost savings would be from the desktop rather than using portable computers with wireless communication. This does not imply that wireless communication is unimportant to this company, just that most communication in substitution for travel would be done from the office, not from other remote locations.

Discussion

These results give us an estimate of the savings which could be expected if the means of communication listed in Table 1 were available. The technique is simple, and can be used for planning short- or long-term telecommunication investment. A dollar value could have been estimated for the time saved, but the subjects were reluctant to disclose their rates of pay. A more detailed analysis would consider the value of their time, including overhead and support. intra-site "travel," for example to other's offices or to conference rooms could also be observed, but this is so frequent that the measurement would be obtrusive, requiring costly shadowing or automated or semi-automated data collection.

Precision would be enhanced with a similar study running for a longer period with a wider sample of participants. However, the fact that the subjects were considering specific, real events in deciding what sort of communication, if any, could be substituted for travel, lends credibility to their reports. C

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