



Market Managed Internet in a Corporate Environment

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M3I assumes that internet technology is becoming the infrastructure of the future for any information that can be transmitted digitally, including voice, audio, video and data service of all kinds. This means that in the future shared resources like the internet can get congested with a need for an economically fair allocation method. M3I suggests using market forces for internet resource management. M3I stands for Market Managed Multiservice Internet. Members of the M3I project team are looking into the ability to change quality of service within seconds and to reduce bad congestion by communicating price changes in real-time to customers. Consumer research done at the research lab of BT and at the University of California at Berkeley show that consumers are interested in using variable pricing. Would using market mechanisms and variable pricing work in a corporate environment as well? That is the main question I am trying to answer in this report. A questionnaire with 71 questions about internet use, shared resources and market mechanisms has been sent out to employees of 3 big corporations. The results of 28 completed questionnaires are described in this report.

2. Introduction

2.1 M3I - Introduction

M3I, Market Managed Multiservice Internet, is a project under the European Union's Fifth Framework Programme. It is part of Key Action 4 "Essential Technologies and Infrastructures", Action Line 4.2.4 "Technologies for network management and service level interworking". The basic M3I contribution is the development of pricing mechanisms which will give the right incentives to customers for efficient use of network resources.

Rapid growth of the internet has resulted in increased need for bandwidth. In the future shared resources like the internet may need to be allocated in an economically fair way. The goal of M3I is to design, implement and trial a next generation system that will enable internet resource management through market forces, specifically by enabling differential charging for multiple levels of service. M3I is working on a system that enables differential pricing for multiple levels of service and (dynamic) usage based charging. The assumption is that offering this capability will increase the value of internet services to the customers through greater choice over price and quality and reduced congestion. For the network provider the advantages can be improving of flexibility, reducing management complexity and hence revenues might increase (<http://www.m3i.org>).

If the internet keeps on growing at the same pace as it has done in the past few years, new systems to allocate bandwidth should be in place. By the end of May 2001 the numbers of homes in the UK connected to the net is 10 million - up from 6 million a year earlier. The figures mean that every eight seconds one UK household gets connected to the internet for the first time (<http://news.bbc.co.uk>, July 2001). Applications are getting bigger, streaming media might be used more often and it is possible that people will use the internet for talking to people in the future (Voice over IP - VoIP). Streaming media and VoIP not only need a lot of bandwidth but the quality of the service is very important as well.

2.2 Multiservice internet

M3I suggests using market forces to allocate quality of service (QoS). At the moment most internet-users get best effort internet with no choice for different levels of QoS. Some ISPs differentiate themselves by offering more customised pricing plans for certain user groups by offering a selection of tiered services which differ in the maximum access bandwidth. A Dutch Internet Service Provider (ISP), Zekatel (<http://www.zekatel.nl>) offers its customers 6 options. All options have a different maximum for traffic generated by the user and the user can check traffic details and see whether he or she gets the right package on a Personal Information Page that is updated daily. DoCoMo in Japan charges customers a low monthly flat rate plus a usage-based fee depending on the number of bytes transferred for the new packet switched network service I-mode (DoCoMo report, 1999).

The demand for internet services, including various Quality of Service (QoS) levels can be managed through a pricing mechanism. Pricing can control congestion when prices go up when demand goes up. If the price is too high users will choose a lower QoS or wait until the prices go down when the network is less congested. When

demand is high, prices are being raised and hence deter the users with low valuation for the service to use it. This leaves the resource to be available for users that value it more and are willing to pay more. An inappropriate pricing system will convey the wrong incentives to the users and can lead to inefficiency, reduced profitability and might ultimately lead to congestion (Oliver et al., 2001).

M3I looks into the ability to change QoS within seconds and to reduce bad congestion by communicating price changes in real-time to customers with the ability for ISPs to charge differentially for applications requiring differing QoS levels. This way customers can flexibly access both high quality and low quality services depending on their particular application needs, instead of being limited to a single best effort service as in the current internet.

Different pricing structures can meet requirements of different user groups resulting in a higher overall value of the network. A small survey (see appendix A) showed that people don't mind paying a bit more for a good quality service but that most people, especially heavy users, prefer paying a flat rate. A flat rate gives users a predictable bill. Peter MacLellan of a Bristol based ISP said that it is simpler for an ISP to have a very simple structure and use averaging of large numbers of users. This requires less monitoring and accounting. It makes offers very easy for the customer to understand and fairly predictable in cost and performance.

2.3 Flat rate

The INDEX report (Altmann et al., 2000) shows that demand is very sensitive towards different pricing structures. In experiments conducted pricing is based either on time, volume, a combination of both or a flat rate buy out option. Subjects in the experiments understood and exploited the flexibility of advanced pricing schemes for their own advantage. The demand for network services was flexible over time. In per-minute pricing experiments the subjects reduced the time they were connected to the internet. While most subjects had a preference for flat rate pricing a vast majority also appreciated and made use of tariff options that permit quick reactions to changing demand. INDEX subjects appreciated the flexibility of requesting higher service quality on demand, even if they had to pay a per-minute rate for the service.

According to an Ofcom survey (<http://news.bbc.co.uk>, 2001) customers with unmetered (flat rate) packages spent about twice as long online as those on usage-based packages. The number of homes plumping for fully unmetered products increased to 24% in May 2001, compared with 18% in February 2001.

The INDEX findings are that subjects transmit a significantly greater number of bytes under flat rate pricing plans compared with usage based plans. The high levels of usage under flat rate pricing plans have the potential to reduce the overall network performance under broadband access technologies. Under a flat rate pricing scheme light users effectively subsidise heavy users. The majority of internet users should benefit from usage-based pricing. Time-based pricing reduces the number of bytes generated by high-volume users, which demonstrates the disciplining effects of usage-based pricing. The consumption of the heaviest users is forced down, leading to a more balanced overall distribution (Altmann et al., 2000).

2.4 Variable pricing

Variable pricing is being used in many areas like air travel, holidays, car rental etc. Customers are used to paying a higher price when flying on peak times and when booking holidays in the summer season. The easyGroup (www.easygroup.co.uk) has set up a chain of internet cafes, easyInternetCafe (formerly known as easyEverything), where variable pricing is used. The price in the easyEverything stores fluctuates depending how busy the store is. Customers purchase Internet Access Credit at the counter. A video monitor at the front of the store (which is updated every five minutes) gives an indication of how many minutes of Internet access the credit currently buys the customer, and a banner along the bottom of the screen will show the actual in-store price and how much credit the customer has remaining on their ticket. Customers buy a fixed amount of credit to access the Internet, and not a fixed amount of time. How long the credit lasts depends on whether the customers surfs at peak or off-peak times. Depending on how busy it is in the store customers can get up to 6 hours of internet access for one pound during quiet hours while during peak hours the customer might only get 15 minutes access for one pound.

Research shows that not all customers are aware of the variable pricing in the easyInternetCafes (Gale et al., 2001). Customers who are aware of the variable pricing don't all take advantage of it. In Amsterdam customers can go online at night for a fixed price of $f2,50$ (approx 80 pence) for 150 minutes while during the day it is possible that you have to pay up to $f2,50$ for 28 minutes. Most customers come to the stores at a time convenient for them. They are either passing by or they come before or after work. According to the subjects prices in the easyInternetCafe don't vary enough during the day to change their behaviour. Most of them say the internet access in the stores is very cheap at all times, even during peak times, so there is no need to come at a less convenient time for better value. Some subjects living on a low budget do come early in the morning or late at night and they only come during the day if they have an urgent email to send or when they are waiting for an important email. The subjects think it is good to have the option to come at different times for different prices but for most of them convenience is more important than price, especially when the overall price is very low and the price differences during the day are not very big.

2.5 User Direct

During the INDEX experiments subjects could change the bandwidth selection instantaneously, even during an active section. This corresponds with the 'User Direct' system developed in the research laboratory of Hewlett-Packard (HPLabs). Much work is done on providing different classes of service according to the different needs of different applications. The HPLabs approach is to give the end user control over quality of service and price, according to his utility for the services. In the User Direct scenario prices are thought as semi-static.

In the basic User Direct scheme the user is offered a list of priority levels at which to send his traffic. Traffic sent at a higher level will be sent at a higher priority and at a higher price. The absolute quality of service of each priority level is not guaranteed, but will depend on the current network state. The differences in QoS are relative, may change in real-time and, on that basis, the user may choose to move up or down the levels accordingly, trading relative quality of service for price of service usage.

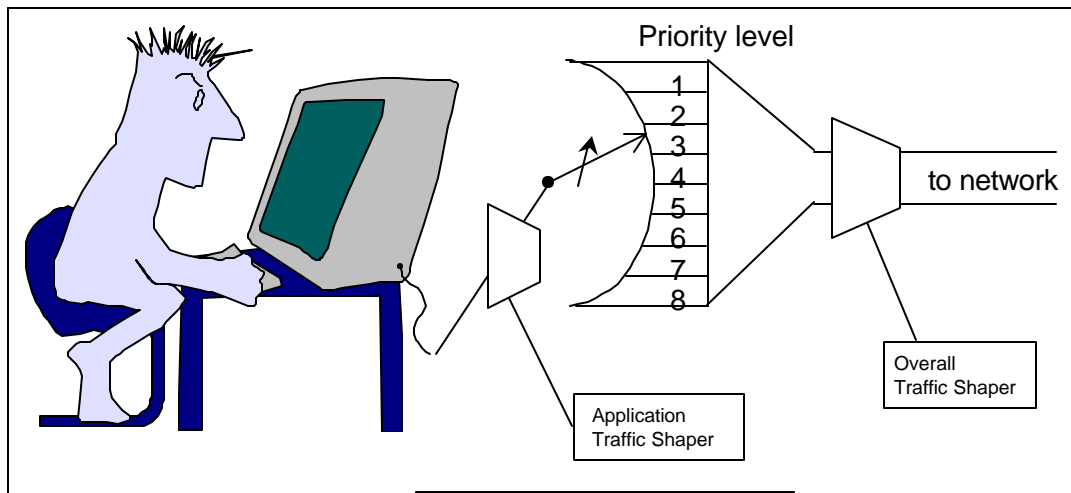


Figure 2.1: Priority Level Selection

The pricing plan is straightforward. Each priority level is priced at a different rate. The prices are strictly increasing with regard to the priority. The usage of the different priority levels will be metered. This could be as the number of bytes transmitted, the number of packets transmitted, or the amount of time connected to the network. The basic choice will be between moving to a better QoS priority level or to a cheaper level. This choice is made on the basis of utility of a session or to the nature of the application. A question is how to give feedback to users so they can predict the network performance because QoS can't be guaranteed since the network performance can change every second. The user will rationally maximise his utility minus the price to be paid for the service. Users in corporate organisations can exercise similar choices but constrained by the policy of the party that is paying.

2.6 Game theory

There is a similarity between resource allocation in network environments and the market mechanisms in economic theory. M3I has been looking into game theory as a model for a next generation system that will enable internet resource management through market forces. The network is the game board and the users are the players; when one player makes a move the other players might have to react and make a counter move. The increase of one player's utility will decrease that of the other.

The level of satisfaction of the user expressed in money is called the utility function.

The utility function depends on 4 factors

1. User skills (to classify/predict the network performance from feedback)
2. Service profile (application needs)
3. Price scheme (pricing structure given by ISP)
4. User objective (goal of user)

The user wants the highest utility for the lowest cost. As lower priorities become congested there will be an incentive to move up priorities. Different qualities of service must be priced differently otherwise users will always use the best one. Selection among alternative behaviours depends for a large degree on what others are doing. Tools of game theory lead to strategies in which optimal behaviour emerges naturally from the selfish interests of the users and the rules of the game (MacKenzie,

2001). Peter Marbach of the University of Toronto says that users in general don't take into account how they change the performance of the network because they either don't care or they don't get enough information. Non-co-operative game theory provides a useful framework for the synthesis and evaluation of network control schemes. While game theoretic concepts are useful in framing the problem and characterizing the solution(s), there remains the issue of implementing adaptive algorithms which seek these solutions on-line in the face of changing traffic and network conditions. (Mason, 1999)

Users prefer constant quality to variable quality. There seems to be a conflict between the network's ideal requirement to use dynamic charging and the user's desire for a stable service with stable pricing (Songhurst, 2001). Results of M3I User Experiment 1 at the research laboratory of British Telecom (Hands et al., 2001) found that quality evaluations were not affected by price band. Price did however influence subjective opinions of acceptability with high price subjects being less tolerant of changes in quality compared to low price band subjects. The level of quality required is heavily task-dependent and subjects think that variable quality is worse than constant quality. They even prefer a fixed to a variable rate when overall quality is worse. Interviews associated with the experiment found that subjects were interested in the concept of variable pricing and would be especially prepared to use it for highly valued services.

2.7 Variable pricing in a corporate environment

The User Experiments for M3I at the research laboratory of British Telecom (BT) show that consumers are interested in using variable pricing. What happens when variable pricing and multiple levels of QoS are being used in a corporate environment? Corporate users don't spend their own money and there is usually a tighter time frame than people using the internet for leisure purposes.

Employees of HPLabs in Bristol are very positive about the ability to choose between a low quality and high quality service depending on application need and network congestion. Respondents of a small survey (see Appendix B) think current internet transmission is not very good because of insufficient network resources and even though they think things will turn for the better in times to come, they are not very positive about the sufficiency of network resources in the future either. The results also show that the respondents agree that people who need resources most for their work and people who value them most should get better quality. They are a bit more reluctant towards giving better quality to people who are willing to pay most (De Bruine, 2001).

One budget holder in HPLabs says that he wants bills to be predictable, so he prefers a flat rate. Variable pricing might work; he can see the benefit of the ability to choose low and high quality of service but there needs to be some kind of system in place to control the costs of the network. A possibility is to give employees a certain number of tokens per month to buy higher priorities depending on their job description and tasks. He does think that his employees will behave responsibly when they can control quality and price for their network access.

Another person says that monitoring is important because not everybody thinks employees will be using variable pricing in a responsible way. There seems to be a tendency towards the thought that employees don't care about spending company's

money, so employees would always choose the highest priority. So monitoring usage and reviewing bills will be necessary if the company doesn't trust its employees. Monitoring all usage and reviewing bills will be a big extra workload for the budget holder.

If employees don't care about spending company's money, it will be hard to come up with the right incentives needed to change the behaviour of employees when the network is congested. We interviewed a couple of HPLabs employees who work from home quite a lot. HP pays for the internet connection after the employees receive the bill at their home address. The 2 employees we talked to said that they do care about the company's budget. They feel privileged that they can work from home and don't want to get in trouble by being online too long and spending a lot of money that way. They enjoy working from home so much that that is an incentive to keep the costs for the company as low as possible. They don't stay online longer than necessary.

Users usually want to access a shared resource like the network as soon as possible (now!). If users don't care about the budget, if they are selfish and don't get any feedback about how their behaviour effects the performance of the network, it will be difficult to set up an appropriate system. In work employees have a time frame and they should be able to do their work properly without having to wait because of congestion. Especially when the media is time based like VoIP it is not always possible to wait until the network is less congested.

So can pricing control congestion in a corporate environment where employees are not aware of the cost of their internet connection and when they are not spending their own money? Do market mechanisms work in a corporate environment? We have set up a survey trying to answer these questions.

Subjects were asked to make a tick mark on the line between "Not at all" and "Yes, definitely", indicating their grade of agreement with the statement. The line was 100 mm long and we measured each response in millimeters. In the www-questionnaire 26 radio buttons numbered from 0 to 25 represented this graphical rating scale. These results have been multiplied by 4 to make the scores comparable to the scores on the paper version of the graphical rating scale.

All results have been coded so they could be analysed in SPSS (Statistical Package for the Social Sciences). Code 999 has been used for missing values. Values were set at 0 where answers were not checked for questions where more than one answer was possible.

1.02 What devices do you use for work?

More than one answer possible

- Desktop PC
- Home PC
- Laptop/Notebook
- Laptop/Notebook with Wireless Internet Card (WLAN)
- Palm device/Handheld computer
- Electronic organiser
- Pager
- Mobile phone
- WAP phone
- Handheld calculator
- Other,

Quantitative analysis using SPSS was carried out on the questionnaires e.g. means, histograms, as well as correlations to assess relationships between data. Skewness refers to the symmetry or asymmetry of the frequency distribution. Kurtosis refers to the flatness or peakedness of one distribution in relation to another. Median is the score of the respondent in the middle while mode is the score which appears most.

4 Results

This chapter describes the results of the survey into multiservice internet and variable pricing in a corporate environment.

4.1 Profile and Work

Twenty-four (24) respondents completed the electronic version of the questionnaire online and 4 respondents completed a paper version. Half of the respondents (14) are managers; 3 departmental managers, 3 project managers, 6 line managers and 2 respondents filled in 'other'. Six (6) of the managers have 1 to 5 people reporting to them, 4 have in between 5 and 20 people reporting to them and 3 managers have 20 – 35 people reporting to them. All managers but 1 are budget holders.

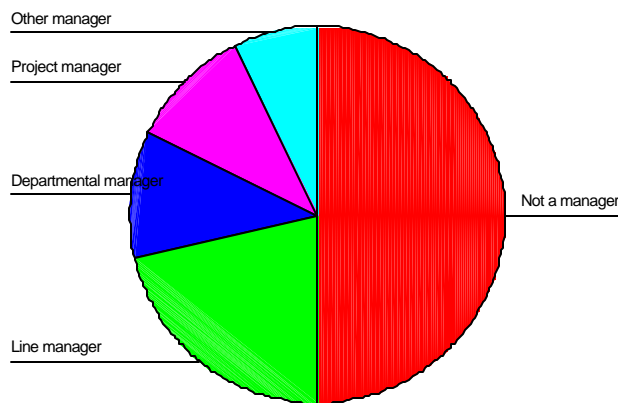


Figure 4.1, Managers

The respondents work in work groups of variable sizes. Nine (9) respondents have 10 or less people in their work group, 5 respondents work in a group of between 10 and 35 people and 4 work in a group bigger than 35 people. Ten (10) respondents didn't fill in this question. Half of all respondents (14) have colleagues working abroad.

Most respondents work from home sometimes, only 1 respondent never works from home at all. In most cases the company pays for the Internet connection at home or at least part of it. Six (6) respondents have a fast connection paid for by the company, for another 6 respondents the company pays the telephone bill and 3 respondents pay the bills themselves.

The respondents are away from their desk but in the building for 42% of the time. Nineteen percent (19%) of the time they spend out of the building but in the complex/on the campus. Almost 18% of the time is spend in the metropolitan area, 24% out of the metropolitan area but in the country and 22% of the time is spend abroad.

When travelling the respondents use the telephone most to communicate with their work group. Email and voicemail are used a lot as well for communicating when travelling. When the respondents are working at their desk they use email more than face-to-face communication and the telephone is used a lot as well. Even though

email scored higher than face-to-face communication, more respondents (15) respondents prefer face-to-face over email (8 respondents).

The respondents who replied say that they spend more than half of their time at work on the Internet. The mean is 57.7 and the median is 68. Twenty-five percent (25%) of the data is under 31 and another 25% has a score of 84 or higher. Emails with or without attachments are used most on the Internet and browsing the World Wide Web happens quite a lot as well.

Table 4.1, Internet Use

Internet use	Email without attachments	Email with attachments	Browsing/World Wide Web	FTP for up/downloading files	Streaming media (Audio/video)	Other
Total score	29	51	62	68	64	4
/resp	1.318	1.962	2.214	4	4	4
#1-answer	15	8	5	0	0	0

Out of 17 respondents 8 don't use a laptop with wireless LAN (WLAN), while the other 9 respondents who answered this question use a laptop with WLAN 70% of the time. Twenty-five (25) respondents say they would like to use a laptop with WLAN for 60% of the time. The study into WLAN use within HPLabs of Beech & Geelhoed (2001) shows that WLAN users are split into 2 groups; those who use the WLAN all the time and those who use the WLAN only occasionally. More than half of the participants in the study of Beech & Geelhoed use the WLAN for more than 70% of the time while 25% uses the WLAN less than 30% of the time.

4.2 Shared Resources

Shared resources within the company mentioned by the respondents of this survey are meeting rooms, the network, telephones, printers, carpool cars and (lab) space. The demand for meeting rooms, the network and network storage is too high at some times.

Table 4.2, Resources

Shared Resources	Demand Too High	Scarce Resources
26 resp Meeting rooms	12 resp Meeting rooms	4 resp Money
21 resp Network	8 resp Network	3 resp Manpower
5 resp Telephones	2 resp Network storage	3 resp Space
4 resp Printers		2 resp Bandwidth
4 resp Carpool cars		3 resp Other
3 resp (Lab) Space		

According to the respondents most resources are evenly distributed over employees and/or work groups. Five (5) respondents say that an employee can ask for more/less use of a particular resource and 3 respondents say it depends on the task of the employee. Three (3) respondents don't know how resources are allocated and 7 respondents didn't answer the question (see figure 4.4). Three (3) respondents say that employees with higher position in company get higher priority for some resource use while almost half (13) of the respondents say that all resources are distributed evenly.

Money, manpower, space and bandwidth are mentioned as scarce resources, which can be so scarce that it can be a problem. Respondents who mention bandwidth as a scarce resource are more willing to pay extra for a faster internet connection.

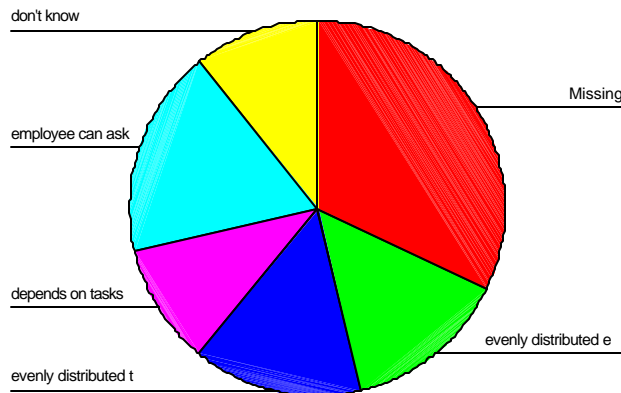


Figure 4.2 Allocation of Resources

Managers are mainly the people with control over the employees spending but employees have some control themselves as well. Twenty-one (21) respondents say their manager have control over their spending, 13 say they have control over their own spending and 6 respondents say the manager as well as the individual have control over spending. Most respondents (23) have to ask permission from their manager before buying a new piece of hardware. More than a quarter (8) of the respondents say that all spending has to be approved in advance while another 8 respondents say that spending is monitored and reviewed afterwards. Three (3) respondents say there is a written policy for spending and 5 respondents don't know how the spending of the company's money is managed. Spending money sometimes has an influence on the work group because there will be less money to spend for the others in the group.

Twenty-five (25) of the 28 respondents say that they have trouble sending information via the internet because the network is congested in approximately one-third of the time (see figure 4.3a). If there would be a possibility to pay more for higher internet speed, the respondents say they would use this possibility approximately 42% of the time (see figure 4.3b). There is a significant correlation between these data. Respondents who say that they have trouble sending information because of a congested network are willing to pay extra for a faster connection. Another survey into market mechanisms in corporate environments (De Bruine, 2001) shows that HP employees would like the ability to access both high quality and low quality services depending on application needs and network congestion. They think it would be good to give the best quality to users who need network resources most for their work but they are less enthusiastic about distributing available network resources in such a way that the users who are willing to pay the most should get the best quality.

Deadlines are quite important in the work the respondents do with a mean of nearly 70 and in 44% of the time the respondents make urgent phone calls that can't wait. There is a significant correlation between having to make urgent phone calls and the willingness to pay extra for a better signal. Only 2 respondents say that for post everything gets sent standard 1st class while 8 respondents say that the post room sorts this out and 9 respondents choose a class/priority per item.

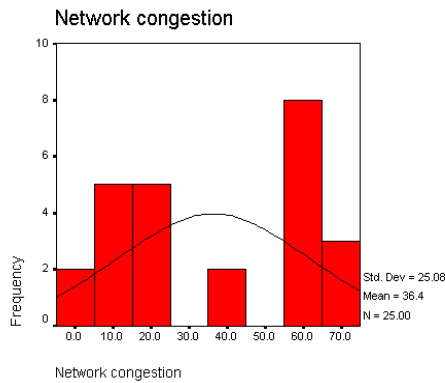


Figure 4.3a

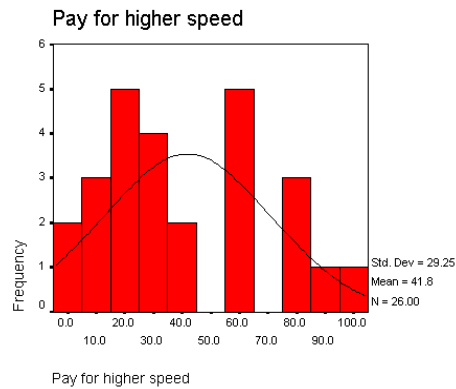


Figure 4.3b

4.3a - Network congestion (Have you ever wanted to send something via the internet but it couldn't get through because the network was congested?): The histogram is slightly skewed towards the lower end of the scale with a mean of 36.36, the median is 36 and it is platykurtic. Twenty-five percent (25%) of the respondents have a score lower than 9.5 and another 25% have a score higher than 59.

4.3b - Pay for higher speed (Say you can choose different speeds for the internet. You have to pay a pound for a higher speed; the normal speed is for free. How often would you go for a higher speed?). The mean of the data is 41.81, the median is 30.50 and the mode is 64. This histogram is also slightly skewed towards the lower end and is platykurtic but less flat than figure 4.3a. A quarter of the respondents score lower than 16 and another quarter score higher than 64.

4.3 Market Mechanisms

Most of the respondents (19) say they sometimes choose to fly on a Sunday if they can get a cheaper ticket by flying out a day early. Five (5) say they would never do that. When flying, 2 out of 23 respondents fly coach/tourist class, a majority of 19 respondents flies mostly business class and 2 respondents fly mostly first class. When buying tickets half of the respondents (9 out of 18) buy a flexible full refundable/changeable ticket and a quarter of the respondents (7) don't know what kind of tickets they have when travelling.

The preferred payment method for internet at work is a flat rate (7 respondents) with a flexible rate (standard low rate but pay extra when you need a better quality of service) as second choice (5 respondents). Four (4) respondents don't know what they prefer (see figure 4.4). At home 6 respondents prefer a flat rate and 5 prefer a flexible rate. Four (4) respondents say they like to pay per minute (pay for the time you are using the internet). Three (3) respondents think it is a good idea to have an option to pay extra

for a faster internet connection at work, 10 respondents don't think that is a good idea and a quarter (7) of the respondents don't know if that is a good idea or not.

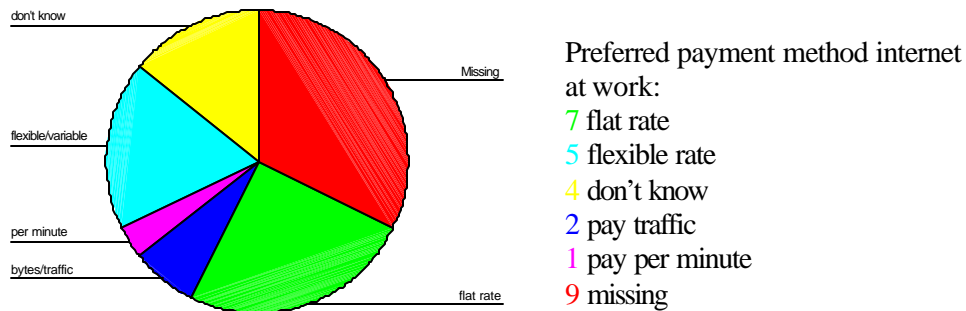


Figure 4.4a, Internet Payment at Work

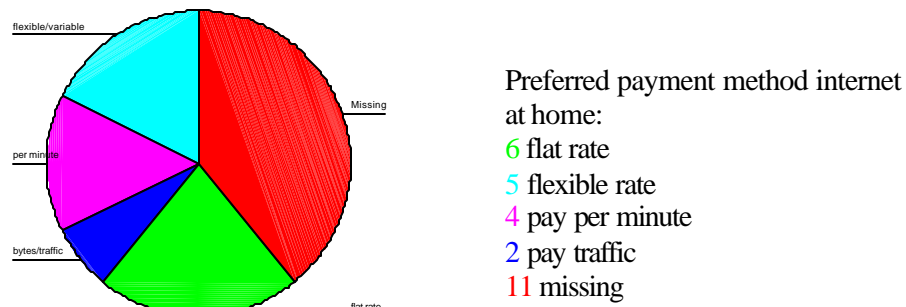


Figure 4.4b, Internet Payment at Home

Twenty-seven (27) respondents replied to the question: Do you think variable pricing would work in a corporate environment? There are no scores over 80 and the mean is 34, so the respondents are not very positive about variable pricing in a corporate environment.

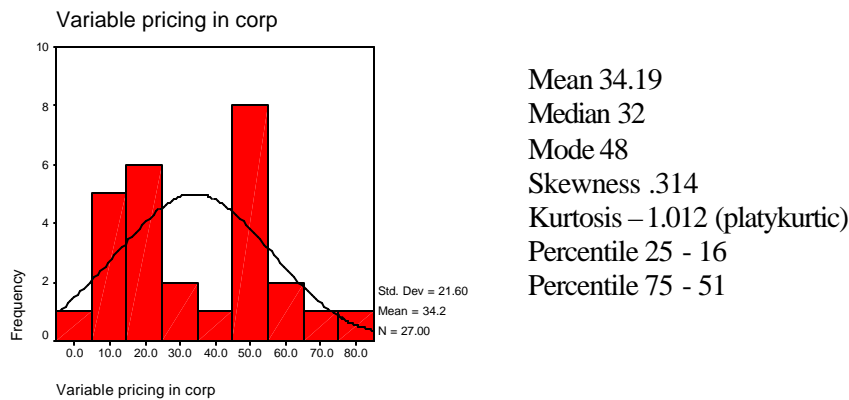


Figure 4.5

In general the respondents are quite willing (mean of 58) to pay extra for better service but the respondents are less enthusiastic about paying extra for a better mobile phone signal. There is a correlation between these results, respondents who are willing to pay more for a better service are also more likely to pay extra for a better mobile phone signal. When away for work, about half of the respondents wait until off-peak time on their mobile phone to make a phone call. Less than a third of the respondents like to pay for certain TV channels and the results for paying extra for a rush hour lane are quite spread out with a mean of 45.6 Different quality paper and print for different jobs is not used a lot. Respondents who use different quality paper for different jobs also use different quality of print.

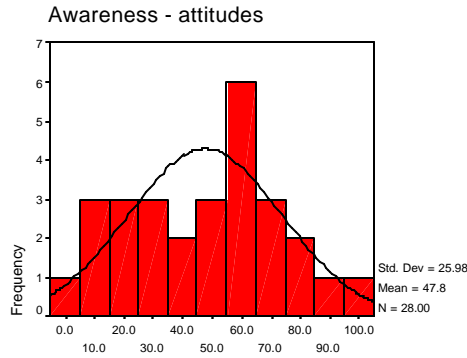
4.4 Market Mechanisms in Corporate Environment

Most respondents (15) say that there are no individual budgets within the company, while 9 respondents answered that some people have individual budgets. Everybody agrees that spending gets monitored within the company but 4 respondents answered 'don't know' and 10 respondents didn't answer the question. There is a significant difference between the answers given by managers and by non-managers. Seven (7) managers say that all spending has to be approved in advance by the budget holder and 5 say that the company trusts their employees and use self-control. Respondents who are not managers don't know how spending of company's money is managed.

The manager decides whether something is an urgent matter or not according to 10 respondents. Four (4) respondents say that they decide for themselves and 3 respondents say the team/work group decides what is urgent.

Nine (9) of the respondents have a mobile phone for work of which the company pays the bills for 7 of the respondents. Nobody pays the bills for a work mobile phone themselves.

One (1) respondent says there is a fining scheme for abusing shared resources, 17 respondents say there is no fining scheme and 10 respondents don't know if there is one or not. Only 1 respondent knows the cost of his/her internet connection at work, with a majority of 23 respondents who don't know. Eight (8) respondents are aware of overhead costs per employee in the company, 13 respondents don't know the costs of overheads. A quarter thinks that employees are aware of overhead costs and with a mean of almost 48 thinking that people's attitudes will change when they are aware of the costs.

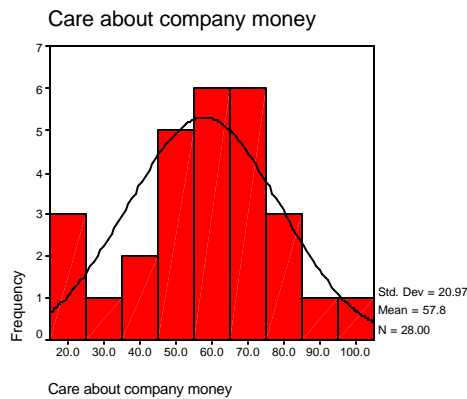


Mean 45.75
 Median 52
 Mode 60
 Skewness .30
 Kurtosis -.796
 Percentile 25: 25
 Percentile 75: 67

Awareness - attitudes
 Figure 4.6, Awareness will Change Attitudes

Not all respondents think it's necessary to monitor all spending with a mean of 45.6. The respondents are also not that bothered about colleagues accessing non-work related web sites during work (mean = 26.7). With no score lower than 20 and a mean of 58.8 the respondents think that employees care about spending the company's money. The results whether they care about spending the company's money are much higher with no score below 40 and a mean of 76.9. When asked whether they want their colleagues to be careful with spending company's money the mean is 73.9. There is a positive significant correlation between these results. Respondents who care about spending the company's money think their colleagues care about it as well and they do want their colleagues to be careful with spending the company's money. The respondents who say that they want colleagues to be careful are more bothered about colleagues surfing the web for non-work related sites. There is no significant difference between managers and non-managers on whether the employees care or in thinking whether their colleagues care about spending the company's money.

Do you think employees care about spending the company's money?



Mean 57.79
 Median 60.5
 Mode 48
 Skewness -.358
 Kurtosis -.162 (mesokurtic)
 Percentile 25: 48
 Percentile 75: 72

Figure 4.7a

Mean 76.93
 Median 80
 Mode 60
 Skewness -.687
 Kurtosis .813 (mesokurtic)
 Percentile 25: 64
 Percentile 75: 85.75

Do you care about spending the company's money?

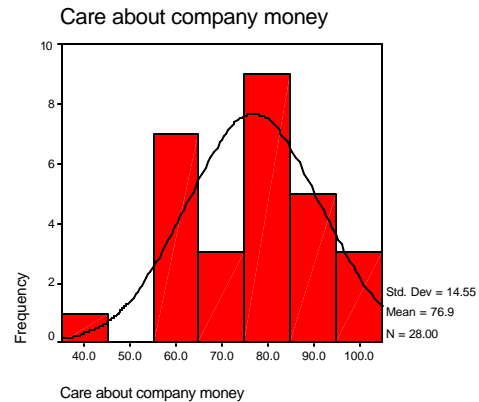


Figure 4.7b

Do you want your colleagues to be careful with spending company's money?

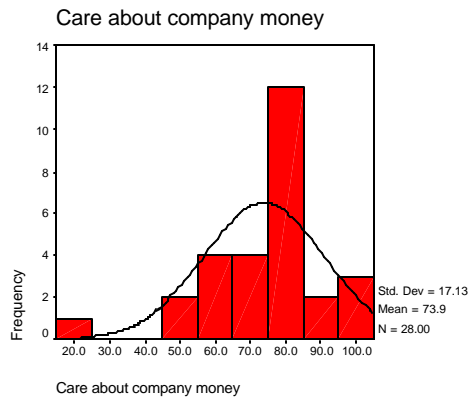


Figure 4.7c

Mean 73.86
 Median 76
 Mode 76
 Skewness -1.333
 Kurtosis 3.813
 Percentile 25: 65
 Percentile 75: 83.75

4.5 Scenarios

When respondents need to send a big file to a colleague in the USA on Friday afternoon and the network is really slow, 12 respondents say they would wait until the file has been sent via the slow connection, even if this means working overtime on a Friday afternoon while 6 respondents would like to pay extra for better quality of service so the file arrives within a few minutes.

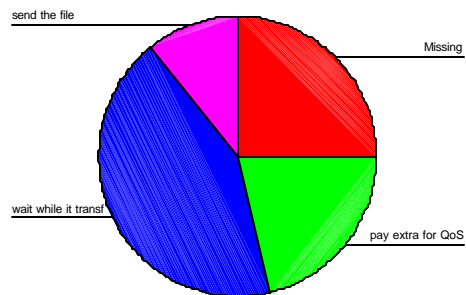


Figure 4.8a

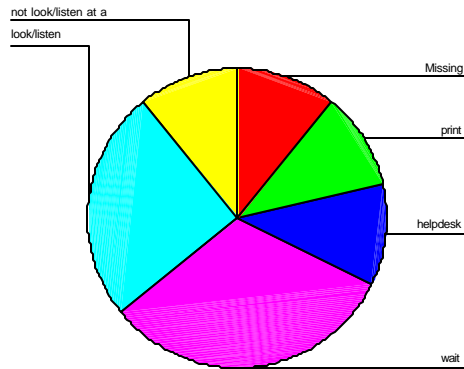


Figure 4.8b

When watching a video presentation of an important message from their CEO on their computer when streaming isn't very smooth because there is a delay, 9 respondents would wait until the network is less congested and try again later and 7 would look and listen to it there and then, even when the quality is bad.

The respondents mentioned earlier that meeting rooms are scarce resources. When all rooms are booked 10 respondents say they don't care, and that they would walk around and look for an empty meeting room while 8 respondents like to have a charging in place so people are more careful booking meeting rooms.

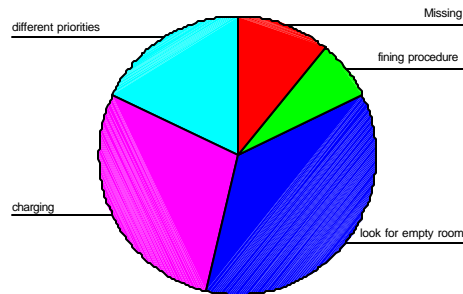


Figure 4.8c

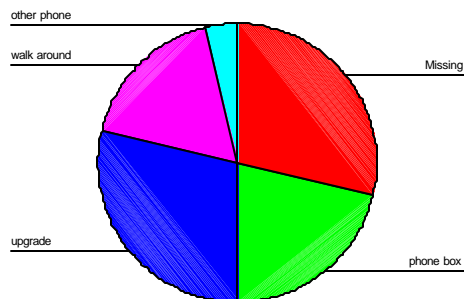


Figure 4.8d

Eight (8) respondents like to have the opportunity to upgrade their phone to a higher quality service so they can make the phone call there and then when there is a bad signal at a conference in the countryside. Six (6) say they will wait until they can leave the conference room and walk to a phone box/hotel lobby.

5 Summary and conclusions

M3I is working on a system that enables differential pricing for multiple levels of service and (dynamic) usage based charging. A survey has been set up to find out about attitudes towards this in a corporate environment.

People in this survey use the internet for more than 50% of the time for their work. They mainly use email with or without attachments and they surf the world wide web. Even when working at their desk, email is used more to communicate with colleagues than face-to-face contact. Telephone is used a great deal as well, which might be interesting if more people are going to use the network for Voice over IP in the future. Streaming media is hardly used at all at the moment.

A questionnaire with 71 questions was designed and sent out to managers and other employees of big corporations like Hewlett-Packard, British Telecom and Orange. The questionnaire was very long and the data can be compared to results gathered in interviews. Twenty-eight (28) people returned a completed questionnaire. Five clear issues have been raised in the survey.

- Positive attitude towards different levels of service and upgrading to higher priorities

People are positive about different levels of service in a corporate environment, which corresponds with the results of a small survey done earlier this year at HPLabs (De Bruine, 2001). Especially people who sometimes have trouble sending material via the network would like to see a possibility to pay extra for a faster connection. There seems to be a positive tendency towards upgrading the QoS for mobile phones as well.

People who often have to make urgent phone calls are more likely to upgrade their mobile phone to get a better signal. People who want to pay for a better signal also wouldn't mind paying more for a better service in general. However, when sending big files they don't mind waiting until it gets through instead of upgrading to a higher priority which might speed up the sending process.

Meeting rooms and the network are named as shared resources for which the demand is too high sometimes. Some people would like to see a charging system in place for booking meeting rooms but most of them don't mind walking around trying to find an empty room. The network is a scarce resource and some people say that it happens sometimes that they can't send something via the internet because it's too congested. These people wouldn't mind paying a pound to get extra speed.

- Most employees are ignorant about costs and budgets

Most people are not aware of the costs for overheads and for internet connections in work. Half of the respondents think that awareness of costs will change attitudes. Good feedback about costs will improve awareness and is important when implementing a variable pricing scheme.

We can conclude that most people care about spending the company's money. People who care think their colleagues care as well, and they want their colleagues to care about spending the company's money.

People in work have deadlines and sometimes have tight time frames. Sometimes it might be necessary to upgrade to a higher priority, especially when the network is severely congested. Caring about spending the company's money doesn't necessarily mean that employees won't use higher priorities which cost money. People have different priorities and people value their work differently, so a good clear policy about priorities should be in place.

Since people seem to be ignorant regarding policies and budgets within their company, managers should be aware of the policies and communicate them clearly to their employees. Managers can work on the awareness of policies and budgets. For a multiservice system it is important that costs are communicated clearly to the users.

- People prefer predictable bills over variable bills

The preferred method for paying for an internet connection both at work and at home is a flat rate with a flexible rate as second choice. At home people don't mind paying internet access on a per-minute basis, but a flat rate gives a predictable bill which is preferred both at home as in a corporate environment.

In most cases managers are budget holders and they don't want to get variable bills because it will be hard to allocate budgets when you can't calculate the cost for network use in advance. Either a clear policy with guidelines or some kind of pre-paid system (like tokens) can help keeping bills predictable. One should take care that the implementation of a multiservice internet doesn't mean extra workload for budget holders when they have to monitor the use of different priorities and review all costs involved.

- Managers and budget holders are the key people to talk to about policies and budgets for multiservice internet

All spending is being monitored and budgets are mainly under the control of managers. For most purchases employees have to ask permission from their manager. Since managers are in charge of budgets and spending in most cases, they are the people to talk to when a company wants to implement market mechanisms in their organisation.

Using variable pricing for internet access in work can mean a big cultural change and new policies should be in place. In most company's employees are not used to think about costs every time they use the network. It is important to get the management of a company behind the new pricing scheme and make sure that they will communicate the policies about using different priorities clearly to their employees.

- Attitudes towards variable pricing in a corporate environment are not positive. Even though the preferred payment method for the internet is a flat rate, the people are quite positive about upgrading mobile telephones and paying extra when the network is congested. However, in general the people are not positive about market mechanisms in the work place.

Implementing market mechanisms in a corporate environment means a culture change and shouldn't be thought of lightly. Good feedback about the costs, company policies and a solution to keep bills as predictable as possible should be in place and the whole procedure of choosing different priorities should be clear to all employees within the company.

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Appendix A

I asked a few friends and colleagues two questions and asked them to get back to me with a short answer. All people I sent the email to are heavy Internet users and some of them have cable /ADSL installed at home. Some of them have their own business.

Questions: Q (1) - Are you willing to pay more money for your internet connection if it would improve the quality? (Quality being speed but also quality of streaming media like music and the frame rate of streaming video)

Q (2) - Do you rather pay a flat rate or do you rather pay for what you get or what you need at a particular moment (so pay a bit extra if you want to send a big file or if you want to watch a film)?

Abstract of results: Most subjects would want to pay more for a faster internet connection or people are paying more already because they recently switched to cable (Blueyonder.co.uk). Most subjects prefer a flat rate fee. A few people who are not very heavy users prefer a usage-based charge and two heavy users would like a flat-fee and pay extra when they need it.

Results

Q1	Q2
Bit more	Flat rate
More	Pay as you go (or if no internet at work > flat rate)
More	Option to change QoS depending to suit what I'm doing
Bit extra	Flat rate
More	Flat rate
More	Flat rate
More (and more if ISP wouldn't break down so often)	Flat rate
More	Flat rate + extras
Not necessarily (Over time, I actually expect to pay less for better quality)	Flat rate (heavy user)
A bit more	Flat rate
Pay	Flat rate
Pay for ADSL	Bandwidth shouldn't be an issue. So I think charging extra for things like 'pay per use' internet is a bad idea
Pay more money if otherwise the connection was so dodgy that I couldn't comfortably use it. I'd be willing to pay more if it halved the download time. But if the difference in quality was small I'd probably go for the cheap option	If pay-per-use looked a lot cheaper for my usage patterns I'd go for pay-per-use. Otherwise, flat rate, even if at an estimate pay-per-use would be a little (but only a little) cheaper, because it's comforting to know in advance how big my bills are going to be
More	Flat rate
More	Flat rate
More	Flat fee
More	Pay as you go (not a heavy user)
More	Flat fee (heavy user)
More	Flat fee (started watching gigs online since 24hr access)
More	Flat fee

Appendix C

Questionnaire Corporate Survey

Thank you very much for participating in this survey. All information given in this survey will be used for research purposes only and you will remain anonymous.

If you have any questions about the procedure or about the questions in this questionnaire, please call Annelies de Bruine at Hewlett-Packard's Research Lab on 0117.3128581.

Please read all the questions and fill in the questionnaire as honestly as possible. It will take approximately 20 minutes to fill in the questionnaire.

M3I - Market Managed Multiservice Internet (www.m3i.org)

M3I is a project under the European Union's Fifth Framework Programme. The goal of M3I is to design, implement and trial a next generation system that will enable Internet resource management through market forces (*high demand and/or request for higher quality of service – higher price, low demand/low quality of service – lower price*), specifically by enabling differential charging for multiple levels of service. Offering this capability will increase the value of Internet services to the customers through greater choice over price and quality and reduced congestion. For the network provider, flexibility will be improved, management complexity reduced and hence revenues will increase.

Research question: *M3I is looking into distributing limited shared resources through market mechanism; differential charging for multiple levels of service. The question is whether market mechanism would work in a corporate environment to share limited resources.*

The questionnaire has 5 different sections. In the first section we are asking you to answer questions about your work and your position within the company. The second part is about shared resources. In the third section we are asking about market mechanisms and the fourth part is about market mechanisms in a corporate environment. We give you a few scenarios in the final part and ask you to give a response that is most suitable.

1. Profile

This section is about your work, devices you use in your work and your interaction with colleagues.

1.01 What is your job title?

Please tick the most appropriate box - ? -

1.02 Do you have a management function?

- ? Yes
- ? No

If yes, are you a [More than one answer possible](#)

- line manager
- departmental manager
- project manager
- other,

1.03 How many people report to you?

- ? Nobody
- ? 1-5 employees
- ? 5-10 employees
- ? 10-20 employees
- ? 20-35 employees
- ? 35-50 employees
- ? 50+ employees

1.04 Are you a budget holder?

More than one answer possible

- No
- Yes, company budget
- Yes, departmental budget
- Yes, project/Team budget
- Yes, individual budget
- Yes,

1.05 How often on average do you work from home?

- ? Never
- ? Less than 1 day per month
- ? Less than 1 day per fortnight
- ? Less than 1 day a week
- ? 1-2 days a week
- ? 3-5 days per week

1.06 Does your company pay for an internet connection at home if you want to work from home?

- ? Yes – company pays for fast connection (ISDN/(A)DSL/cable)
- ? Yes – company pays telephone bill for modem/telephone connection
- ? Company pays part of the bill
- ? No, I pay the bills myself
- ? Not applicable

1.07 How big is your team/work group? This can be a project team or any other group of people you work with on a daily basis.

- ? 1-5 people
- ? 5-10 people
- ? 10-20 people
- ? 20-35 people
- ? There are more than 35 people in my team/work group

1.08 Is everybody in your team/work group situated in the same building as you are?

- ? Yes, we all work in the same building
- ? No, but we are in the same complex/campus
- ? No, we work in different locations in the country
- ? No, part of our team/work group are working in other countries

1.09 What devices do you use for work ?

More than one answer possible

- Desktop PC
- Home PC
- Laptop/Notebook
- Laptop/Notebook with Wireless Internet Card (WLAN)
- Palm device/Handheld computer
- Electronic organiser
- Pager
- Mobile phone
- WAP phone
- Handheld calculator
- Other,

1.10 What applications do you use on the net (intranet/internet)? *Please RANK ORDER in order of frequency (1 for highest frequency)*

- ___ Email without attachments
- ___ Email with attachments
- ___ Browsing/World Wide Web
- ___ FTP for uploading/downloading files
- ___ Streaming media (audio/video)
- ___ Other,

1.11 How do you mainly communicate with your colleagues in your team/work group when you are working at your desk? *Please RANK ORDER in order of frequency (1 for highest frequency)*

- ___ Face-to-face
- ___ Email
- ___ Telephone
- ___ WAP phone
- ___ Paper memos
- ___ Fax
- ___ Telephone conference
- ___ Videoconference
- ___ Voice over the internet (Voice over IP)
- ___ Net meeting
- ___ Voicemail
- ___ Other,

1.12 How do you communicate with your colleagues in your team/work group when you are travelling? *Please RANK ORDER in order of frequency (1 for highest frequency)*

- Email
- Telephone
- WAP phone
- Paper memos
- Fax
- Telephone conference
- Videoconference
- Voice over the internet (Voice over IP)
- Net meeting
- Voicemail
- Other,

Please make a mark on a line. So for instance

How thirsty are you?

/_____ /_____ /

Not at all Very much

The mark close to "Very much" indicates that you are quite thirsty indeed.

1.13 Do you ever use a wireless enabled computer (laptop/notebook with WLAN-card)?

Never |_____| Always

1.14 Do you want to use a wireless enabled computer (laptop/notebook with WLAN-card)?

No, not interested in WLAN |_____| Yes

1.15 How often are you away from your desk?

a. In building away from desk

Not at all |_____| Always

b. Out of building in campus/complex

Not at all |_____| Always

c. Out of building/complex but in metropolitan area

Not at all |_____| Always

d. Out of metropolitan area but in the country

Not at all |_____| Always

e. Out of country

Not at all |_____| Always

1.16 What proportion of you work is done using the internet?

Not at all |_____| Always

2. Shared Resources

This section is about shared resources. When resources are scarce, using the resource might affect other people who want to use the same resource. You can see it as a game with the shared resource being the game board and the users are the players. When a player makes a move it will affect the other players who have to make a countermove. Examples of shared resources are the network, carpool cars and meeting rooms. A network can be congested, all carpool cars can be on the road just when you need to go somewhere and the meeting rooms can be in use by other people.

2.01 What resources do you share within the company?

Please write down below. More than one answer possible:

- For example: Meeting rooms
 Carpool cars
 Network

-

2.02 Are you aware of any congestion or particular times when the demand is too high for these resources?

- ? yes, for which resource(s)
.....
.....
- ? no

2.03 In general, how are resources allocated?

- ? Most resources are evenly distributed over employees
? Most resources are evenly distributed over teams/work groups
? Depends on job title of employee
? Depends on tasks of employee
? Employee can ask for more/less use of particular resource
? Other,
? I don't know

2.04 Is there a hierarchy within the company for shared resources?

- ? Yes, employees with higher position in company get higher priority for some resource use
? Yes, employees with higher position in company get higher priority for all resource use
? No, all resources are evenly distributed
? No, but employees can get different priority for certain jobs
? Other,
? I don't know

2.05 Who has control over your spending?

More than one answer possible

- I do
 My manager
 The team/work group
 All of the above
 Other,
? I don't know

2.06 Are different procedures in place for spending corporate budgets, departmental budgets and project budgets?

- ? Yes
- ? No
- ? I don't know

2.07 How do you manage spending of company's money by employees?

- ? We trust our employees with the budgets and use self-control
- ? All spending has to be approved in advance by the budget holder
- ? We monitor spending and review it afterwards
- ? We have a written policy
- ? Other,
- ? I don't know

2.08 If someone in your team/work group spends money, does this directly influence others in his or her team/work group?

- ? Yes
- ? Sometimes
- ? No
- ? I don't know

2.09 How does this influence his/her colleagues?

.....
.....
.....

2.10 What resource is so scarce within your company that sharing the resource can be a problem?

.....

2.11 If you want to buy a new piece of hardware for your work, whom do you need to ask permission to?

More than one answer possible

- Nobody
- Someone central in the company
- My manager
- I discuss it with the my team/work group and we decide together
- Other,
- ? I don't know

2.12 If you send out post, do you choose the priority (1st. 2nd, express delivery) or does somebody else make that decision?

- ? I post it internally and the post room sorts it out
- ? Everything goes standard 1st class
- ? Everything goes standard 2nd class
- ? Everything goes standard via express delivery (like FedEx)
- ? I choose priority per item
- ? Other,
- ? I don't know

2.13 Have you ever wanted to send something via the internet but it couldn't get through because the network was congested?

Not at all A lot

2.14 How often do you make a phone call which can't wait?

Not at all A lot

2.15 How important are deadlines in your work?

Not important Very important

2.16 Say you can choose different speeds for the internet. You have to pay a pound for a higher speed; the normal speed is for free. How often would you go for a higher speed?

Not at all A lot

3. Market Mechanism

A market economy is an economic system controlled, regulated, and directed by markets alone; order in the production and distribution of goods is entrusted to this self-regulating mechanism. An economy of this kind derives from the expectation that human beings behave in such a way as to achieve maximum money gains. It works with the operation of the forces of supply and demand. When there is a high demand you pay a high price and at quite times you will pay a lower price.

3.01 Say a flight to NY is cheaper when flying out on Sunday than on Monday morning and you don't have any plans that Sunday. You have to travel to NY for work because you have an important meeting on Tuesday morning. Would you travel a day early for a cheaper rate?

- ? Yes, always
- ? No, never
- ? Sometimes
- ? I don't know

3.02 When you travel, do you travel:

- ? Always cheapest
- ? Mostly coach/tourist class
- ? Mostly business class
- ? Mostly first class

3.03 When you travel, do you have

- ? The cheapest ticket in your class
- ? A flexible full refundable/changeable ticket
- ? I don't know

3.04 What kind of payment would you prefer for internet use at work?

- ? Flat rate (same amount for unlimited use)
- ? Pay per bit/bytes (pay for the amount of traffic you generate)
- ? Pay per minute (pay for the time you are using the internet)
- ? Flexible rate (standard low rate but pay extra when you need a better quality of service)
- ? I don't know

3.05 What would you prefer at home if you had the choice:

- ? Flat rate (same amount for unlimited use)
- ? Pay per bit/bytes (pay for the amount of traffic you generate)
- ? Pay per minute (pay for the time you are using the internet)
- ? Flexible rate (standard low rate but pay extra when you need a better quality of service)
- ? I don't know

3.06 Do you think it would be good to have an option to pay extra for a faster internet connection at work?

- ? Yes
- ? No
- ? I don't know

3.07 In general, are you willing to pay more for a better service?

_____ |
No, never Yes, all the time

3.08 Are you willing to pay extra to get a better signal for your mobile phone in remote areas?

_____ |
No, never Yes, all the time

3.09 When you are away for work, do you wait until off-peak time on your mobile phone to make a phone call?

_____ |
No, never Yes, all the time

3.10 Are you willing to pay more to watch certain television programs at home like football matches or films?

_____ |
No, never Yes, all the time

3.11 Would you want to pay extra to use an extra lane to drive to work so you can avoid traffic congestion and get to work faster?

_____ |
Not at all Yes, definitely

3.12 Do use different quality of paper for different kinds of work?

_____ |
No, never Yes, all the time

3.13 Do use different quality settings for your printer for different kinds of work?

_____ |
No, never Yes, all the time

3.14 Do you think variable pricing would work in a corporate environment?

_____ |
Not at all Yes, definitely

4. Corporate Environment

Research has been done into market mechanism outside work, but we would like to find out whether market mechanisms would work within a corporate environment as well. If you need a better quality of service for your work and you have to pay extra money for that better quality of service, how will that be accounted for and who is responsible for the budget?

4.01 Do employees within your company have individual budgets?

- ? Yes
- ? No
- ? Some people do
- ? I don't know

4.02 Who gets accounted for the money spent within your team/work group?

More than one answer possible

- Individuals
- Team/work group
- The budget holder
- Other,
- ? I don't know

4.03 What policies are in place for network use?

More than one answer possible

- No policies
- Written policy
- Monitoring
- Other,
- ? I don't know

4.04 Does your spending get monitored/reviewed?

- ? Yes
- ? Sometimes
- ? No
- ? I don't know

4.05 Who decides whether something is an urgent matter or not?

- ? Employee decides for him/herself
- ? The team/work group decides
- ? The manager decides
- ? Other,
- ? I don't know

4.06 Do you have a mobile phone you use for work?

- ? Yes
- ? No

If yes, who pays the bills?

- ? Company receives and pays the whole bill
- ? I receive the bills but the company pays for it
- ? Company pays only the phone calls that are work related
- ? Company pays a part of the bills
- ? I pay the bills myself
- ? Not applicable

4.07 Do you have a charging/fining scheme at work for abusing sharing resources?

? Yes

? No

? I don't know

4.08 Do you know the cost of your internet connection on an annual basis?

? Yes

? No

4.09 Are you aware of costs of overheads per employee in your company?

? Yes

? No

4.10 Do you think all employees are aware of these overhead costs?

Nobody Everybody

4.11 Do you think awareness of costs will change employees' attitudes?

Not at all A lot

4.12 Do you think employees care about spending the company's money?

Not at all A lot

4.13 Do you care about spending the company's money?

Not at all A lot

4.14 Do you want your colleagues to be careful with spending company's money?

Not at all A lot

4.15 Would you reprimand someone if he/she spends more money than necessary?

No, never Yes, always

4.16 Does it bother you if employees would access non-work related web sites during work hours?

Not at all A lot

4.17 Do you want employees to take matters into their own hands when co-workers access non-work related web sites during work hours by reporting their co-workers to the management or speak to the co-worker in question themselves?

No, never Yes, always

4.18 Do you think it's necessary to monitor all employees' spending?

Not at all A lot

5. Scenarios

Please read the scenarios carefully and choose the answer that suits you **best**. Please only choose one answer per scenario.

5.01 FTP

You need to send a big file to a colleague in the USA on Friday afternoon. It is time to go home but you do need to send out the file before you can go home. The network is really slow and you want to make sure the file arrives before you leave work. It is an important file so you want to check whether the recipient receives the file ok. Would you

- ? Pay extra for better quality of service so your file arrives within a few minutes
- ? Wait until the file has been sent via the slow connection, even if this means working overtime on a Friday afternoon
- ? Send the file and hope it gets through alright
- ? Wait with sending the file until Monday morning

5.02 Streaming

You are watching a video presentation of an important message from your CEO on your computer but the streaming isn't very smooth because there is a delay. The message is important and you are expected to watch it. Would you

- ? Ask for a printed version
- ? Ask your IT-helpdesk how you can solve the problem
- ? Wait until the network is less congested and try again later
- ? Look and listen to it now, even when the quality is bad
- ? Not look/listen to it all

5.03 Meeting room

You want to book a meeting room for a very important meeting with guests from outside the company but all rooms are booked. You notice it happens quite often that meeting rooms are booked in advance but not used, which means you can't find a meeting room while some of them are booked but empty. The only way to find this out is to check which meeting rooms are free which can be annoying, especially when you have important guests. Do you want to:

- ? Have a fining procedure in place so people who book but don't use rooms get fined?
- ? You don't care, you just walk around looking for an empty meeting room
- ? Have a charging in place so people are more careful booking meeting rooms
- ? Give managers within the company different priorities so a manager can override bookings

5.04 Mobile phone

You are at a conference in the countryside. Your mobile phone doesn't have a good coverage, the signal keeps going down and people on the other side of the line have trouble hearing you. You have a short 5 minutes-break and you need to make a phone call to your secretary/admin because you need important information faxed to the conference hotel for your presentation this afternoon. Would you

- ? Wait until you can leave the conference room and walk to a phone box/hotel lobby
- ? Like to have the opportunity to upgrade your phone to a higher quality service so you can make the phone call there and then
- ? Walk around until you find a spot where the coverage is a bit better
- ? Ask to use someone else's phone

Thank you very much. All data collected will be used for research purposes only and will remain confidential. All participants are anonymous. If you want to receive a copy of the report, please send an email to annelies_de-bruine@hp.com