INVENTORY CONTROL OF SPARES

IN EUROPE

INPUT

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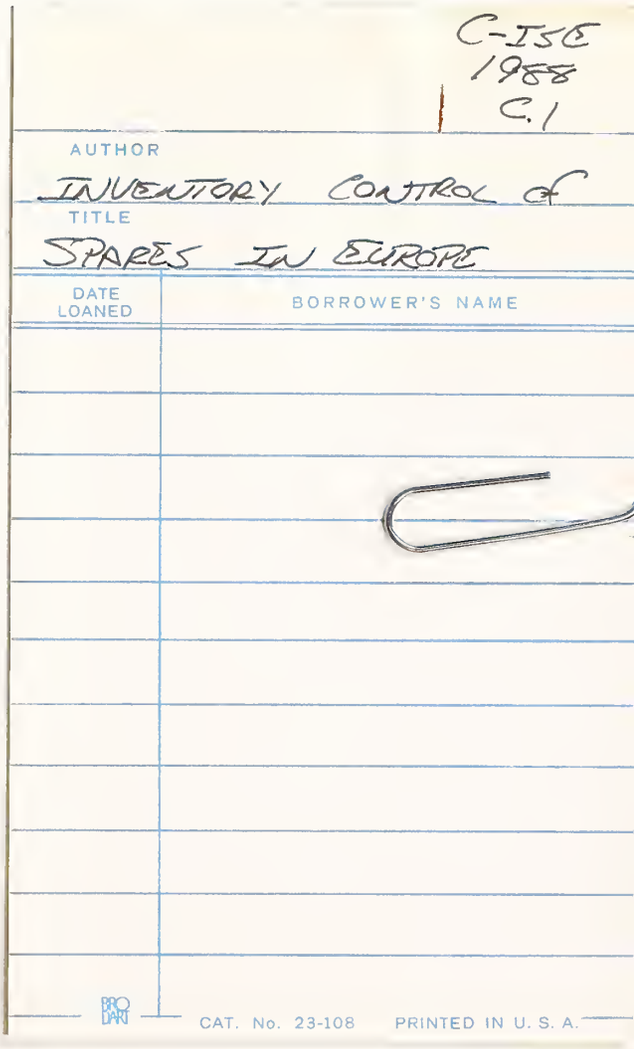
INVENTORY CONTROL OF SPARES IN EUROPE



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Abstract

One of the most important issues in the supply of maintenance services, both within the vendor organisation and with the customer, is the provision of spare parts. From the supplier point of view the cost of holding unnecessary stock is high, and from the customer point of view the timely supply of remedial parts is a key issue.

INPUT user research indicates that spares availability is one of the two aspects showing least user satisfaction: this report examines possible causes of this perception and suggests means of improving both customer perceptions and supply performance.

The data upon which this report is based are extracted from a sample of 1321 respondents in fourteen different companies, spread across nine European countries.

In addition there is an analysis of prime survey results, and an evaluation of the methods used to promote good stock-holding and supply policies for spares, and consequent customer satisfaction.

Established inventory and supply techniques are also mentioned, for which detailed mathematical background can be found in both standard and specialist reference books.

This report contains 92 pages, including 66 exhibits.

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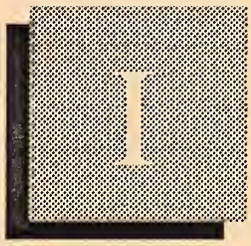
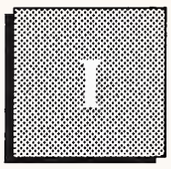
Exhibits (Continued)



Introduction



Introduction

A Purpose and Scope of Report

One of the most important issues in the supply of maintenance services, both within the vendor organisation and with the customer, is the provision of spare parts. From the supplier point of view the cost of holding unnecessary stock is high, and from the customer point of view the timely supply of remedial parts is a key issue.

INPUT user research indicates that spares availability is one of the two aspects showing least user satisfaction: this report examines possible causes of this perception and suggests means of improving both customer perceptions and supply performance.

The data upon which this report is based were extracted from a sample of 1321 respondents in fourteen different companies, spread across nine European countries. This research was conducted during 1987, and the full analysis of service aspects is available in INPUT's *Customer Services in Europe, 1987 Annual Report* (December 1987).

In addition there is an analysis of prime survey results of the methods used to promote good stockholding and supply policies for spares, and of consequent customer satisfaction.

Established inventory and supply techniques are also mentioned, for which detailed mathematical background can be found in both standard and specialist reference books.

B

Methodology

The data for the first part of this study was collected by INPUT during 1987 as part of the annual survey of service performance. The data was then analysed at INPUT with the results tabulated and examined for interpretation.

In addition, current spares management techniques were examined for relevance, and appropriate conclusions drawn for the guidance of service vendors.

C

Report Structure

This report is organised as follows:

- Chapter II is an Executive Overview, giving a concise summary of the key points from the study.
- Chapter III deals with the comparisons between companies and any correlation data.
- Chapter IV covers the importance and satisfaction ratings of individual companies.
- Chapter V covers the importance and satisfaction ratings of individual countries.
- Chapter VI details the various spares management strategies and considerations.
- Chapter VII gives the conclusions and recommendations.

D

Interpretation of Data

In any tables of satisfaction and importance, the ratings are out of 10:

Importance

0 = no importance
5 = average importance
10 = extremely important

Satisfaction

0 = totally and absolutely dissatisfied
5 = average satisfaction
10 = totally satisfied

The Satisfaction Index throughout this report is based on the difference between the importance and satisfaction ratings, in order to eliminate cultural effects on the strength of individual ratings. The questions for importance and satisfaction were asked at the same time, and the answers given reflect the respondents' (relative) value judgements at that time.

The interpretation of the Satisfaction Index is as follows:

a) Figures of 10 and 10, or 6 and 6, give a difference (and satisfaction index) of zero, indicating that the important needs are fully satisfied.

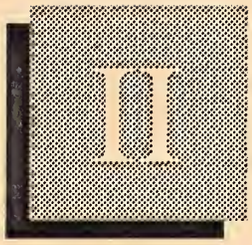
b) Figures of importance 8 and satisfaction 9 would indicate an overfulfillment of the needs, and give a satisfaction index of -1 or, in the INPUT text, (1).

c) Figures of importance 6 and satisfaction 5 indicate underfulfillment of the needs but, with a satisfaction index of 1, possibly customer concern rather than real dissatisfaction.

d) The top of the Satisfaction Index scale would look like:

(1)	overfulfilled
0	completely satisfied
1	concerns and worries
2	real dissatisfaction
3	pain level

e) Data for the standard error, where appropriate, is printed in the INPUT 1987 Annual Report.



Executive Overview

II

Executive Overview

A

Spares Availability—Company Comparisons

Only Olivetti at 0, Concurrent at 0.1 and ITL at 0.2 had satisfaction indices indicating well-satisfied customers in respect of spares availability.

Out of these three companies, only Olivetti had a satisfaction index for System Availability well away from that for spares availability—the other two matched very closely.

EXHIBIT II-1

SPARES AVAILABILITY—COMPANY COMPARISONS

- Only 3 Companies Well Satisfied
- But 2 Companies over the Concern Level
- And 4 Companies Near the Concern Level
- Satisfaction Ranking Close to Hardware Maintenance Satisfaction Ranking
- No General Correlation with Company Break Rate Record
- No General Correlation with Hardware Fix Times
- No Correlation with System Use or Size
- Olivetti and ITL the Best Performers

Unisys at 1.3 and Wang at 1.6, however, had indices between the concern and dissatisfaction levels, and were also poorly rated for Systems Availability.

Honeywell NCR and ICL, at 0.9, were all approaching the customer concern level and, apart from NCR, had poor indices for Systems Availability.

Apart from Olivetti and HP, the rest of the companies had satisfaction indices very close to those for hardware maintenance, and the rankings are nearly identical.

For the rest of the aspects that might have been expected to have had a close correspondence, none could be detected, which gives companies a relatively free hand to implement some fairly dynamic supply policies.

If one considers a combination of hardware fix time and spares availability, ITL and Olivetti come out very clearly as the best performers.

B

Spares Availability—Country Perceptions

Germany at 0.5 and Belgium at 0.6 had the best satisfaction indices, even though these are not particularly good: these also matched very well with the indices for overall hardware support.

Denmark at 1.0, France at 1.2 and Sweden at 0.9 had the worst satisfaction indices: in the case of Denmark there was no correspondence whatsoever with the satisfaction index for overall hardware support, but the other two countries matched very well.

The index for Norway was particularly bad at 1.9, which is very close to the real dissatisfaction level, and may be a function of longer distances to site, or remote spares holdings.

Overall there is a good correlation between the satisfaction indices for spares availability and overall hardware maintenance across the countries and, since this does not hold for individual companies, it would appear that the companies balance out within each country.

The heavy skew to the higher ratings for the countries shown indicates an undersatisfied expectation, whether or not this is based on any reality other than customer perceptions.

EXHIBIT II-2

SPARES AVAILABILITY—COUNTRY COMPARISONS

- Germany and Belgium Best Satisfied
- Denmark, France and Sweden at Concern Level
- Norway at Real Dissatisfaction Level
- Good Correlation with Hardware Maintenance Satisfaction Except for Denmark
- Indicates That Companies Average Out in Countries, but Differ Separately (i.e., No General Correlation at Company Level)
- Denmark, France, Norway, Sweden Heavily Skewed to 10 Rating

C

Spares Availability—Customer Expectations

Taking individual companies within individual countries there is no correlation between satisfaction with spares availability and overall hardware maintenance, customer views on future vendor performance, system size or system use.

This would indicate that, apart from one or two companies that do have some apparent correllation, the other companies could afford to experiment with less costly services—meanwhile keeping the customer-critical and more easily satisfied services more visible.

As stated in the body of the report, a greater customer satisfaction could be engendered by getting into a closer relationship with customers, and 'educating' their ideas and perceptions—without putting more resources into spares supply.

EXHIBIT II-3

SPARES AVAILABILITY—CUSTOMER EXPECTATIONS

- Not Tied to Overall Maintenance Satisfaction
- Not Tied to Views on Future Service Performance
- Not Tied to Hardware Fix-Time Satisfaction
- Not Tied to System Size or Number of Terminals
- Hence Great Latitude for Service Strategies

D

Design and Spares Strategy

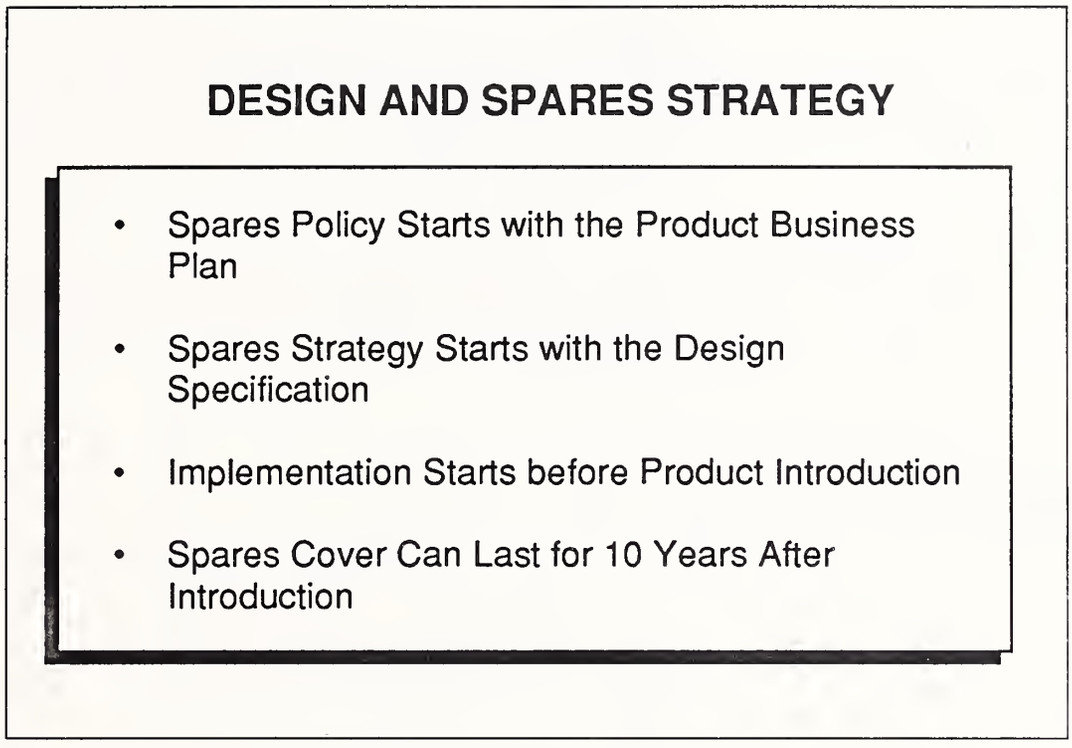
Too often the spares policy for new products is made sometime after product introduction, when the first calamity is just occurring.

Good Manufacturing Practice, and good spares supply practice, dictates that the spares policy be decided at the time the business plan is formulated, particularly since a large proportion of the total company profit can come from the maintenance operation.

In addition, it is essential that the spares strategy, even for the incidence of parts replacement, be evolved together with the design specification—in order that the business plan can be achieved.

It must not be forgotten that some customers, particularly government agencies, will insist on a 10-year maintenance cover dating from the time of the last production machine. This will impose an essential discipline of planning machine run-down policies and obsolete parts provision.

EXHIBIT II-4



E

Market Considerations

As part of the product business plan, it is necessary to determine the relationships between the product and service images, so that a correct choice can be made for product image, reliability and spares cost (among many other considerations as well).

It is necessary to consider the relationship of reliability and spares revenue and, by reason of volume, whether a lower cost spares/lower reliability product would produce better revenue/profit than a high-cost spares/high-reliability machine option—and any permutation.

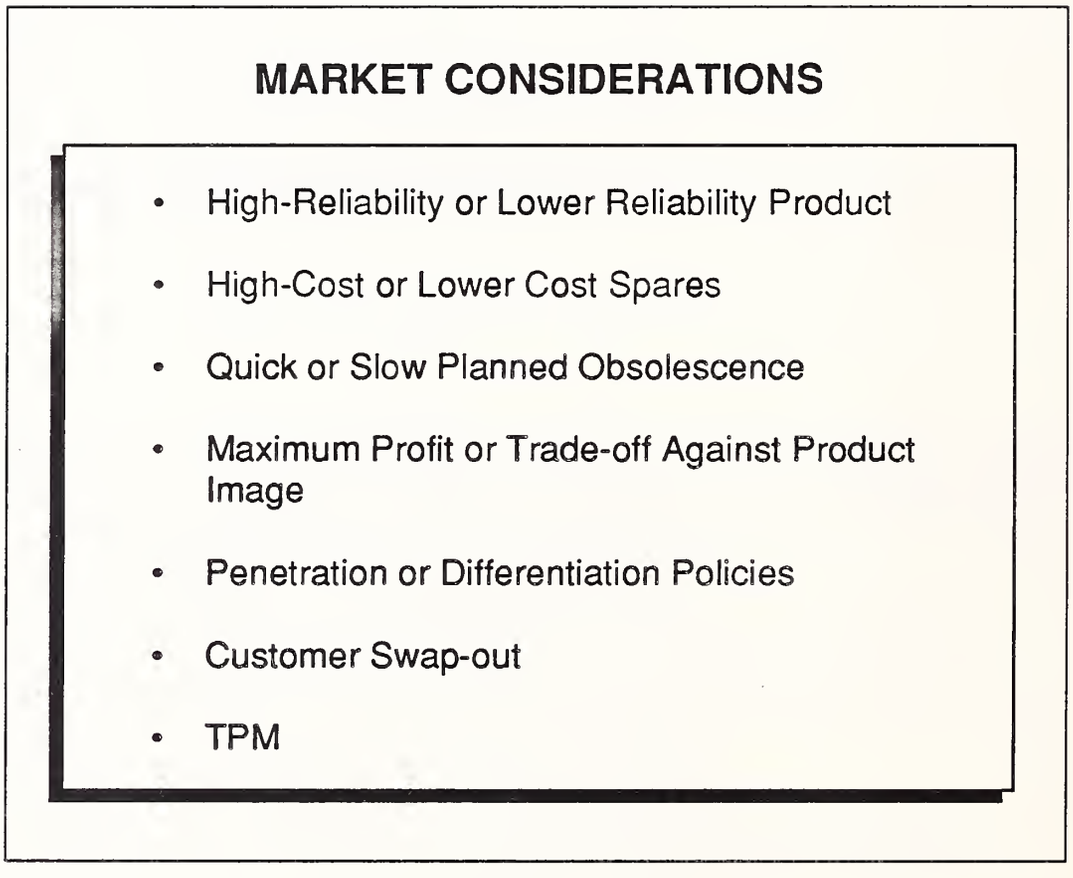
In addition, the rate of obsolescence of both product and spare parts should be considered at the design and business plan stage, in order to ensure that no bad news emerges in product mid-life.

Another aspect is that of maximization of spares revenue, perhaps at the expense of product image with the actual or potential customer—this can really only be addressed properly at the initial business plan stage. Again, it must be decided whether to go for head-on penetration policies on maintenance, of which spares is a critical and emotive part, or to differentiate the service in some way that emphasises the good points of the service being provided, while giving a good return on spares investment.

Dependent upon the strategy being evolved, consideration should also be given to the possibility of selling kits of replacement parts to the customer, in order to save time, and possibly expense, by the customer's swapping out defective parts. This type of policy has the effect of reducing inventory and getting money up-front.

Even more critically nowadays, consideration must be given to the spares supply policies for TPM companies, both from the point of view of price and lead time.

EXHIBIT II-5



F

Inventory Considerations

Frequently a company lacks a coherent product business plan due to the power play between Marketing, Design, Production, Service and Accounts.

It is the view of INPUT that a proper business plan can only emerge if all the players are targeting the identical objective—otherwise product direction is lost, as is the opportunity to optimize overall returns.

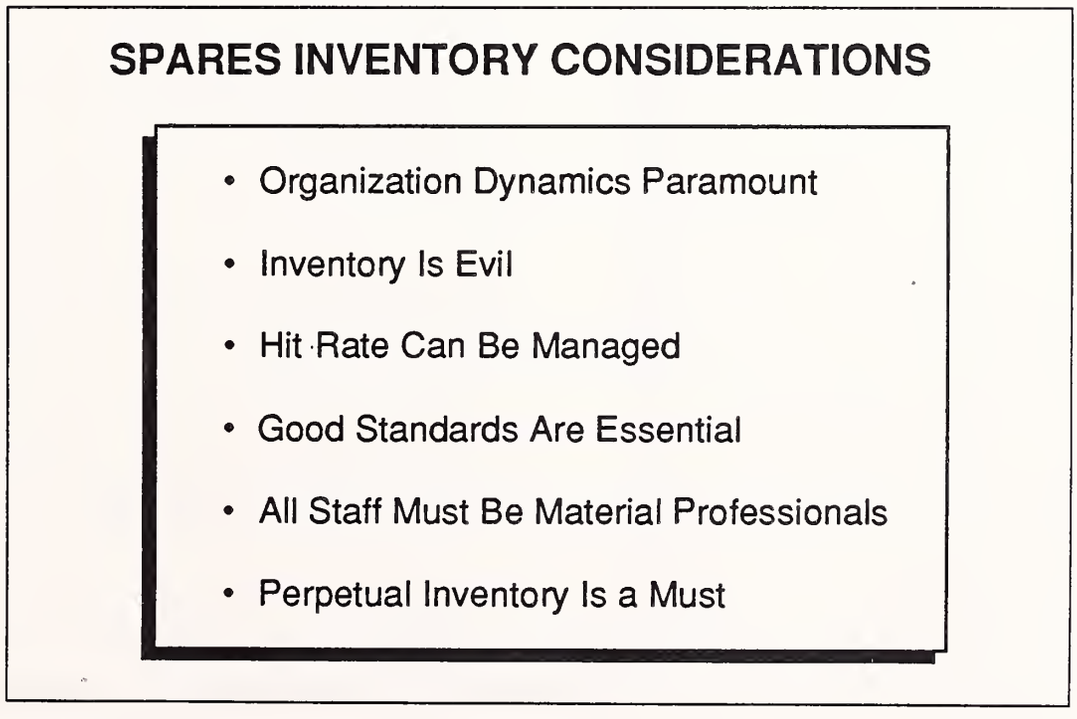
Despite a degree of criticism that accountants get for being pedantic about numbers without being able to visualize the real world, a good precept to start with on spares stock is that INVENTORY IS EVIL.

This philosophy does, of course, need to be balanced against hit rate targets, but it is a good starting position.

Hit rate itself can be managed as long as there are good standards for spares demand and supply (and lead time), but this strategy does need well-trained material control and provisioning professionals for whom low inventory, high hit rate is an accepted discipline.

It is then essential to look after and control what is bought and issued to a precise degree—hence perpetual inventory (and standard costing) is a must.

EXHIBIT II-6



G

Achievable Inventory Targets

Production stores running under MRP can achieve 98% transaction (and stock) accuracy, and there is no reason that a spares store, with less transactions, cannot achieve the same or better levels of accuracy using the same techniques.

One thing commonly avoided or missed, particularly when long-standing stores personnel are introduced to new systems, is adequate training, monitoring and control of such staff. Accuracies of 99% and better are essential, and staff that are not able to meet such standards need to be allocated to less-stringent work.

In general, stores inventories in the UK average a 3.5 stock turn but, with the types of policies given in the text of this report, a turn of 10 is 'easily' obtainable, and 20 is possible.

In order to meet any business plan it is necessary to have an adequate costing strategy such that the inaccuracies in costing and variances are minimised.

EXHIBIT II-7

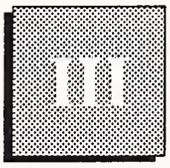
ACHIEVABLE INVENTORY TARGETS

- 99% and Better Transaction Accuracy
- 1% Maximum Data Input Error—Monitored and Corrected
- Minimum Stock Turn of 10—Aim for 20
- Standard Costing within Plus or Minus 2%
- Year-End Variance within 2%
- Hit Rate for Emergency Orders: 99% within 1 Day, 100% within 3 Days
- Hit Rate for Stocking Orders: 100% within 2 Weeks

A variance of +2% on an inventory of $10 million with a stock turn of 10 could represent a bottom-line loss of $2 million!

Given the strategy of establishing a hit rate within a time frame, and provisioning accordingly, it is quite possible to achieve the hit rates illustrated. This strategy would also cut inventory and carrying cost, and facilitate better supply policies.

Company Comparisons and Correlations



Company Comparisons and Correlations

A

Satisfaction Indices by Principal Use

Exhibit III-1 breaks down the Spares Availability satisfaction indices by principal computer use and ranks them. It can be seen that there is, overall, a fair match with the overall Hardware Service satisfaction indices—only those ranked 4 and 6 change places.

However, the standard error for both calculations is of the order of 0.05, and the total difference in the overall hardware satisfaction index (top to bottom) is only six standard errors—hence these rankings should be treated as for guidance only.

With reference to Exhibit III-2 it can be seen that although the satisfaction indices tend the same way, there is a significant displacement from the zero (completely satisfied) point on the hardware ordinate, and that there is no correlation.

However, the plotting of the same curve for individual companies that have good correlation between Hardware Service and Spares Availability (see Exhibit III-4) could give a better correspondence with the theoretical position, shown as a dashed line.

Nevertheless, there is a big difference in the Spares Availability satisfaction indices, with only a small minority totally satisfied (15), and the majority nearing or over the customer concern level.

This would indicate that, in mainstream applications, there is significant undersatisfaction with spares availability, and that this needs addressing as a problem, albeit that the solution may be customer education rather than the supply of more timely spares.

EXHIBIT III-1

SATISFACTION INDICES BY PRINCIPAL USE
(Ranked by Spares Availability)

PRINCIPAL USE	SPARES AVAILABILITY SI	RANK	HARDWARE SERVICE SI	RANK	CELL SIZE
Other Uses	(0.65)	1	0.80	1	15
Real-Time (Internal)	0.66	2	0.97	2	184
Administration	0.85	3	0.98	3	948
Development	0.86	4	1.11	6	123
Industrial Automation	1.15	5	1.10	5	29
Real-Time (External)	1.32	6	1.09	4	22

( ) = Well Satisfied

0 = Satisfied

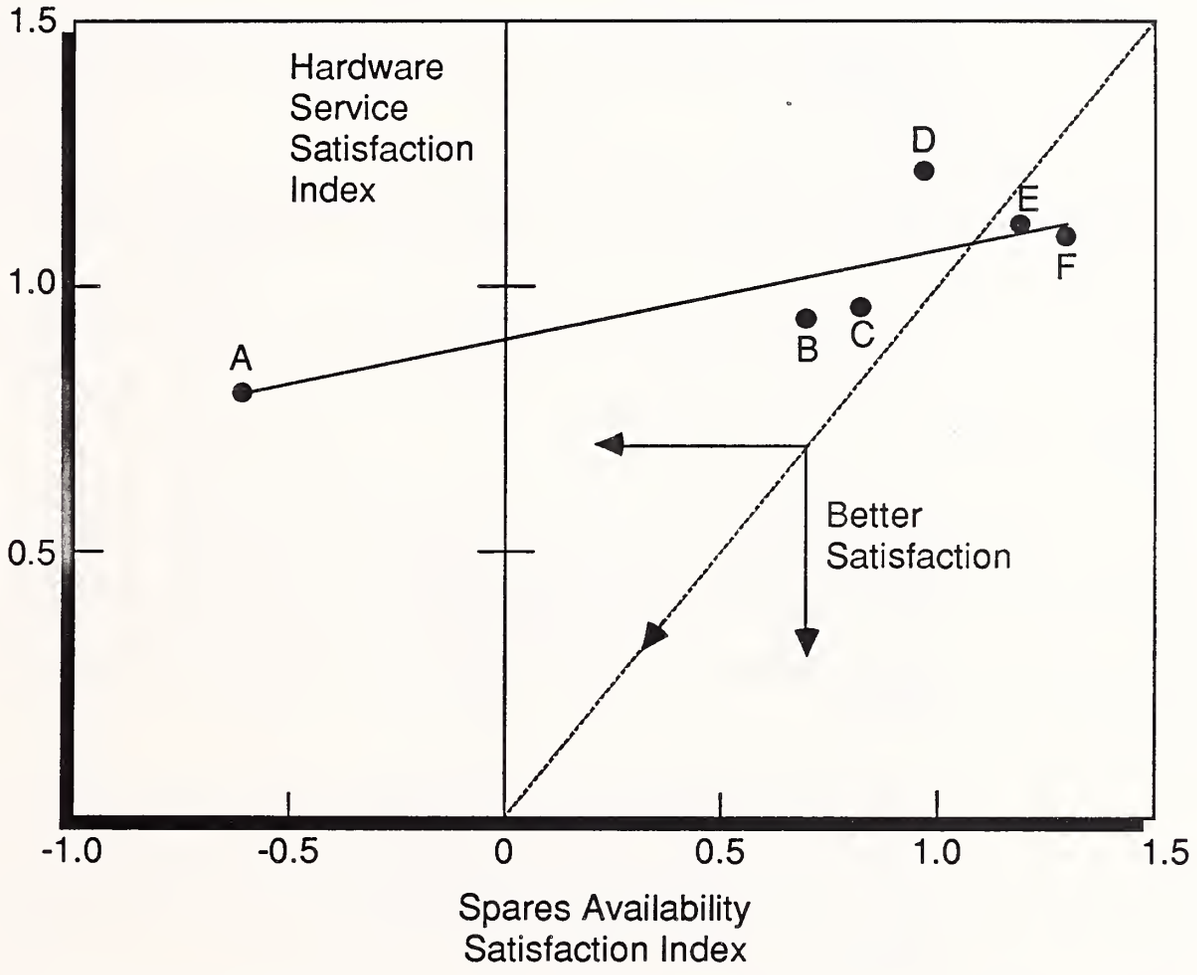
1 = Concern

2 = Real Dissatisfaction

Sample Size: 1,321

EXHIBIT III-2

SPARES AVAILABILITY SATISFACTION INDEX BY HARDWARE SERVICE SATISFACTION INDEX



A = Other Uses
B = Real-Time Internal
C = Administration
D = Development
E = Industrial Automation
F = Real-Time External

B

Spares Availability and HW Maintenance Satisfaction

In Exhibit III-3 the importance and satisfaction ratings for both Spares Availability and Overall Hardware Maintenance are tabulated against each company, and the difference is shown in the end column.

Comparing the satisfaction indices, it can be readily seen that nine out of the fourteen companies are very close, but some others drift off significantly.

This would indicate that there is some degree of correlation for specific companies, but that it is not general to the population.

This could lead to the interpretation that the down-rating of supplier performance in this area is historically based and, as with documentation, part of the culture response.

A better perspective of the results can be obtained from Exhibit III-4, where companies in or along the means box are the better performers. These companies may have less latitude to reduce spares availability than those companies with a bigger difference essentially because there is a degree of correlation. Due note must also be taken of the sign of the difference.

For the two companies with zero difference and a high importance rating (ICL & IBM), there might again be a problem as there is a high importance rating for both spares availability and hardware maintenance (with hardware maintenance higher in both cases), indicating a criticality of need that must be satisfied.

With companies along the 0.1 line, there is a good degree of correlation, and care would need to be taken before any changes were made to the relative levels of service in spares availability or hardware maintenance overall.

However, with companies outside the box, the linkage would appear to be relatively weak, thus offering a number of opportunities:

- improve the service
- reduce the service to reduce cost
- educate customers to accept less or appreciate better what they already receive

EXHIBIT III-3

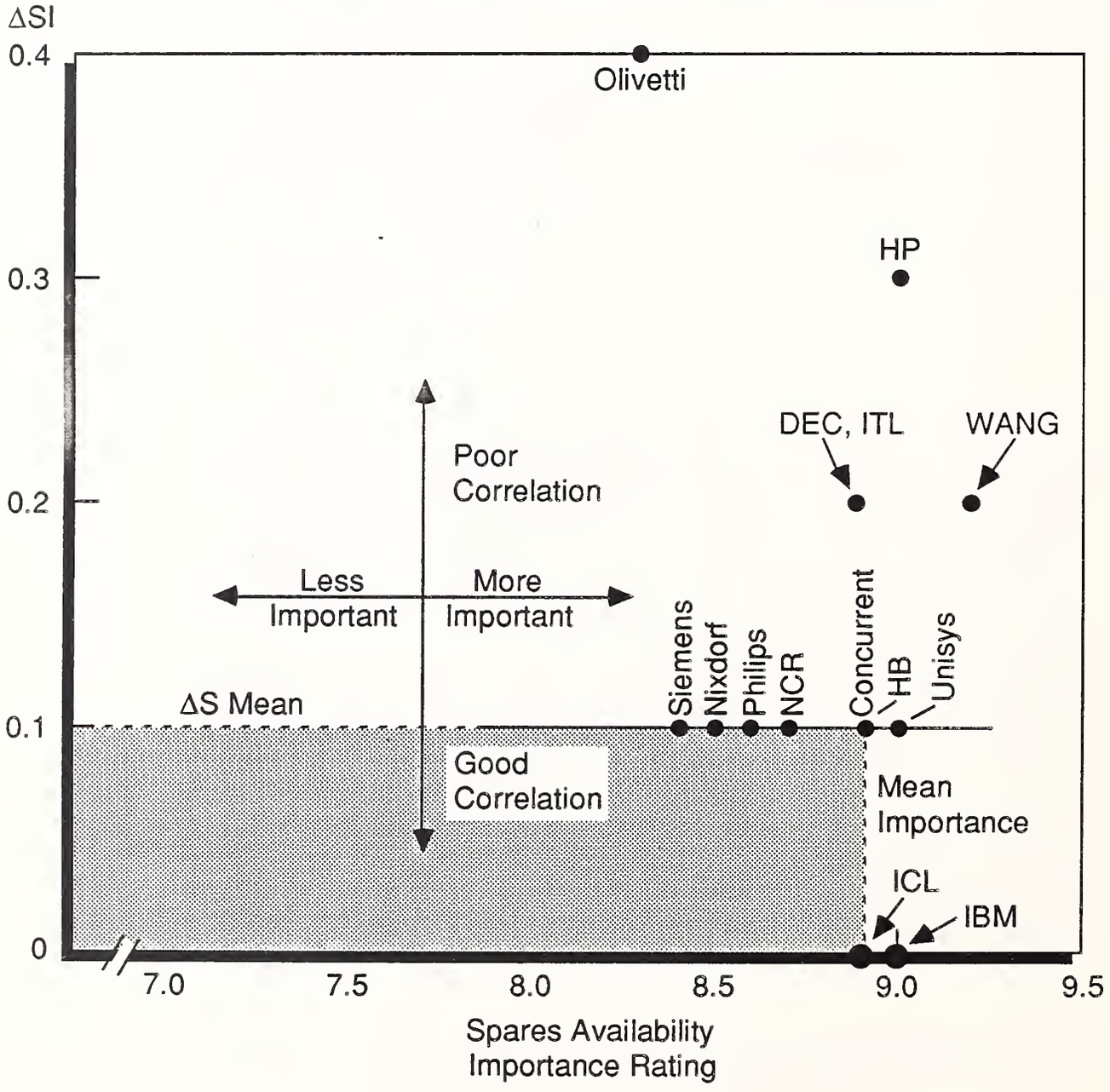
SPARES AVAILABILITY AND HARDWARE MAINTENANCE SATISFACTION

COMPANY	SPARES AVAILABILITY			OVERALL HARDWARE MAINTENANCE			ΔSI
	I/R	S/R	SI	I/R	S/R	SI	
Concurrent	8.9	8.8	0.1	8.5	8.3	0.2	0.1
DEC	8.9	8.1	0.8	9.3	8.3	1.0	0.2
Hewlett-Packard	9.0	8.4	0.6	9.1	8.2	0.9	0.3
Honeywell	8.9	8.0	0.9	9.2	8.2	1.0	0.1
IBM	9.0	8.2	0.8	9.3	8.5	0.8	0.0
ICL	8.9	8.0	0.9	9.1	8.2	0.9	0.0
ITL	8.9	8.7	0.2	8.9	8.5	0.4	0.2
NCR	8.7	7.8	0.9	9.1	8.1	1.0	0.1
Nixdorf	8.5	7.7	0.8	9.0	8.1	0.9	0.1
Olivetti	8.3	8.3	0.0	8.8	8.4	0.4	0.4
Philips	8.6	8.0	0.6	9.1	8.4	0.7	0.1
Siemens	8.4	8.0	0.4	8.8	8.5	0.3	(0.1)
Unisys	9.0	7.7	1.3	9.1	7.9	1.2	(0.1)
Wang	9.2	7.6	1.6	9.2	7.8	1.4	(0.2)
Total/Average	8.9	8.1	0.8	9.1	8.2	0.9	0.1

Sample Size: 1,321

EXHIBIT III-4

CORRELATION OF SPARES AVAILABILITY AND HARDWARE MAINTENANCE AGAINST SPARES-AVAILABILITY IMPORTANCE RATING



ΔSI= difference between spares availability and hardware maintenance satisfaction indices.

C

Spares and System Availability by Company

With reference to Exhibit III-5, it can be seen that the number of system breaks per annum (pa) is set out against the satisfaction indices for Systems Availability and Spares Availability, for each company, and the difference given in the last column.

The first thing to note is that there is no apparent correlation between the number of breaks and the satisfaction with systems availability. The best figure for breaks (Olivetti with only 1.3pa) has a corresponding midrange satisfaction index of 0.5; in contrast ICL (with 4.1) has a low satisfaction index approaching the concern level at 0.9, along with Wang at 2.7 and Nixdorf at 2.4pa. But ITL (at 3.4pa) has a very good systems availability index of 0.3.

The same argument applies to the satisfaction indices for spares availability, where Concurrent and DEC, both with 2.5 breaks per annum have indices of 0.1 (very good) and 0.8 (customer concern) respectively. Likewise, ICL with 4.1 breaks per annum has an index of 0.9 (customer concern), while ITL with 3.4 breaks per annum has an index of 0.3 (good).

Exhibit III-6 gives a perspective of those companies with reasonable correlation, and those where the customer perspective on System Availability and Spares Availability is quite different.

Hence each company will need to examine the ACTUAL effect on systems availability of unacceptable spares supply before committing resources to particular changes.

EXHIBIT III-5

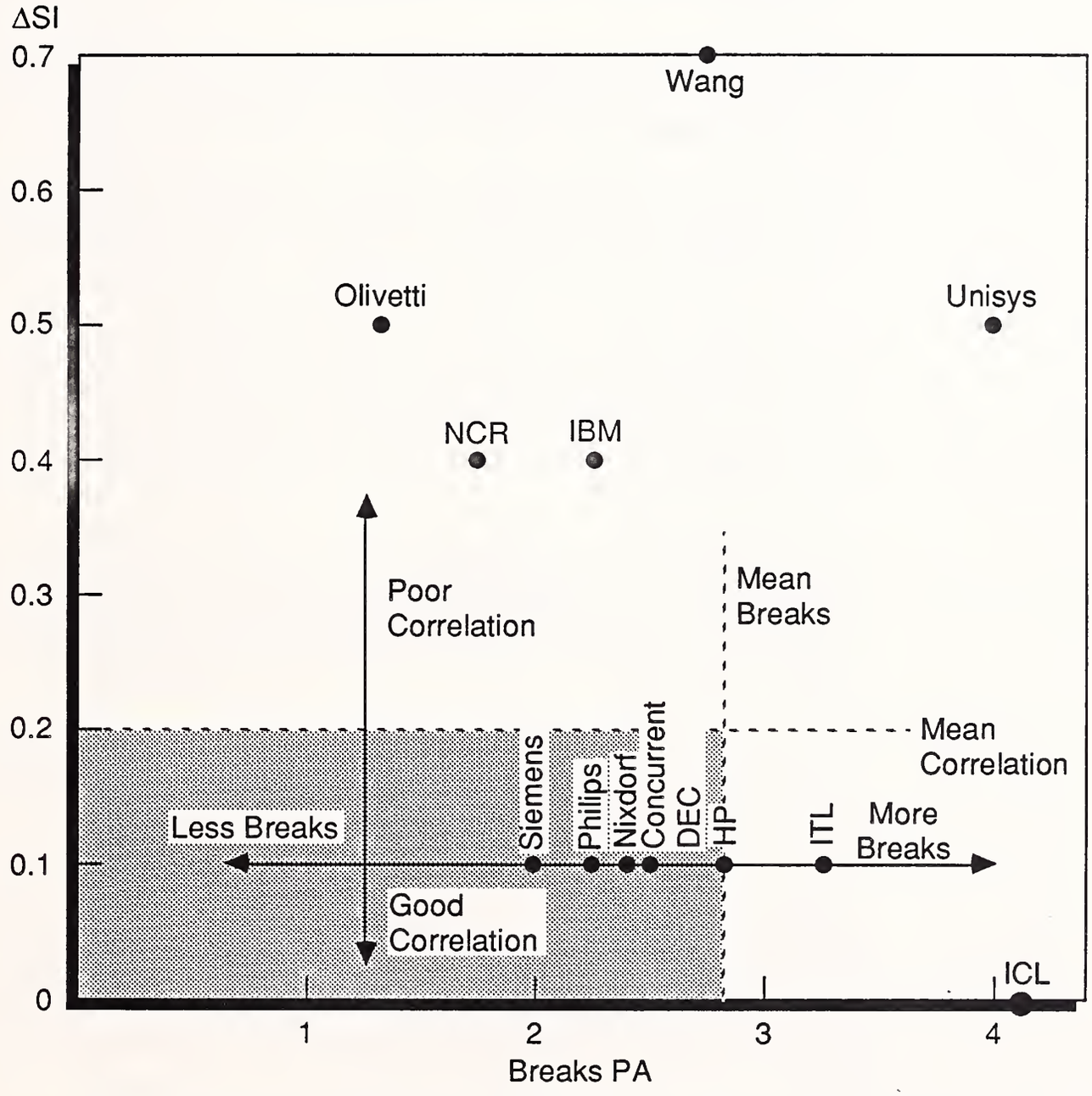
SPARES AND SYSTEM AVAILABILITY BY COMPANY

COMPANY	NO. OF SYSTEM BREAKS PER ANNUM	SYSTEM AVAILABILITY			SPARES AVAILABILITY SI	Δ SI
		I/R	S/R	SI		
Concurrent	2.5	8.8	8.6	0.2	0.1	0.1
DEC	2.5	9.4	8.7	0.7	0.8	0.1
Hewlett-Packard	2.8	9.2	8.7	0.5	0.6	0.1
Honeywell	3.4	9.4	8.7	0.7	0.9	0.2
IBM	2.3	9.3	8.9	0.4	0.8	0.4
ICL	4.1	9.3	8.4	0.9	0.9	0.0
ITL	3.4	9.2	8.9	0.3	0.2	0.1
NCR	1.8	9.2	8.7	0.5	0.9	0.4
Nixdorf	2.4	9.4	8.5	0.9	0.8	0.1
Olivetti	1.3	9.1	8.6	0.5	0.0	0.5
Philips	2.2	9.5	8.8	0.7	0.6	0.1
Siemens	1.9	9.2	8.9	0.3	0.4	0.1
Unisys	4.0	9.2	8.4	0.8	1.3	0.5
Wang	2.7	9.4	8.5	0.9	1.6	0.7
Total/Average	2.8	9.3	8.7	0.6	0.8	0.2

Sample Size: 1,321

EXHIBIT III-6

CORRELATION OF SYSTEM AND SPARES AVAILABILITY AGAINST SYSTEM BREAK RATE



Note: Best performers in the 0.2/2.8 box, i.e., better than average.

D

Spares Availability and Hardware Fix Times

For comparison purposes, in Exhibit III-7 the fix times exclude the response time from phone call to engineer arrival on site—hence one would expect a direct correlation between poor spares availability and long fix times.

Olivetti, with the best satisfaction index (0), has the joint fifth-longest repair time. Concurrent, with the second-best satisfaction index (0.1), has the eighth-longest repair time (4.1hr).

However, DEC with the longest repair time (6.7 hr), and Wang with the second longest (6.2 hr), have satisfaction indices fifth from the bottom and at the bottom respectively—i.e., only one really matches.

To take time itself out of the framework, the difference between expectations and actuality were divided by the experienced hours to see if there was any correlation between expectations (which themselves may be dependant upon suppliers' past performance) and the satisfaction index for spares availability.

The appropriate indices are plotted for each company in Exhibit III-8, where the line for increasing satisfaction is somewhat arbitrary but is included to demonstrate the relative weights of bad fix times and poor spares availability.

The smallest box containing Olivetti represents the area of nearly complete satisfaction, whereas companies outside the outer box are outside an area representing customer concern through to dissatisfaction.

Again, although there are a few matching low numbers, there is basically no obvious correlation. The customers' perception of most of the suppliers is that there is no correlation between the lengths of time it takes to acquire a spare part or to fix a fault. Consequently the majority of suppliers of service may be able to give the improvement of spares supply a low priority.

EXHIBIT III-7

SPARES AVAILABILITY AND HARDWARE FIX TIMES

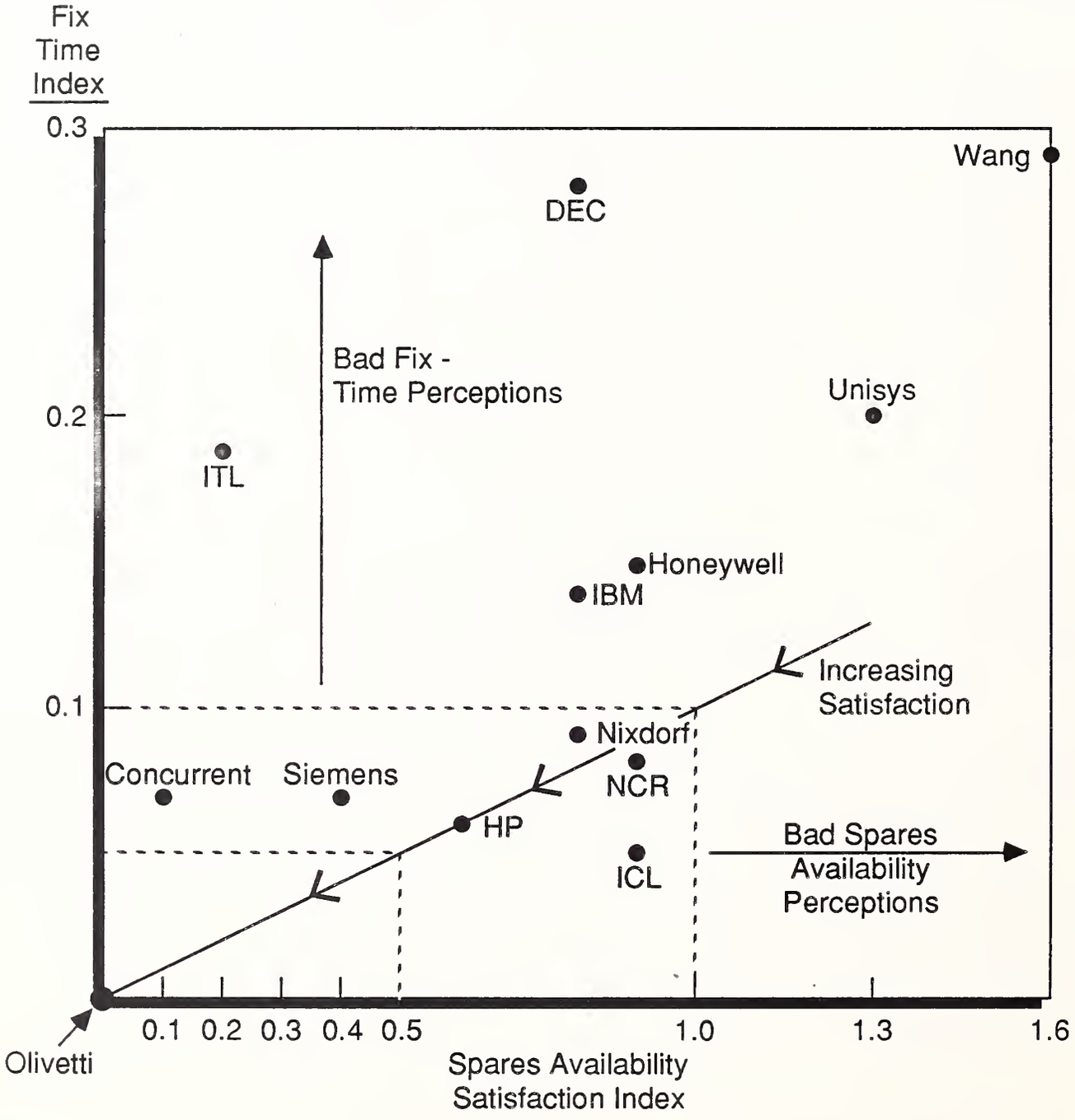
COMPANY	SPARES SATISFACTION INDEX	FIX-TIMES (Hours)		ΔF / EXP
		Acceptable	Exper-ienced	
Concurrent	0.1	3.8	4.1	0.07
DEC	0.8	4.8	6.7	0.28
Hewlett-Packard	0.6	4.3	4.8	0.06
Honeywell	0.9	3.3	3.9	0.15
IBM	0.8	3.2	3.7	0.14
ICL	0.9	3.7	3.9	0.05
ITL	0.2	3.0	3.7	0.19
NCR	0.9	4.4	4.8	0.08
Nixdorf	0.8	4.1	4.5	0.09
Olivetti	0.0	3.9	3.9	0.00
Philips	0.6	3.0	2.8	(0.07)
Siemens	0.4	2.6	2.8	0.07
Unisys	1.3	3.9	4.9	0.20
Wang	1.6	4.4	6.2	0.29
Total/Average	0.8	3.9	4.6	0.15

ΔF/EXP = Difference between experienced and acceptable, divided by experienced.

Sample Size: 1,321

EXHIBIT III-8

SPARES AVAILABILITY AND FIX TIMES PERSPECTIVES



$$\text{Fix Time Index} = \frac{\text{Experienced - Acceptable}}{\text{Experienced}}$$

0 = Fully Satisfied

1 = Customer Concerns

2 = Dissatisfaction

E

Spares Availability and System Size

An examination of Exhibit III-9 will show that, on average, there is no apparent correlation between the satisfaction indices of Overall Hardware Maintenance and Spares Availability. There is a difference of about four standard errors for both sets of data.

Likewise, for large systems there is a substantial difference, for small systems less of a difference, and for medium-size systems the difference is of the order of one standard error.

This is not to say that, by the selection of specific countries or companies, it would not be possible to determine a correlation in those specific cases, and reference should be made to the individual sets of data to determine any possible strategy for a given company within a given country. These data are available from INPUT where not included in published reports.

It is very important to ensure that spares strategies are precisely focused in order to obtain the maximum advantage, or even to obtain some advantage.

EXHIBIT III-9

SPARES AVAILABILITY AND MAINTENANCE SATISFACTION BY SYSTEM SIZE

	HARDWARE MAINTENANCE SATISFACTION INDEX	SPARES AVAILABILITY SATISFACTION INDEX
Large	1.06	0.69
Medium	0.90	0.85
Small	0.98	0.91
Average	1.05	0.82

Sample Size: 1,321

IV

Spares Availability by Company

IV

Spares Availability by Company

A Introduction

Separate histograms for the importance of, and satisfaction with, spares availability are presented for each company so that both the overall satisfaction and the degree of skew can be evaluated.

The histograms, sorted by 'importance' skew characteristics, fall into three broad categories:

- the majority, with decided skew towards the 10 rating
- three companies, with a less-developed skew
- three companies, with only minor skew

For the first category, while there is skew against the importance rating, with most companies the satisfaction rating is reasonably normal, indicating a strong feeling of unsatisfied demand.

In the second category, with Concurrent, DEC and Philips, the satisfaction pattern is the same, but the 8 and 9 importance ratings are stronger compared to the 10 ratings, indicating less strength of customer dissatisfaction with spares availability.

With the third category, taking in ITL, Olivetti and Siemens, there is a near-normal distribution of importance ratings, but the satisfaction figures are quite different and the satisfaction indices for these companies go from good to poor.

Throughout this report it is commented that there is little or no substantial evidence to support correlation between satisfaction with spares availability and satisfaction with other services.

In fact this lack of evidence, together with the data presented in this report, would support the proposition that customer satisfaction with spares availability is independent to a large degree of any actual service performance attribute. Satisfaction appears to be contingent only on a set of customer value judgements about the vendor's level of spares provisioning.

A conclusion of this nature would have important financial implications for the suppliers concerned and for their strategies in relation to customer education and support.

It has been frequently mentioned in other INPUT reports that there is a real need to establish a closer rapport with customers, in order to ensure that they appreciate what the service levels are, and what should be expected—i.e., if the vendor does not set out the appropriate benchmarks for performance, then the customer will choose his own and mark the supplier against these.

A corollary of these ideas is that it is NOT any given level of service that gives any particular level of satisfaction—it is the satisfaction of expectations, and expectations can be altered in a positive way by customer education.

B

Concurrent

Although the majority of the ratings are high, and about a mean of 8.9 (see Exhibit IV-1), the skew is not as pronounced as with the majority of the other companies, thus indicating that the customers are relatively satisfied.

This is, of course, backed up by the good satisfaction index (0.11) and a good overall hardware service satisfaction index (0.2) compared with for the population (0.9).

The histogram, Exhibit IV-2, shows a distribution fairly normally distributed about the 8.8 mean, but with a longer tail on the lower side, hence high importance concomitant with high satisfaction.

EXHIBIT IV-1

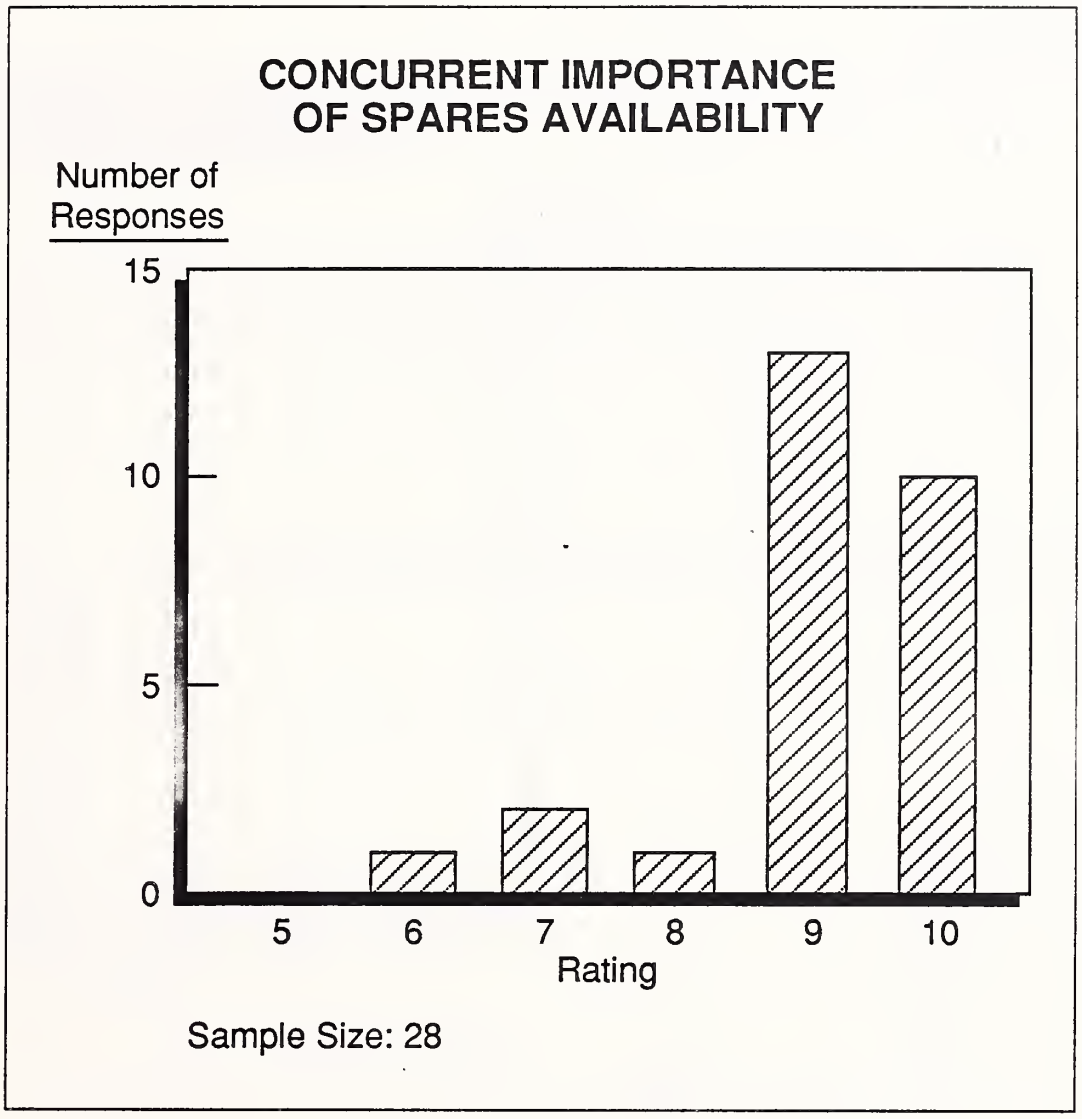
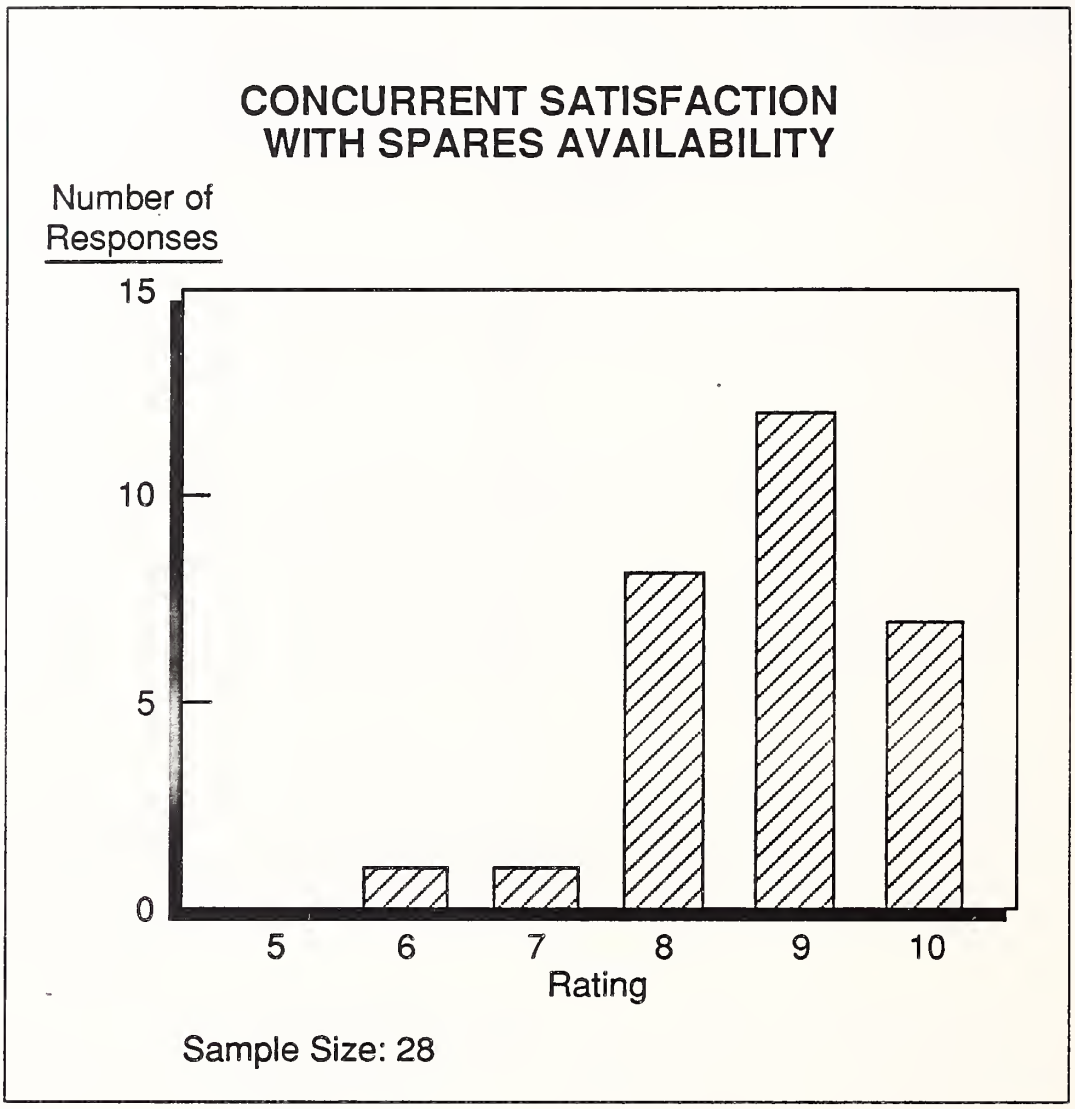


EXHIBIT IV-2



C
DEC

As can be seen from Exhibit IV-3, although there is skew towards the 10 rating, it is not as pronounced as with the majority of the other companies, and the mean is 8.9.

The satisfaction index at 0.8 compares with an overall hardware service satisfaction index of 1, this being at the customer concern level. The histogram, Exhibit IV-4, shows a distribution fairly normally distributed about an 8.2 rating, hence high importance and unsatisfied expectations.

EXHIBIT IV-3

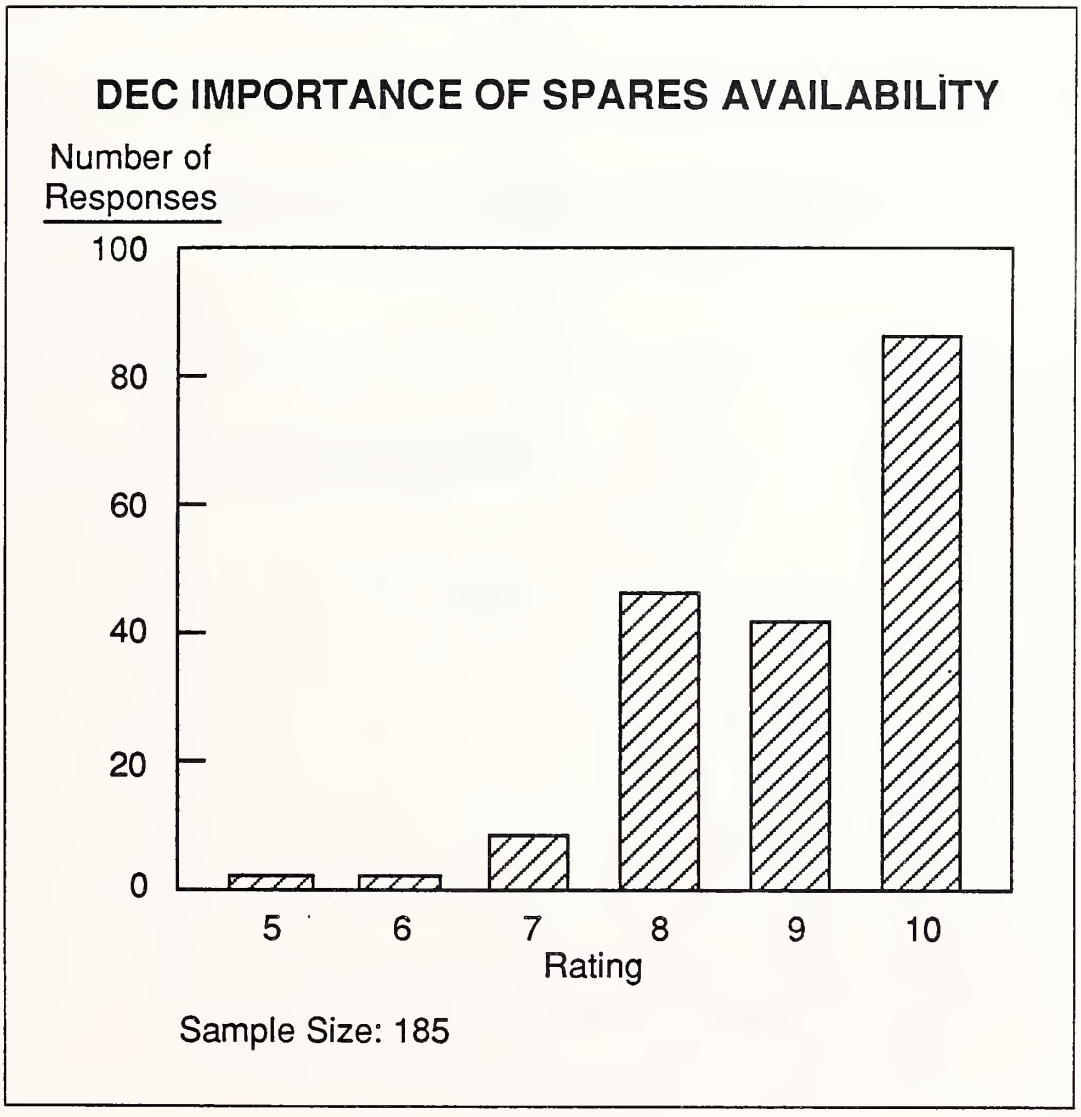
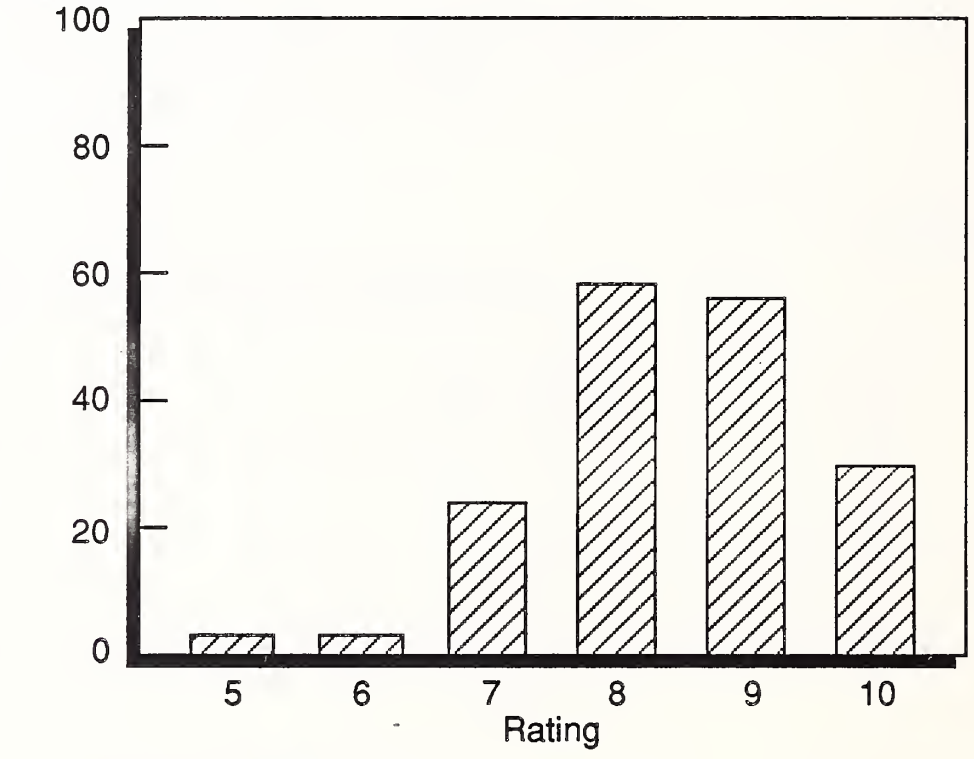


EXHIBIT IV-4

DEC SATISFACTION WITH SPARES AVAILABILITY



Sample Size: 185

D

Hewlett-Packard

From Exhibits IV-5 and IV-6 it can be seen that there is heavy skew in the importance histogram towards the 10 rating, and also significant skew in the satisfaction histogram.

This would indicate that the high importance attached to spares availability is partly matched by the skewed satisfaction.

The satisfaction index at 0.6 is much better than the overall hardware service satisfaction index of 0.9, which itself matches the population mean exactly.

EXHIBIT IV-5

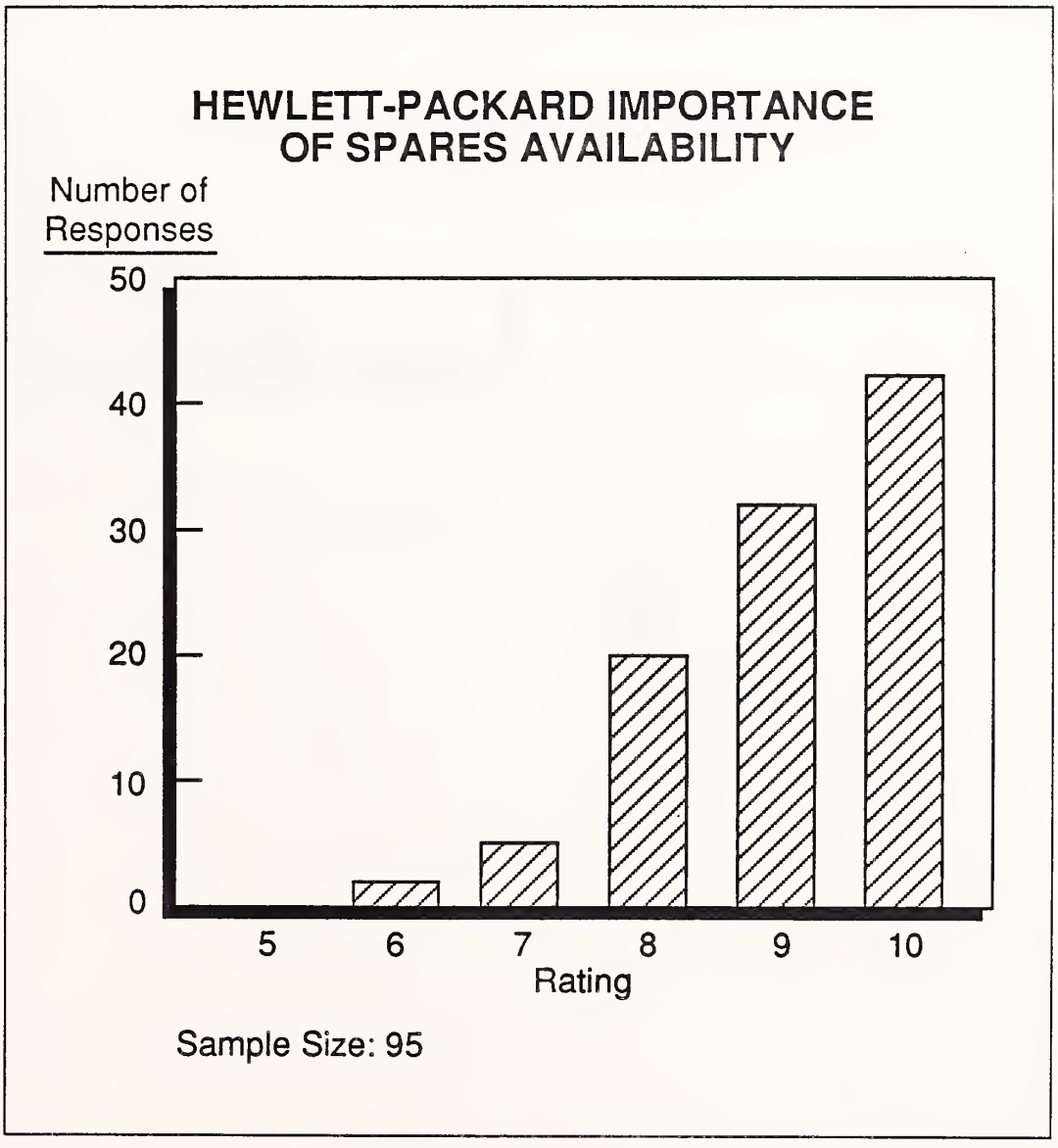
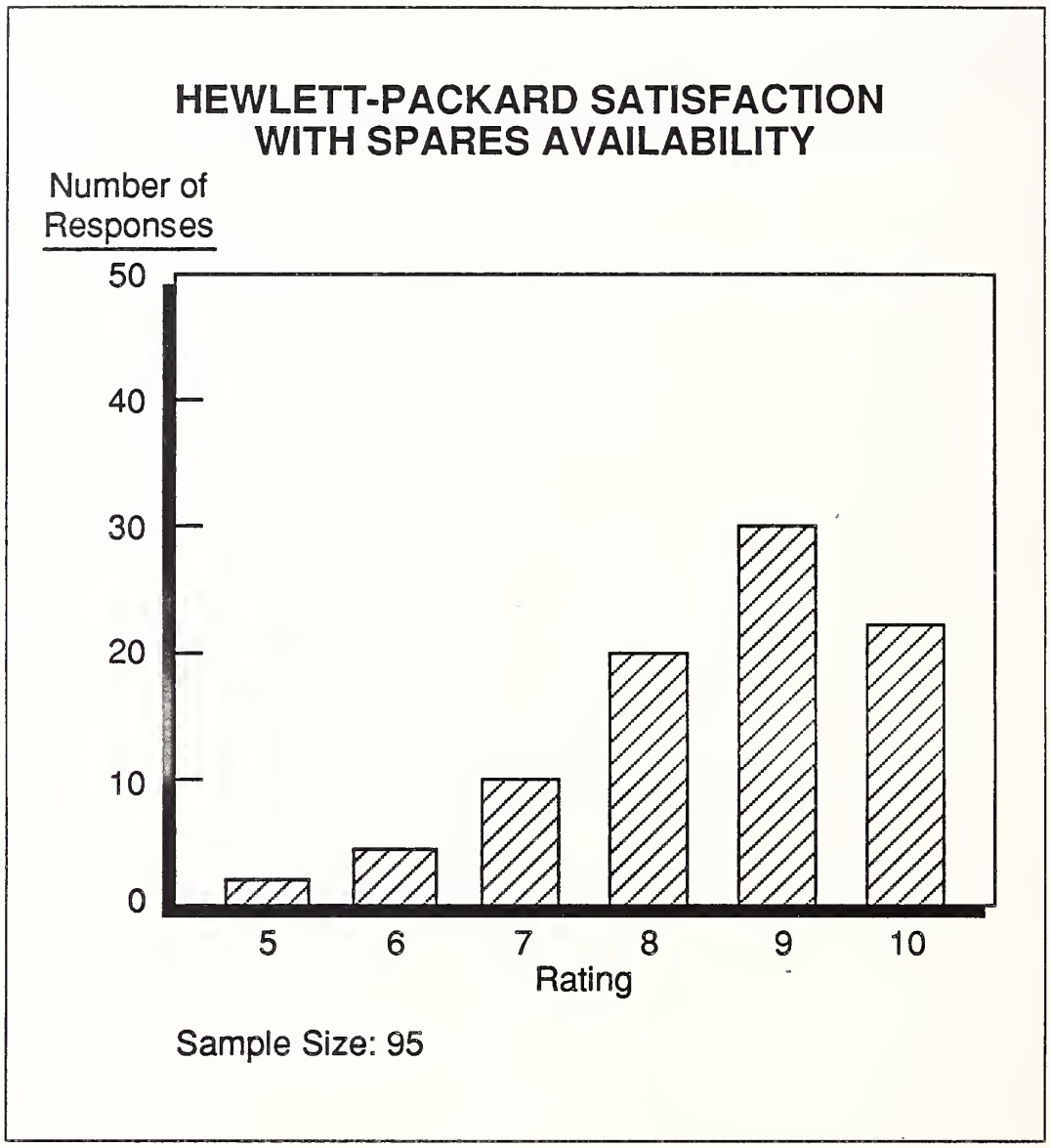


EXHIBIT IV-6



E

Honeywell Bull

The histogram in Exhibit IV-7 shows a strong skew to the top importance ratings, with a mean of 8.9 and a satisfaction index at 0.9 (population 0.99).

Exhibit IV-8 shows a fairly normal distribution about a mean of 8.0, indicating that a high importance attached to spares availability is unmatched with a corresponding satisfaction level.

The satisfaction index at 0.9 corresponds almost exactly with the overall hardware satisfaction index of 1, which itself compares with the population mean of 0.9.

EXHIBIT IV-7

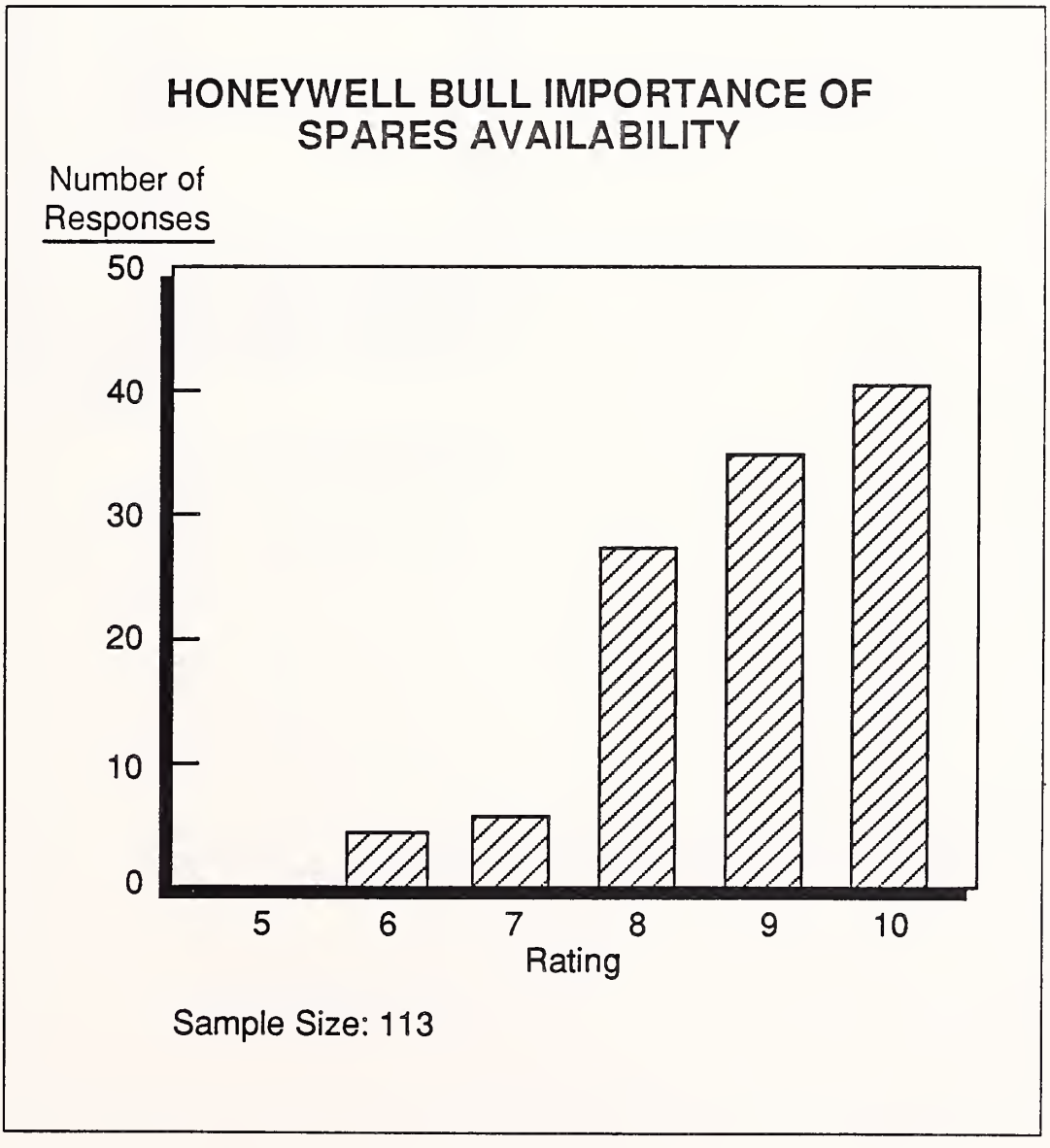
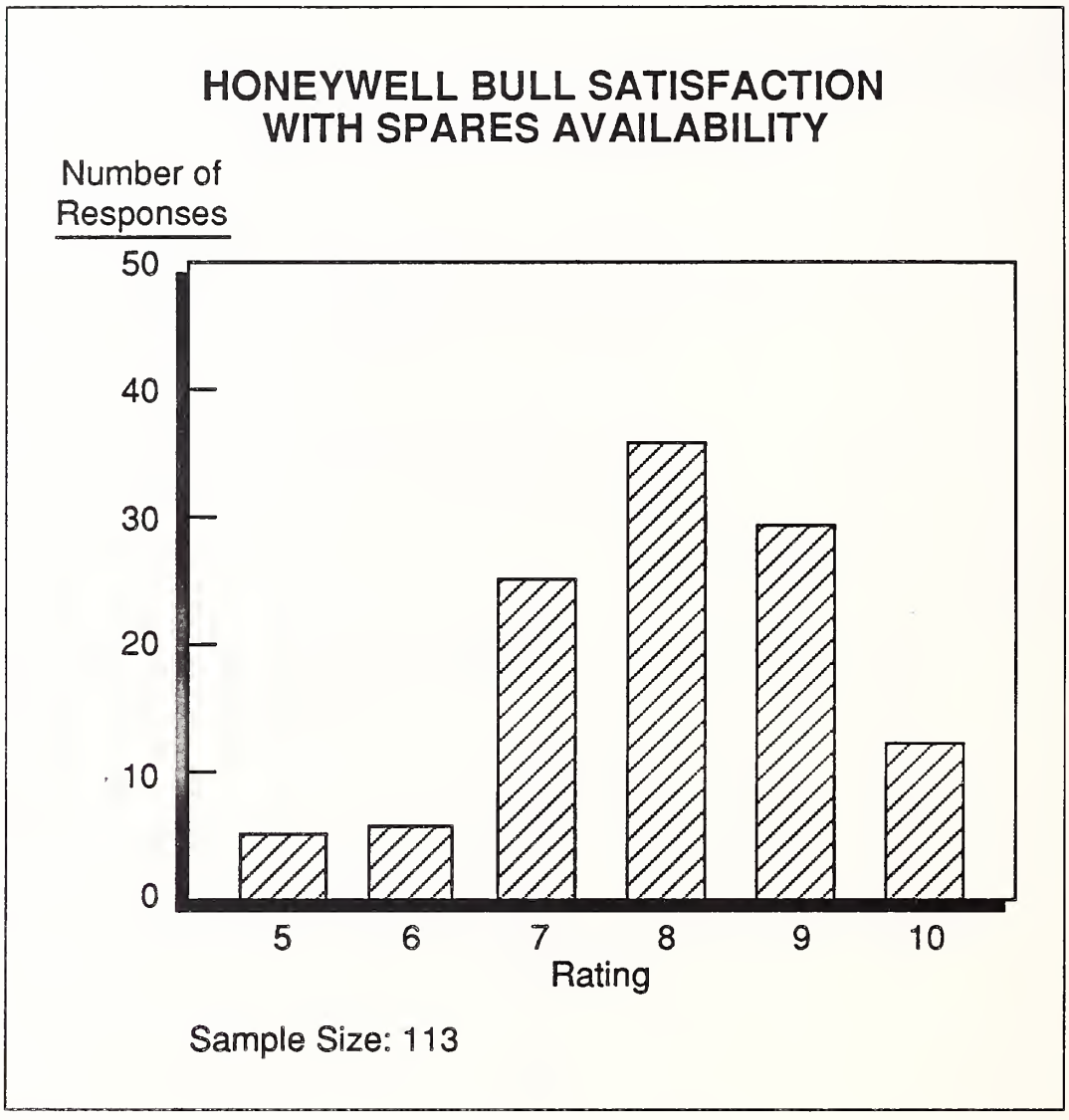


EXHIBIT IV-8



F

IBM

The histogram in Exhibit IV-9 demonstrates a strong skew to the top importance ratings, with a mean of 9.0 and a satisfaction index of 0.8 (population 0.99).

Exhibit IV-10 shows a skewed distribution about a mean of 8.2 indicating that a high importance attached to spares availability is partially unmatched with a corresponding satisfaction level.

The satisfaction index at 0.8 corresponds exactly with the overall hardware satisfaction index of 0.8, which itself compares with the population mean of 0.9, i.e., marginally better than the parent population.

EXHIBIT IV-9

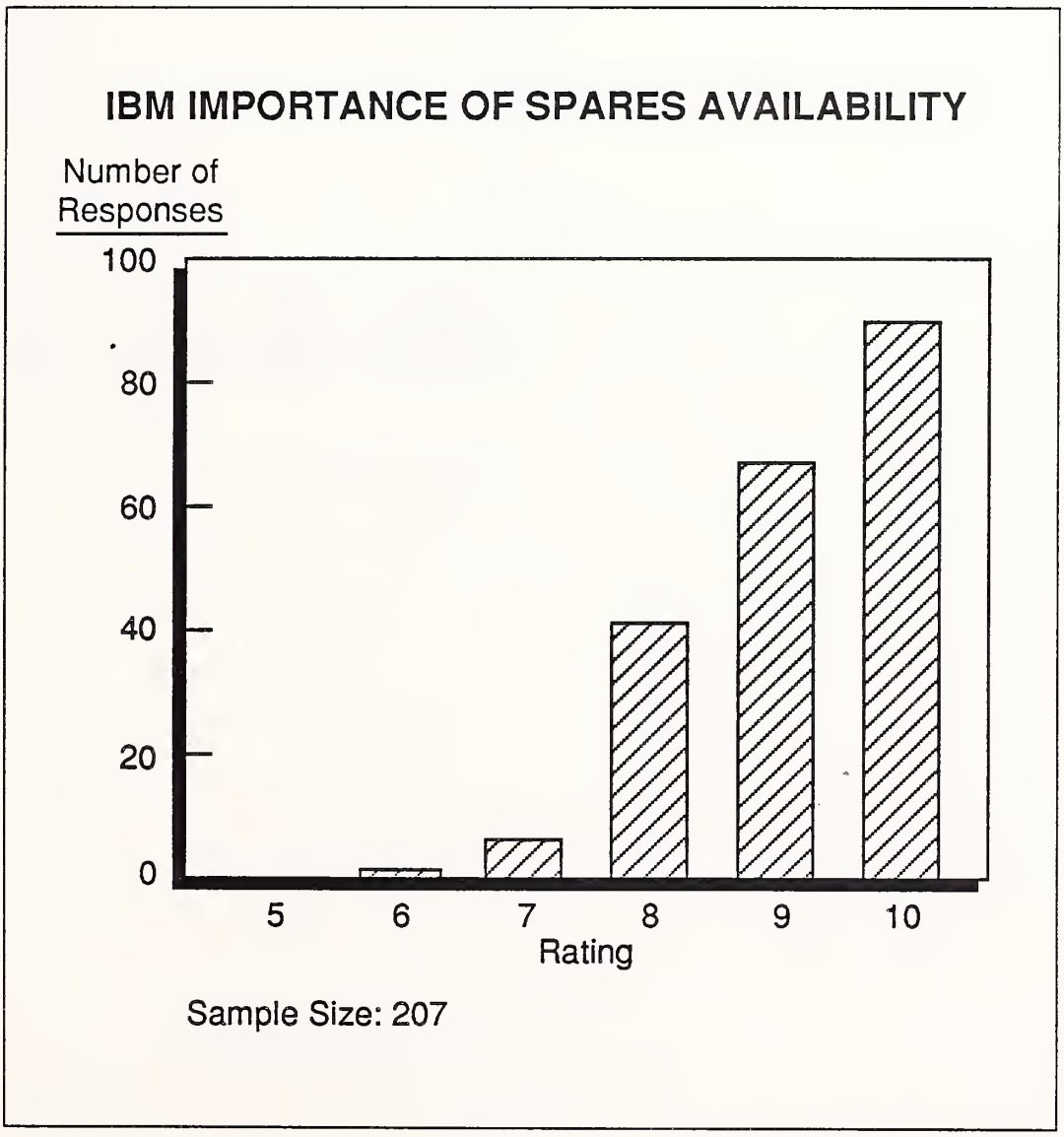
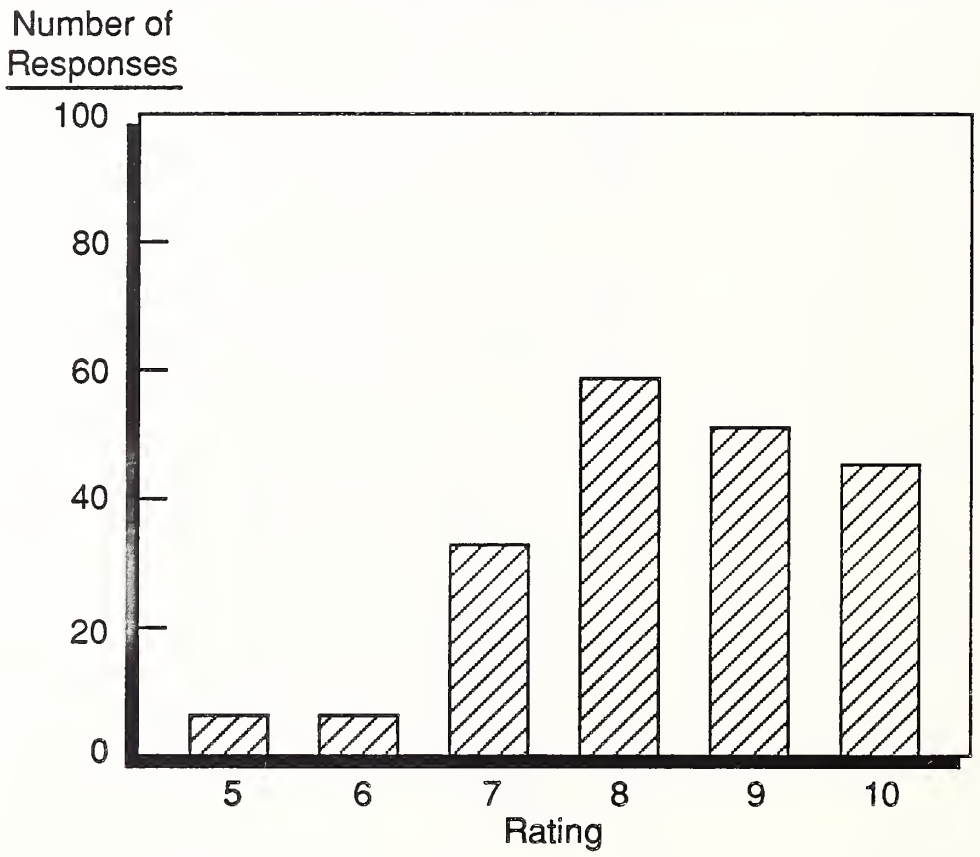


EXHIBIT IV-10

IBM SATISFACTION WITH SPARES AVAILABILITY



Sample Size: 207

G

ICL

The histogram Exhibit IV-11 shows a pronounced skew to the top importance ratings, with a mean of 8.9 and a satisfaction index of 0.9 (population 0.99).

Exhibit IV-12 shows a slightly skewed distribution about a mean of 8.0, indicating that a high importance attached to spares availability is partially unmatched with a corresponding satisfaction level.

The satisfaction index at 0.9 is much better than the index for overall hardware satisfaction at 1.3, which itself compares with the population mean of 0.9.

EXHIBIT IV-11

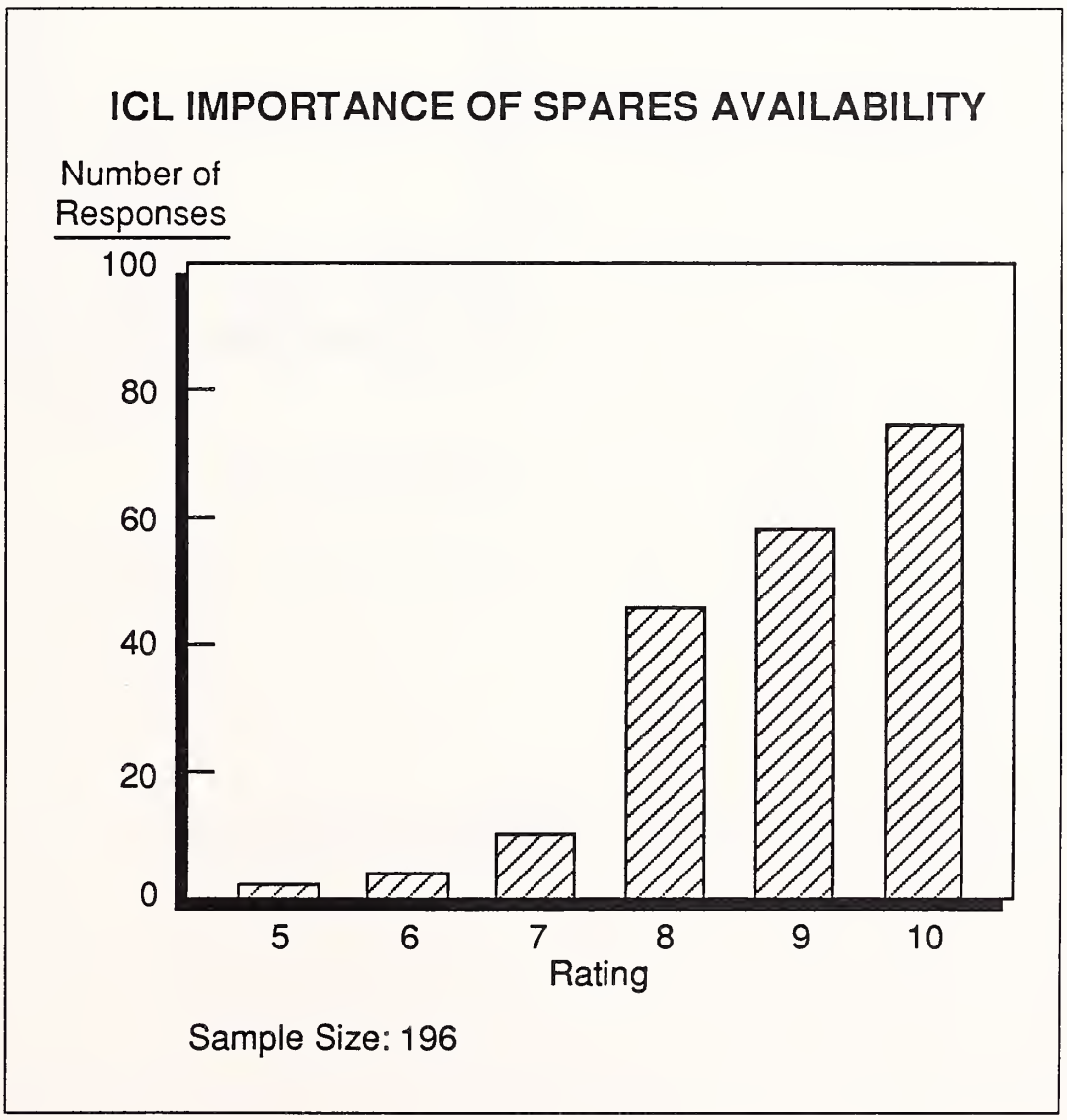
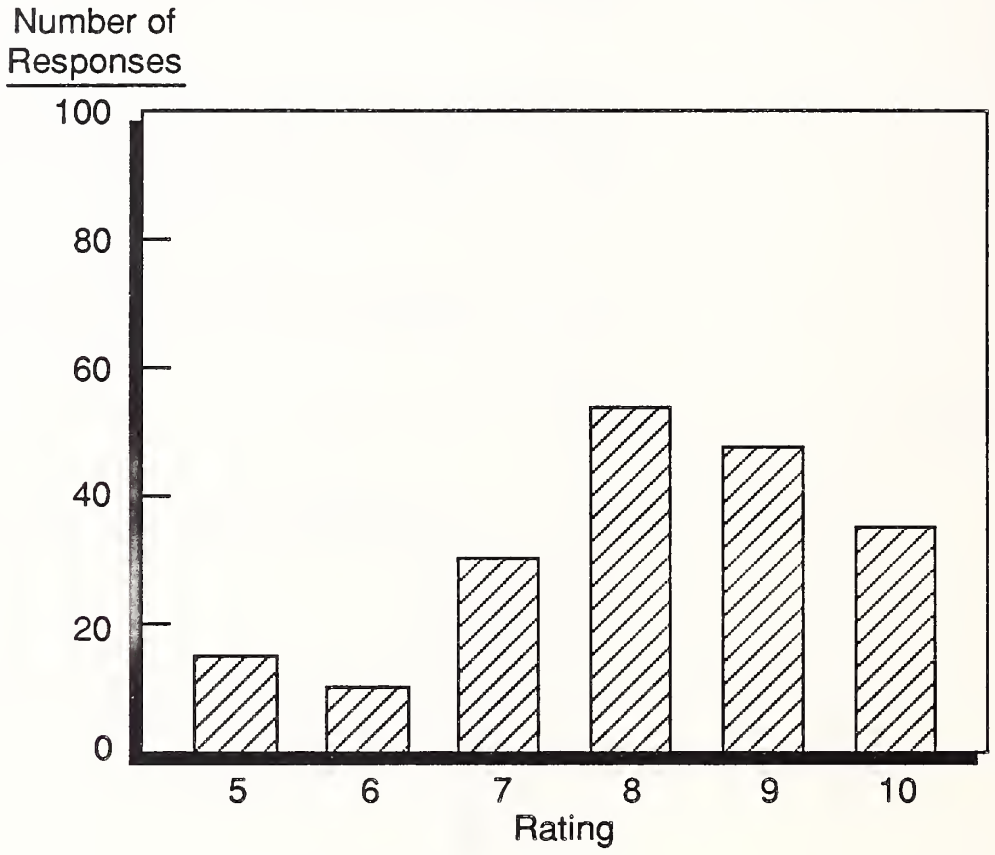


EXHIBIT IV-12

ICL SATISFACTION WITH SPARES AVAILABILITY



Sample Size: 196

H

ITL

The histogram Exhibit IV-13 shows a fairly normal distribution about a mean of 8.9 and a very good satisfaction index of 0.2 (population 0.99).

Exhibit IV-14 shows a quite abnormal distribution about a mean of 8.7, indicating that a high importance attached to spares availability is very well matched with a corresponding satisfaction level.

The satisfaction index at 0.2 is also better than the index for overall hardware satisfaction at 0.4, which itself compares with the population mean of 0.9.

EXHIBIT IV-13

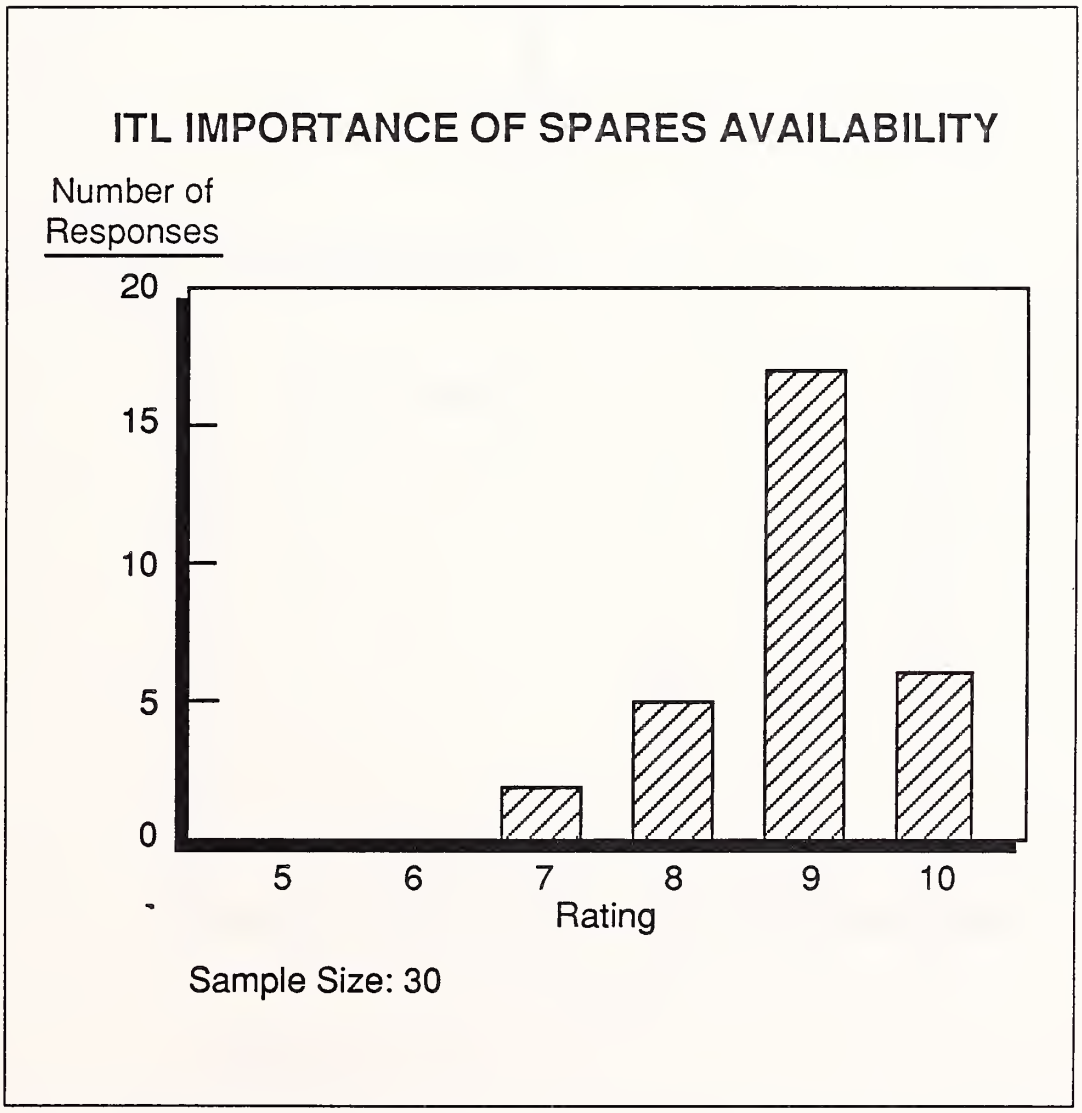
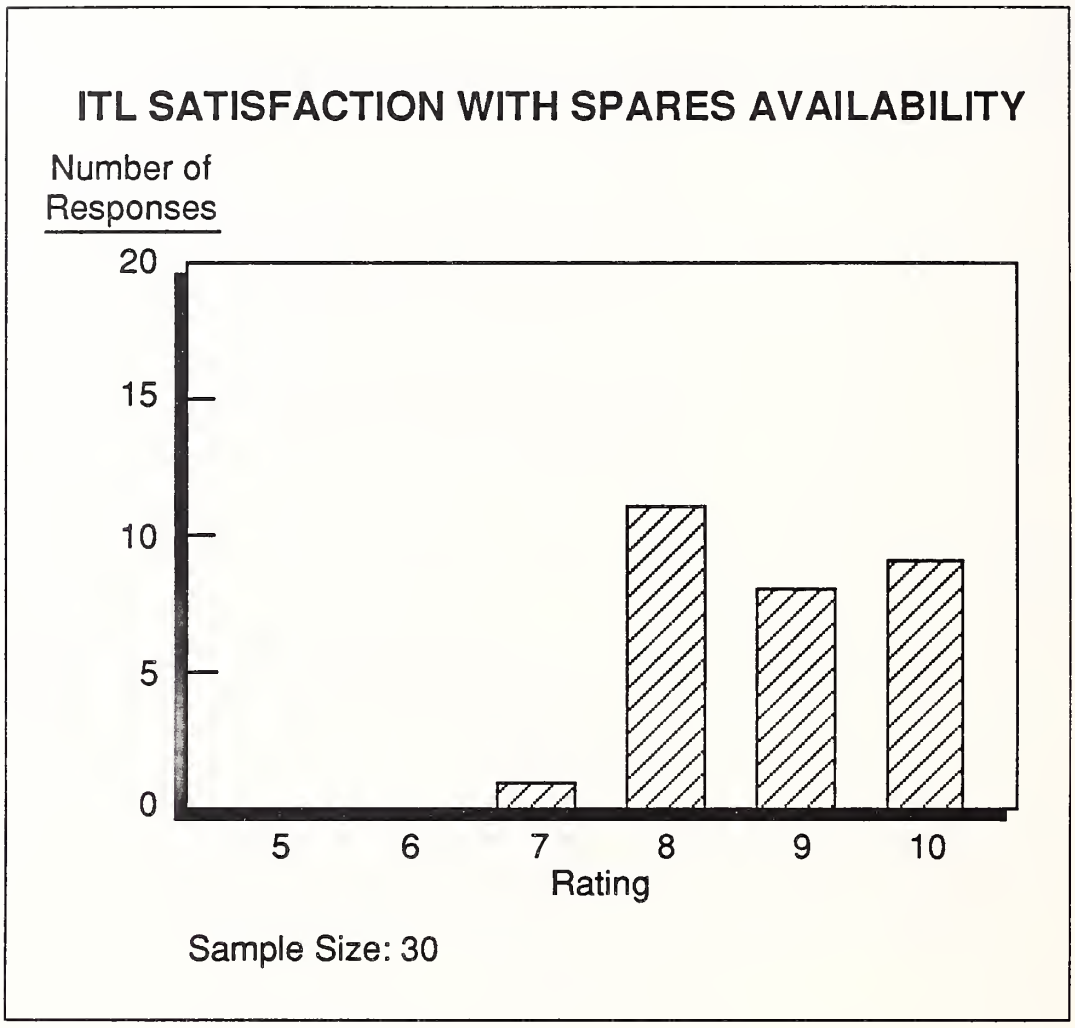


EXHIBIT IV-14



I

NCR

The histogram Exhibit IV-15 shows a pronounced skew to the top importance ratings, with a mean of 8.7 and a satisfaction index of 0.9 (population 0.99).

Exhibit IV-16 shows a slightly skewed distribution about a mean of 7.8, indicating that a high importance attached to spares availability is partially unmatched with a corresponding satisfaction level.

The satisfaction index at 0.9 roughly corresponds to the index for overall hardware satisfaction at 1.0, which itself compares with the population mean of 0.9, i.e., a roughly average performance.

EXHIBIT IV-15

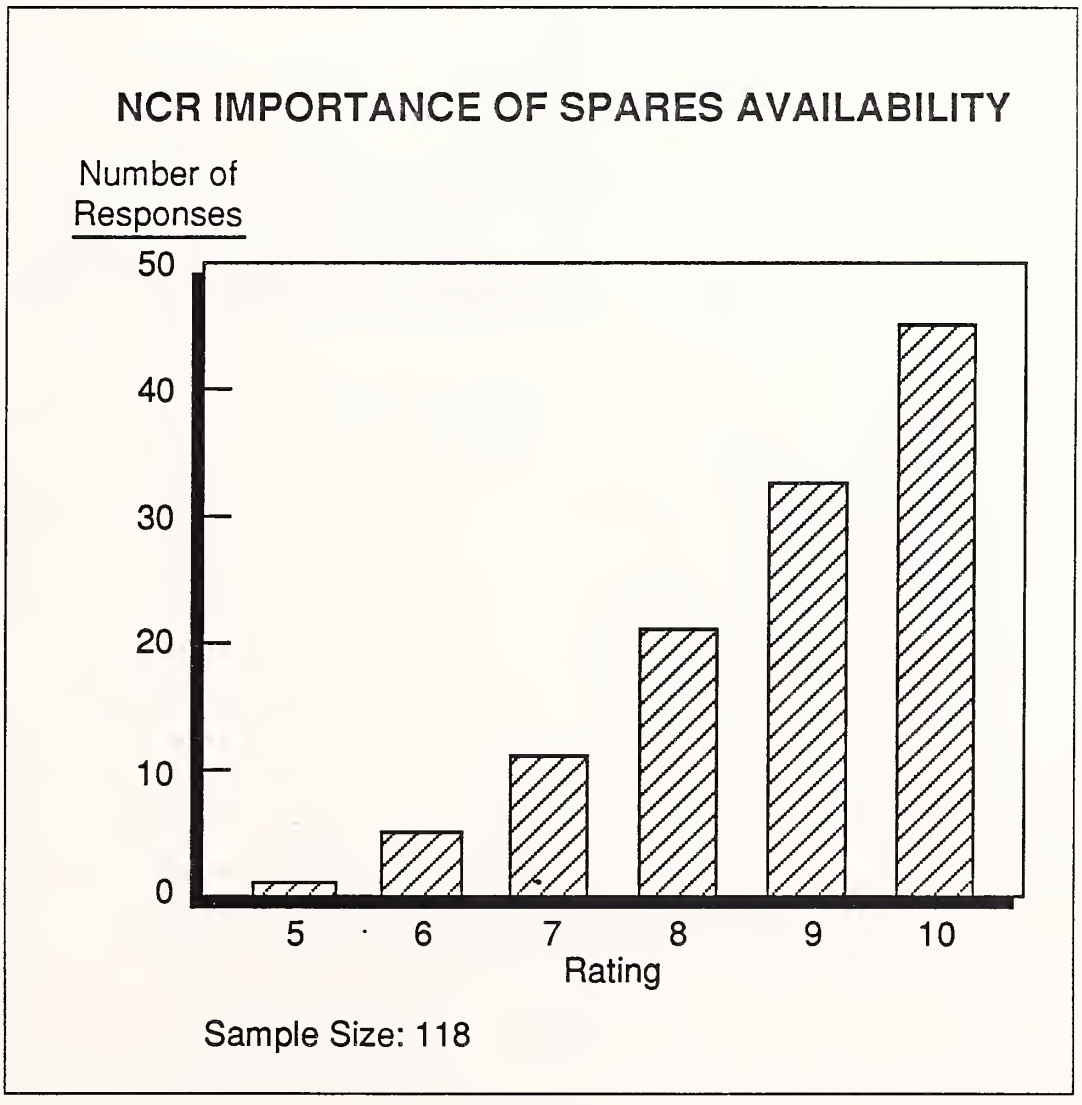
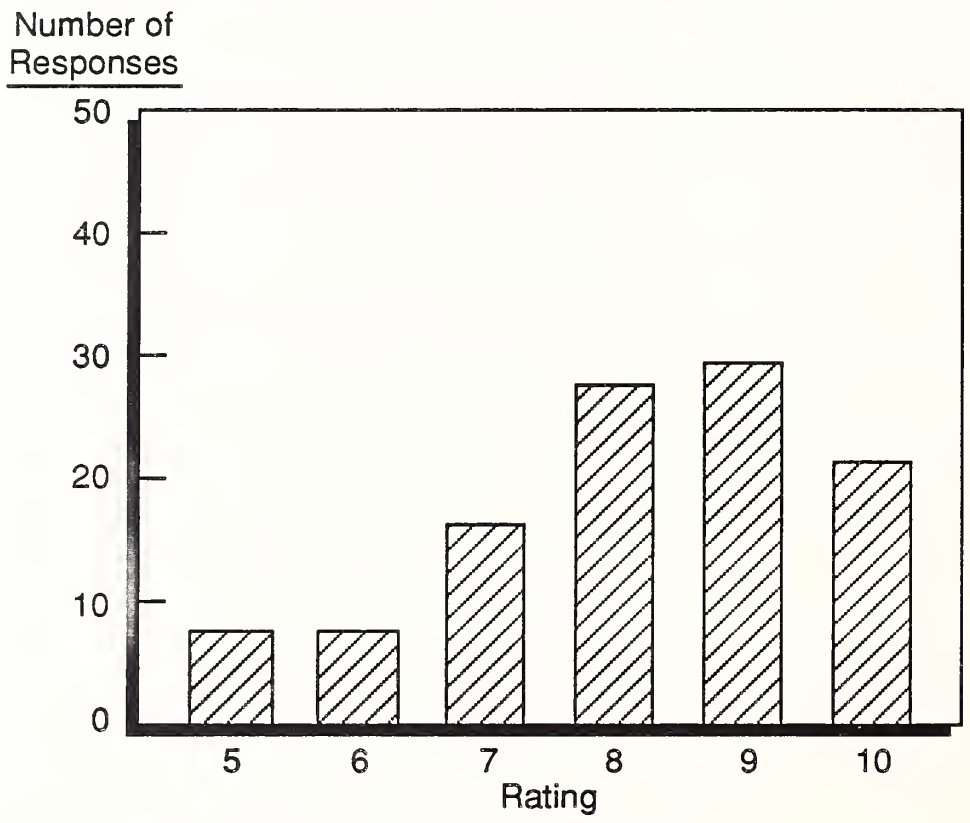


EXHIBIT IV-16

NCR SATISFACTION WITH SPARES AVAILABILITY



Sample Size: 118

J

Nixdorf

The histogram in Exhibit IV-17 shows a strong skew to the top importance ratings (not a normal distribution), with a mean of 8.5 and a satisfaction index at 0.8 (population 0.99).

Exhibit IV-18 shows a fairly normal distribution (with some skew) about a mean of 7.7, indicating that a high importance attached to spares availability is unmatched with a corresponding satisfaction level, with additional indications of some very unsatisfied customers (the lower peak).

The satisfaction index at 0.8 corresponds almost exactly with the overall hardware satisfaction index of 0.9, which itself corresponds with the population mean of 0.9, i.e., a roughly average performance.

EXHIBIT IV-17

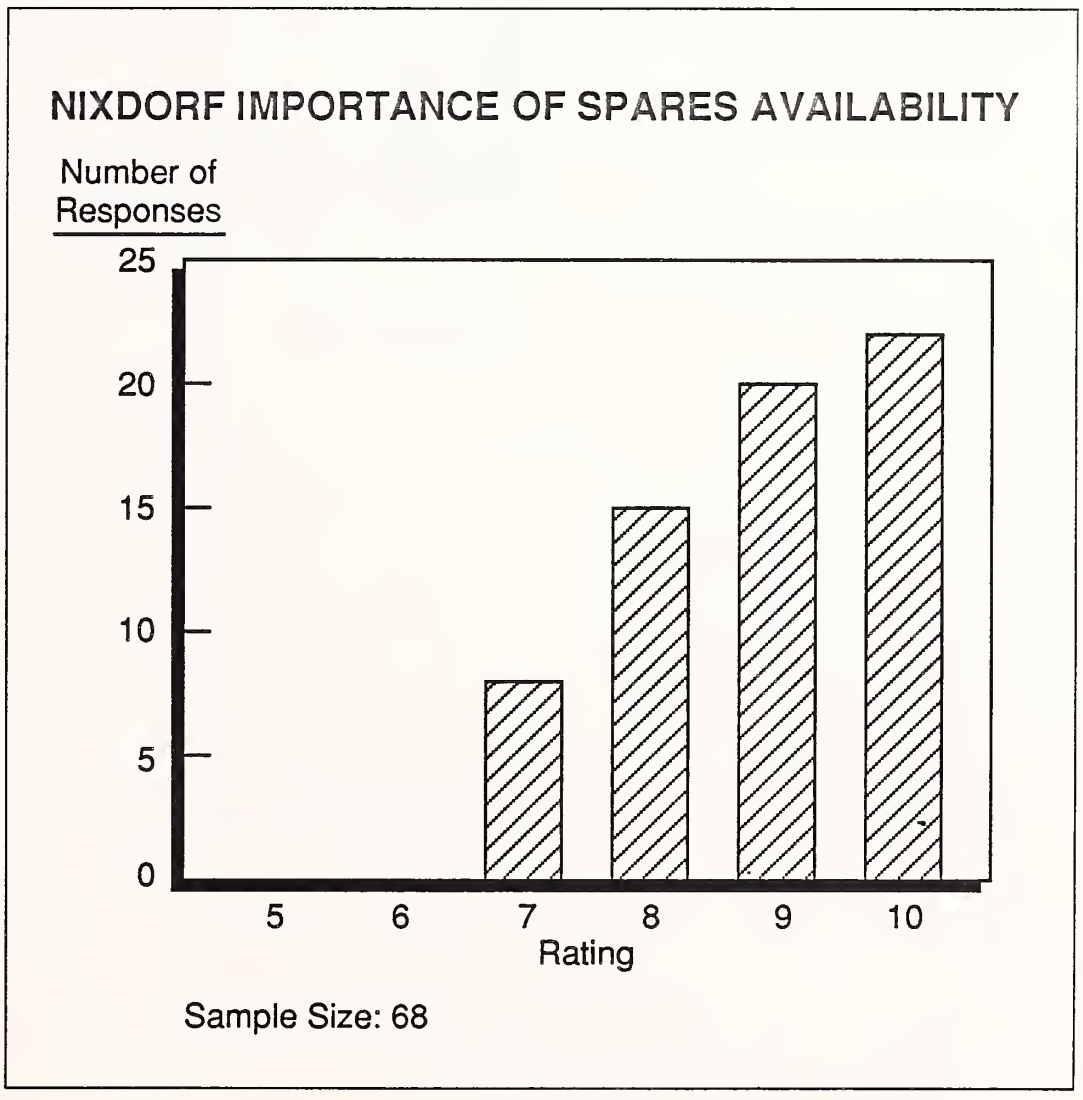
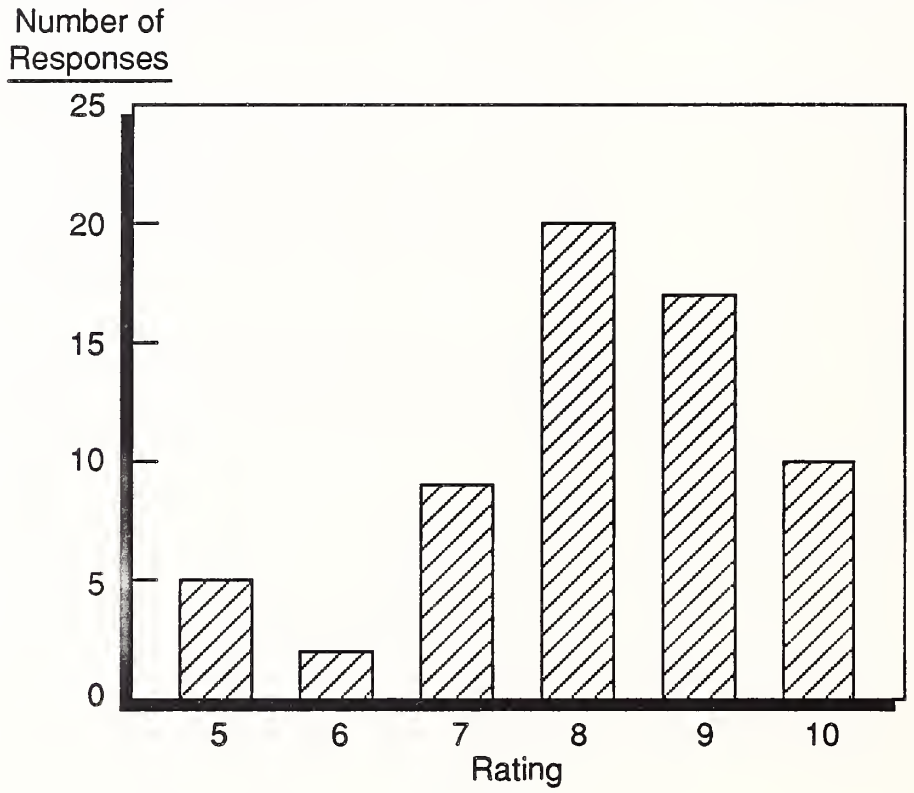


EXHIBIT IV-18

NIXDORF SATISFACTION WITH SPARES AVAILABILITY



Sample Size: 68

K

Olivetti

The histogram Exhibit IV-19 shows a fairly normal distribution about a mean of 8.3 and the best satisfaction index at 0, i.e., full customer satisfaction, (population mean 0.99).

Exhibit IV-20 shows a quite abnormal distribution about a mean of 8.3, indicating that a high importance attached to spares availability is extremely well matched with a corresponding satisfaction level.

The satisfaction index at 0 is also much better than the index for overall hardware satisfaction at 0.4, which itself compares with the population mean of 0.9, i.e., a much better performance than the population average.

EXHIBIT IV-19

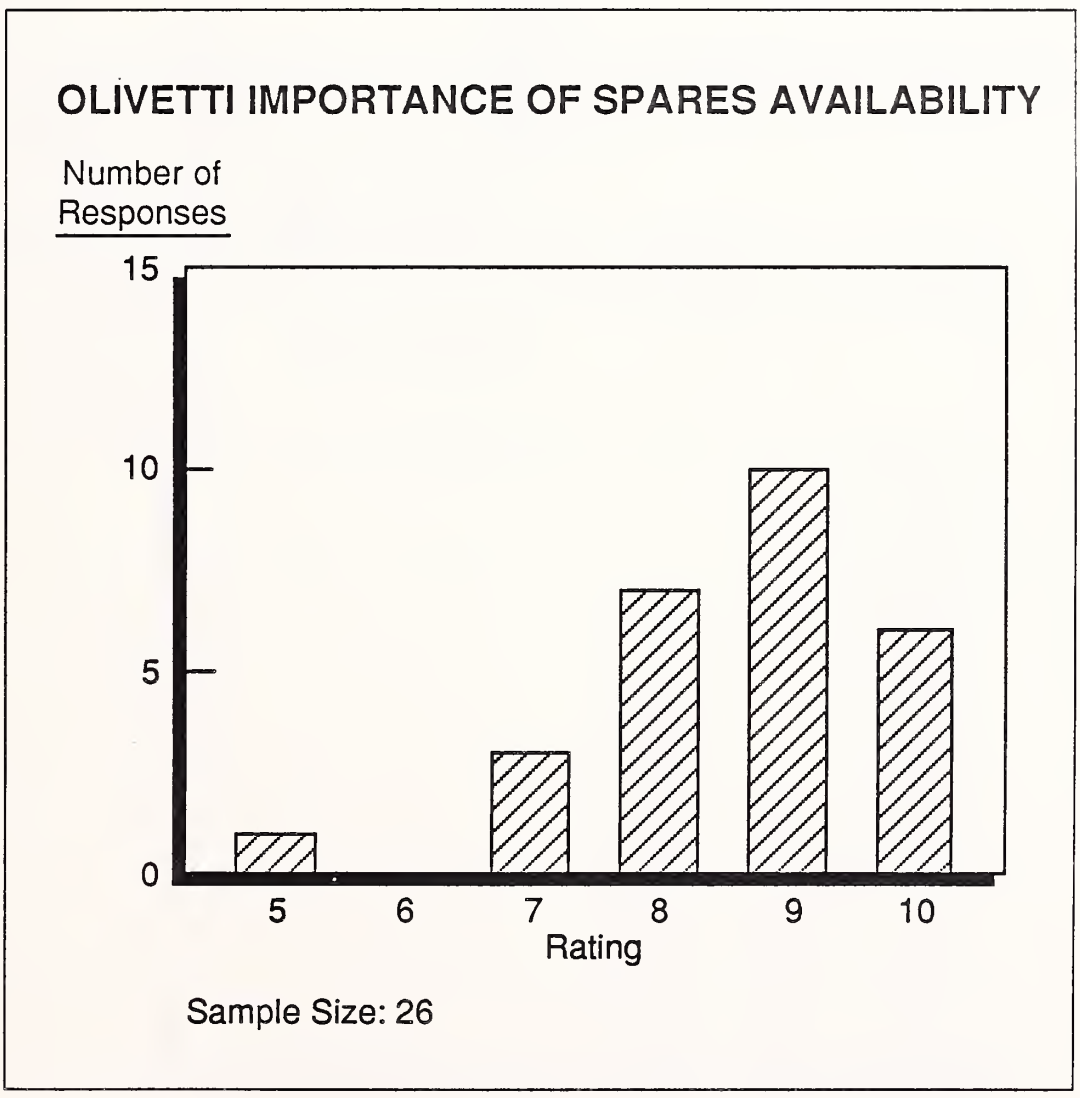
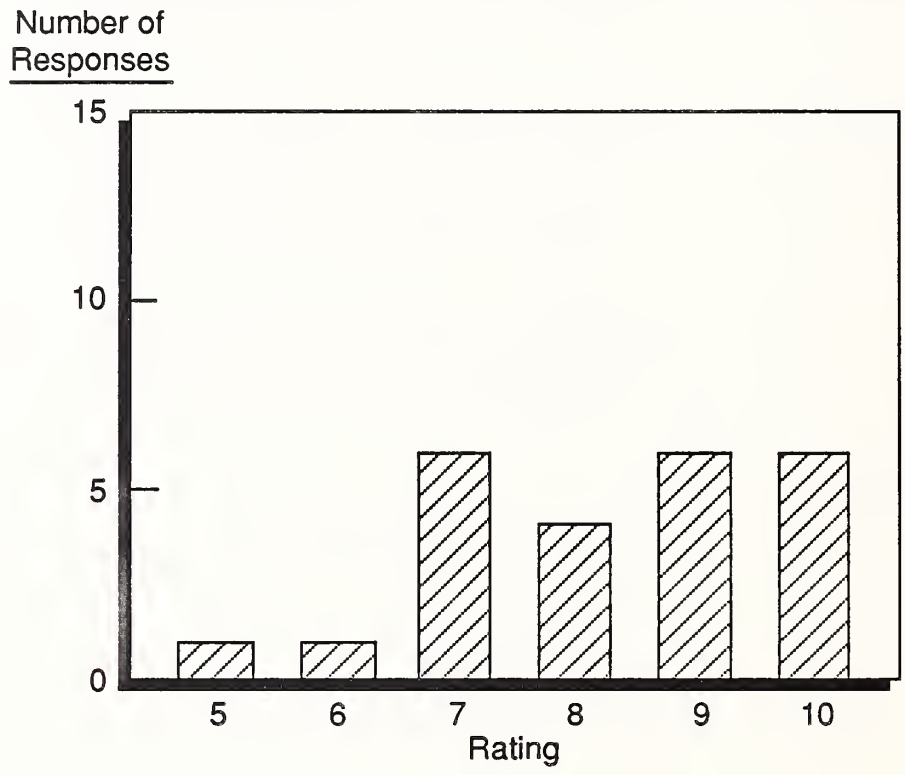


EXHIBIT IV-20

OLIVETTI SATISFACTION WITH SPARES AVAILABILITY



Sample Size: 26

L

Philips

The histogram Exhibit IV-21 shows a strong skew to the top importance ratings (not a normal distribution), with a mean of 8.6 and a satisfaction index at 0.6 (population 0.99).

Due note should be taken of the fact that the sample for this company was only 11.

Exhibit IV-22 shows another abnormal skewed distribution about a mean of 8.0, indicating that a high importance attached to spares availability is only partially matched to the corresponding satisfaction level, with additional indications of some very unsatisfied customers (the lower peak).

The satisfaction index at 0.6 compares with the overall hardware satisfaction index of 0.9, which itself corresponds with the population mean of 0.9, i.e., a better-than-average performance.

EXHIBIT IV-21

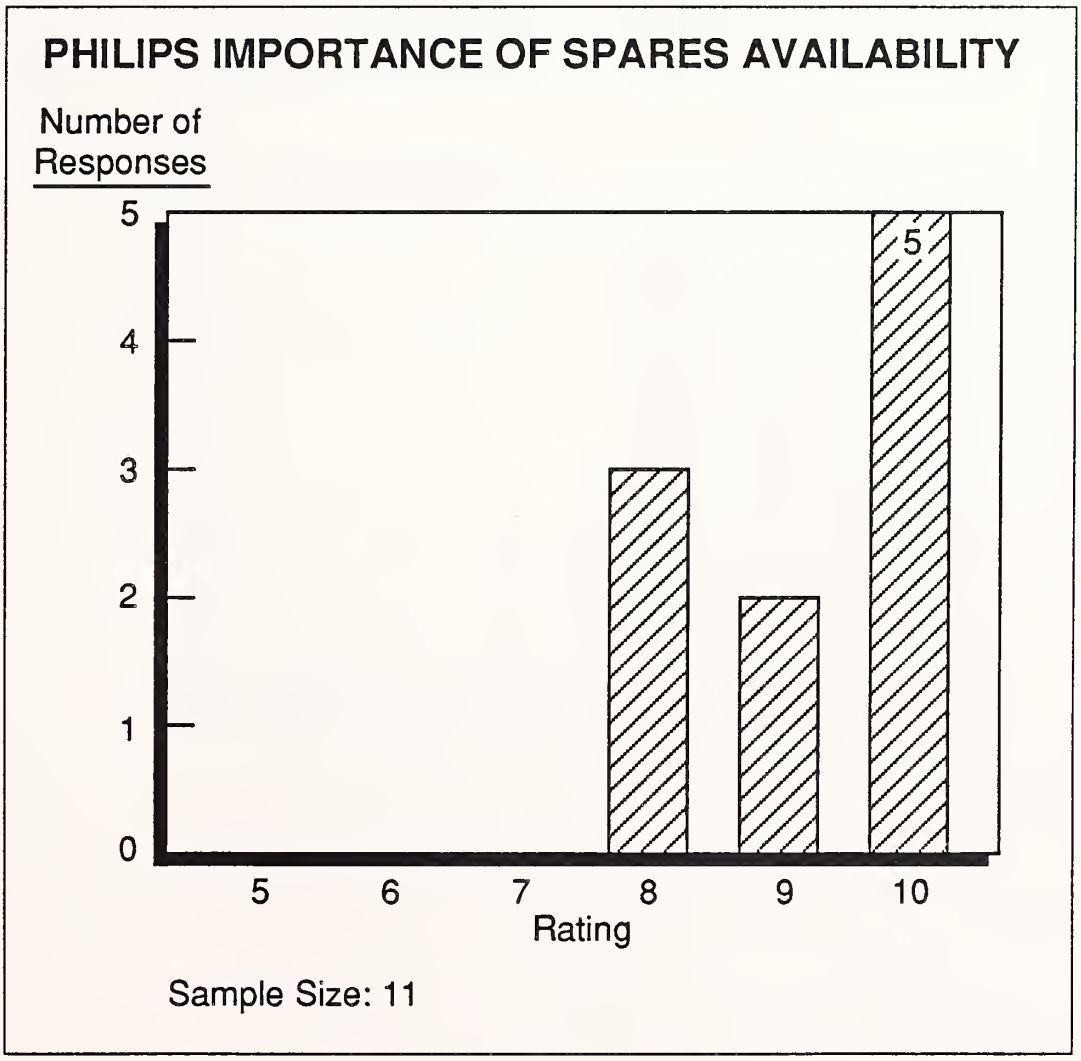
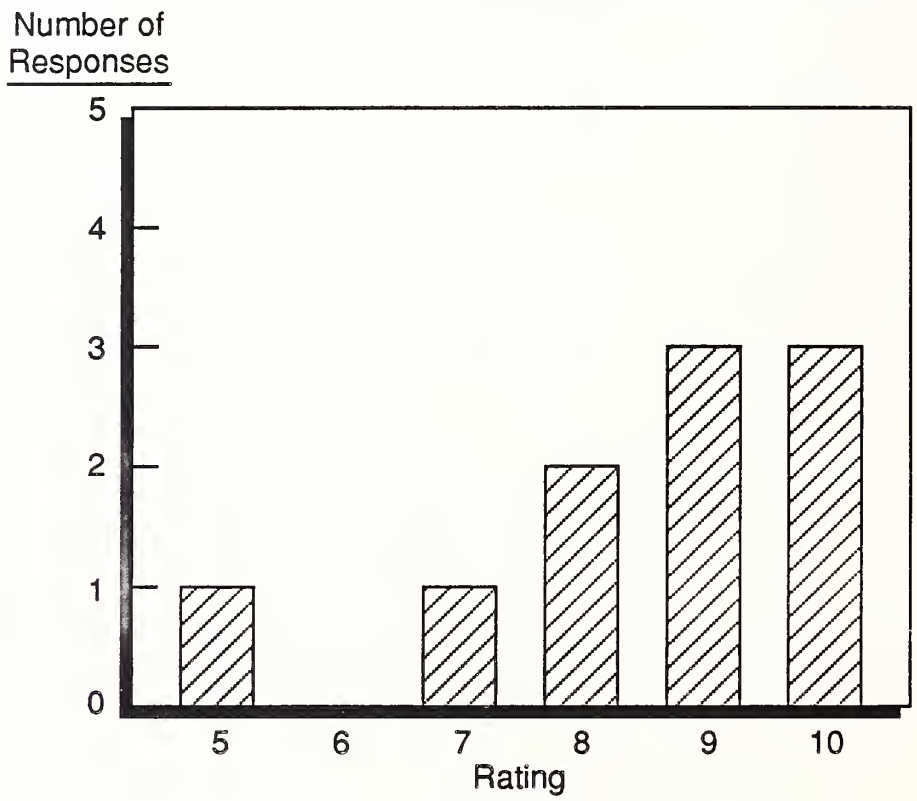


EXHIBIT IV-22

PHILIPS SATISFACTION WITH SPARES AVAILABILITY



Sample Size: 11

M

Siemens

The histogram in Exhibit IV-23 shows a fairly normal distribution about a mean of 8.4 and a good satisfaction index at 0.4, i.e., quite good customer satisfaction, (population mean 0.99).

Exhibit IV-24 shows a quite abnormal distribution about a mean of 8.0, indicating that a high importance attached to spares availability is quite well matched with an average corresponding satisfaction level, except for the indications of some very dissatisfied customers represented by the peaks at the 5 and 6 rating levels.

The satisfaction index at 0.4 is only a little worse than the index for overall hardware satisfaction at 0.3, which itself compares with the population mean of 0.9, i.e., a much better performance than the population average.

EXHIBIT IV-23

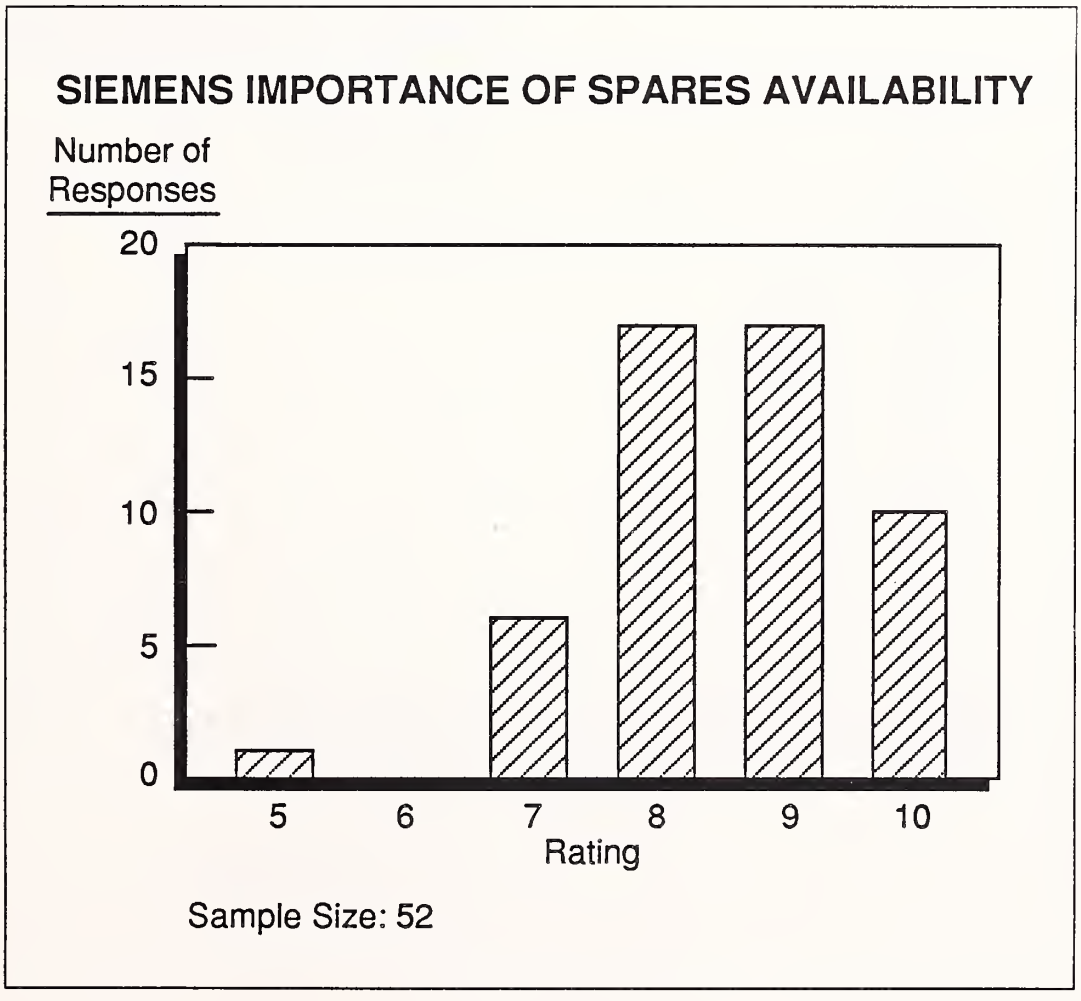
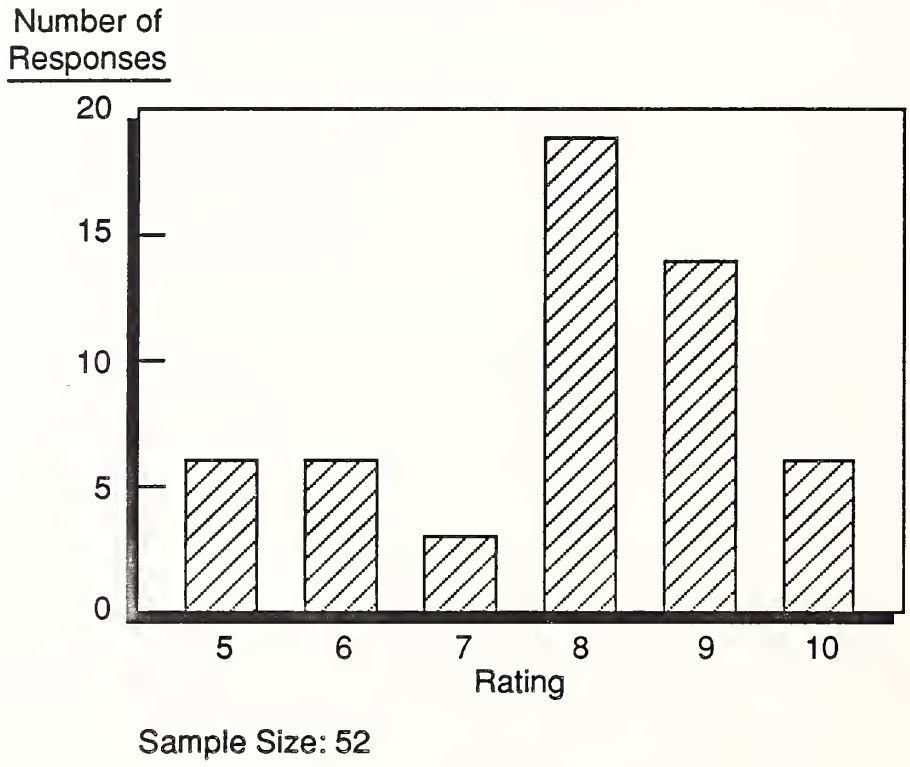


EXHIBIT IV-25

SIEMENS SATISFACTION WITH SPARES AVAILABILITY



Sample Size: 52

N

Unisys

The histogram Exhibit IV-25 shows a strong skew to the top importance ratings, with a mean of 9.0 and a satisfaction index at 1.3 (population 0.99).

Exhibit IV-26 shows a fairly normal distribution about a mean of 7.7, indicating that a high importance attached to spares availability is unmatched with a corresponding satisfaction level.

The satisfaction index at 1.3 corresponds almost exactly with the overall hardware satisfaction index of 1.2, which itself compares with the population mean of 0.9, i.e., a worse-than-average performance.

EXHIBIT IV-25

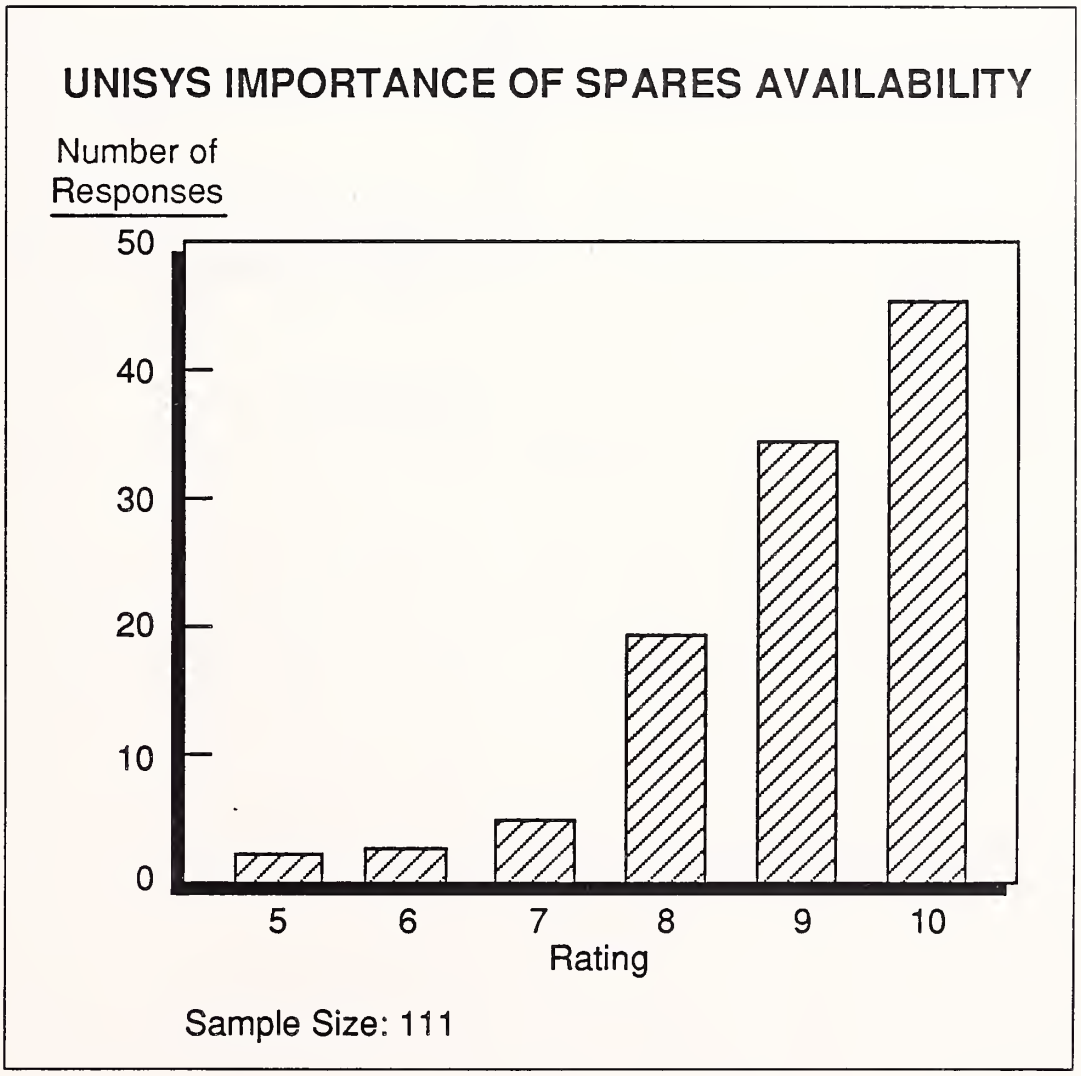
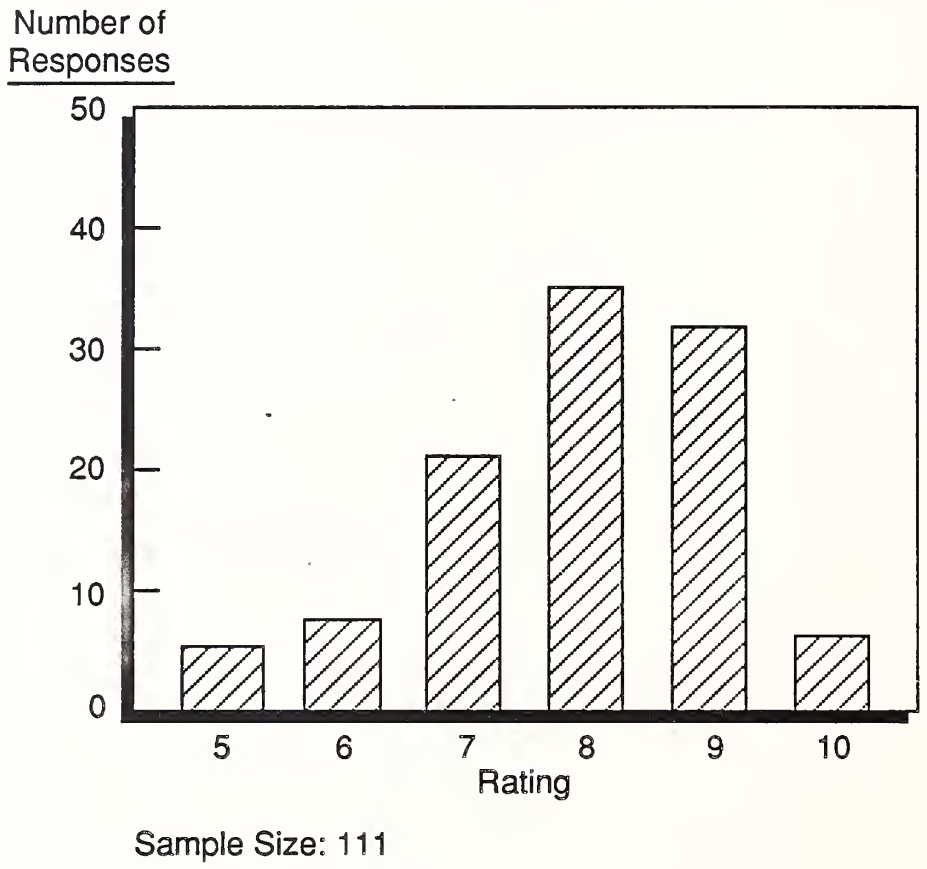


EXHIBIT IV-26

UNISYS SATISFACTION WITH SPARES AVAILABILITY



Sample Size: 111

O

Wang

The histogram of Exhibit IV-27 shows a pronounced skew to the top importance ratings, with a mean of 9.2 and a satisfaction index of 1.6 (population 0.99).

Exhibit IV-28 shows a slightly skewed (non-normal) distribution about a mean of 7.6, indicating that a high importance attached to spares availability is quite unmatched with a corresponding satisfaction level.

The satisfaction index at 1.6 compares with the index for overall hardware satisfaction at 1.4, which itself compares with the population mean of 0.9, a below-average performance.

EXHIBIT IV-27

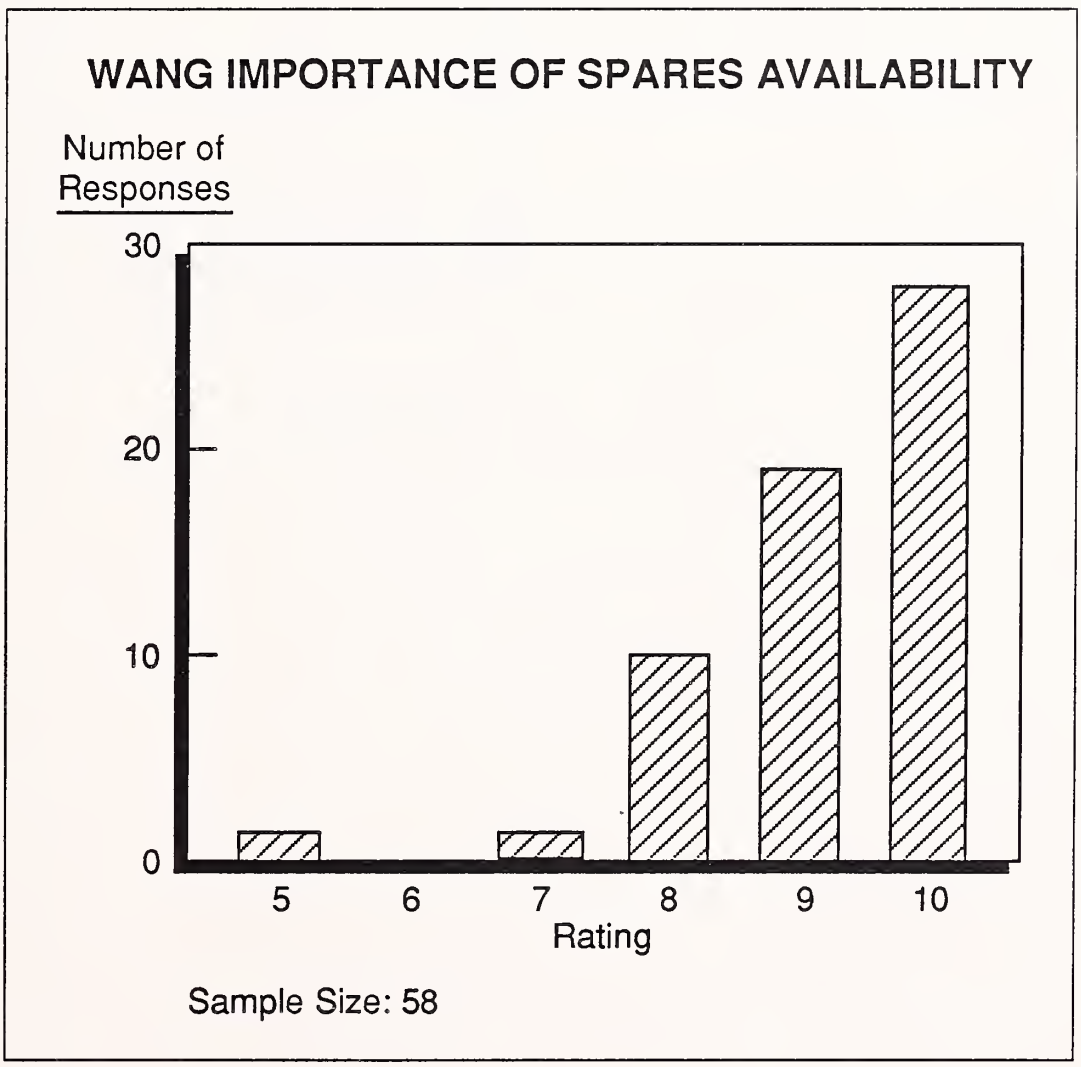
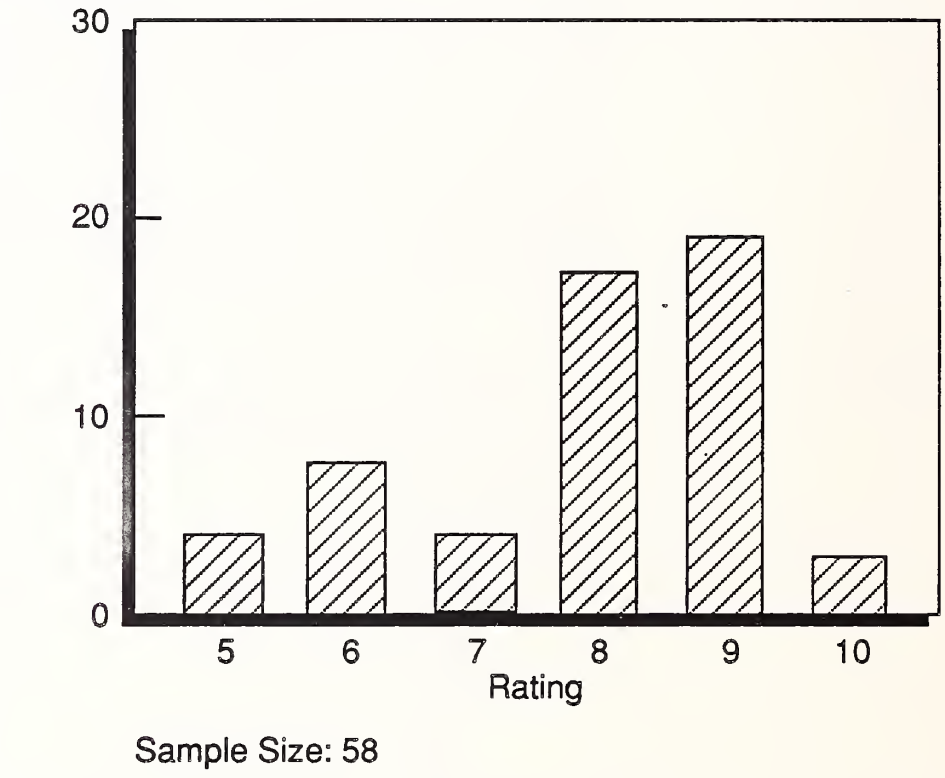


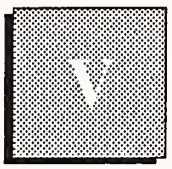
EXHIBIT IV-28

WANG SATISFACTION WITH SPARES AVAILABILITY



Sample Size: 58

Spares Availability by Country



Spares Availability by Country

A

Belgium

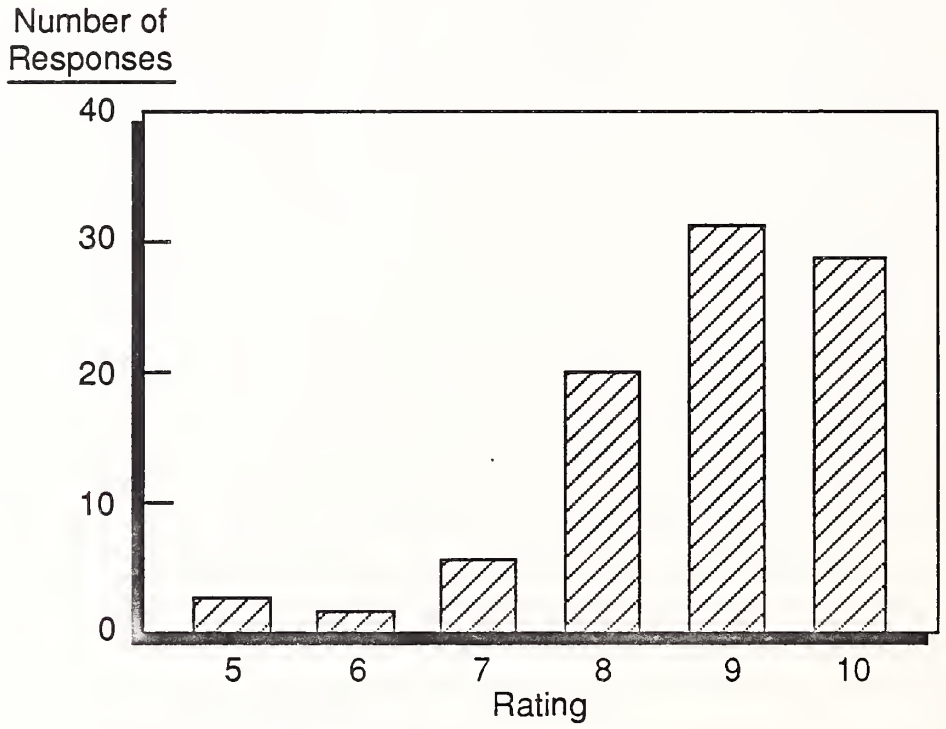
As can be seen from Exhibit V-1, there is a quite heavy skew in importance about a mean of 8.8, and with a satisfaction index of 0.6.

Exhibit V-2 shows a reasonably normal distribution about a mean of 8.2, indicating an undersatisfaction of expectations.

The satisfaction index at 0.6 compares with 0.6 for hardware maintenance as a whole, and with 0.9 for the population mean, a slightly better than average performance.

EXHIBIT V-1

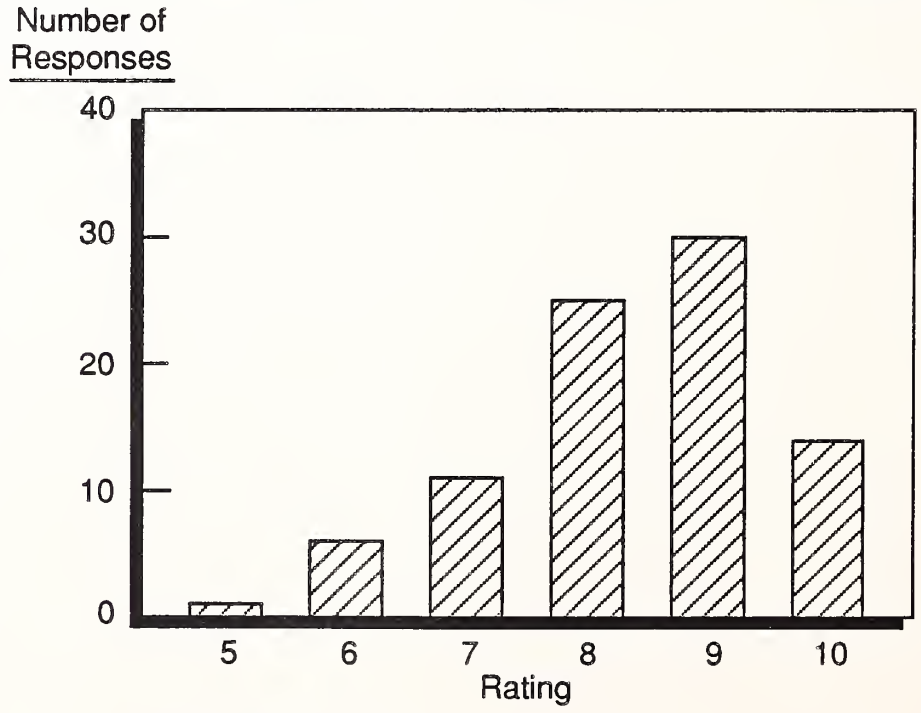
BELGIUM IMPORTANCE OF SPARES AVAILABILITY



Sample Size: 90

EXHIBIT V-2

BELGIUM SATISFACTION WITH SPARES AVAILABILITY



Sample Size: 90

B

Denmark

As can be seen from Exhibit V-3, there is a heavy skew in importance towards the 10 rating about a mean of 9.4, and with a satisfaction index of 1.0 (customer concern level).

Exhibit V-4 shows a reasonably normal distribution about a mean of 8.4, indicating a significant undersatisfaction of expectations, but also a number of customers who are clearly dissatisfied (at the 5 rating).

The satisfaction index at 1.0 compares with 0 for hardware maintenance as a whole, and with 0.9 for the population mean, a much better than average performance.

EXHIBIT V-3

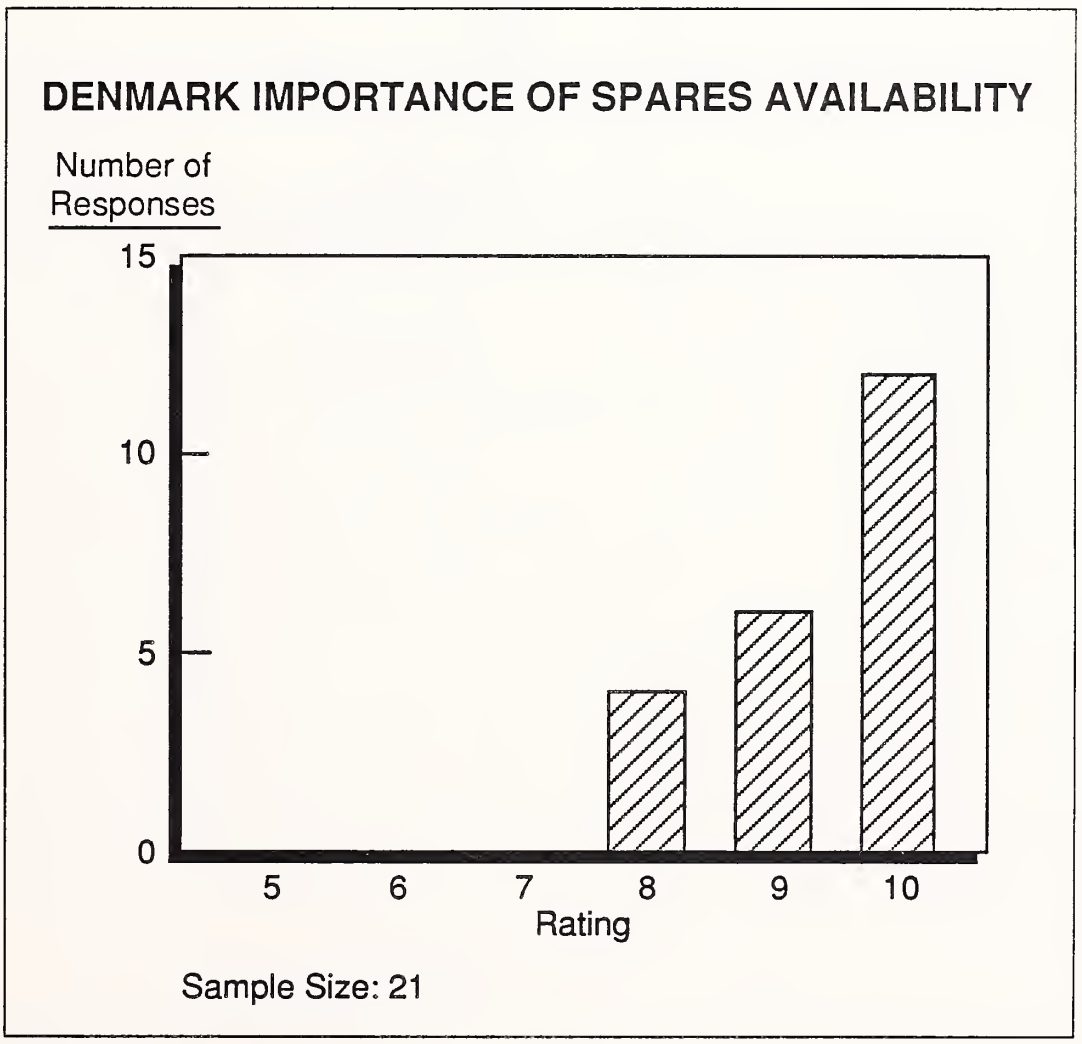
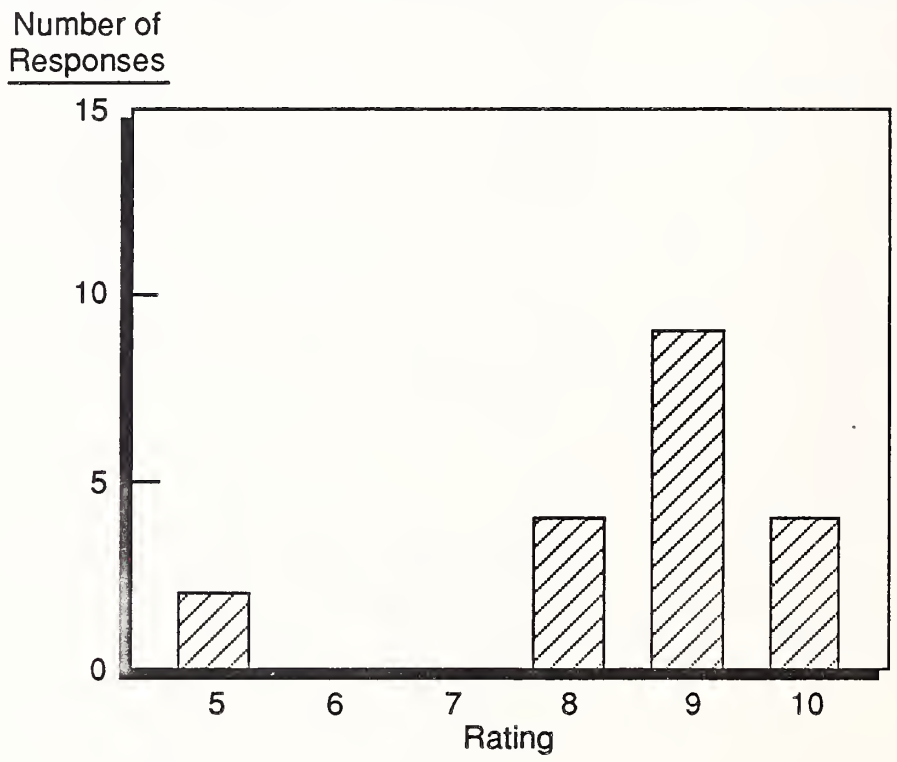


EXHIBIT V-4

DENMARK SATISFACTION WITH SPARES AVAILABILITY



Sample Size: 21

C

France

As can be seen from Exhibit V-5, there is a heavy skew in importance towards the 10 rating about a high mean of 9.3, and with a satisfaction index of 1.2 (over the customer concern level).

Exhibit V-6 shows a skew distribution tailing off in the lower values about a mean of 8.1, indicating a significant undersatisfaction of expectations.

The satisfaction index at 1.2 compares with 1.3 for hardware maintenance as a whole, and with 0.9 for the population mean, a significantly worse-than-average performance.

EXHIBIT V-5

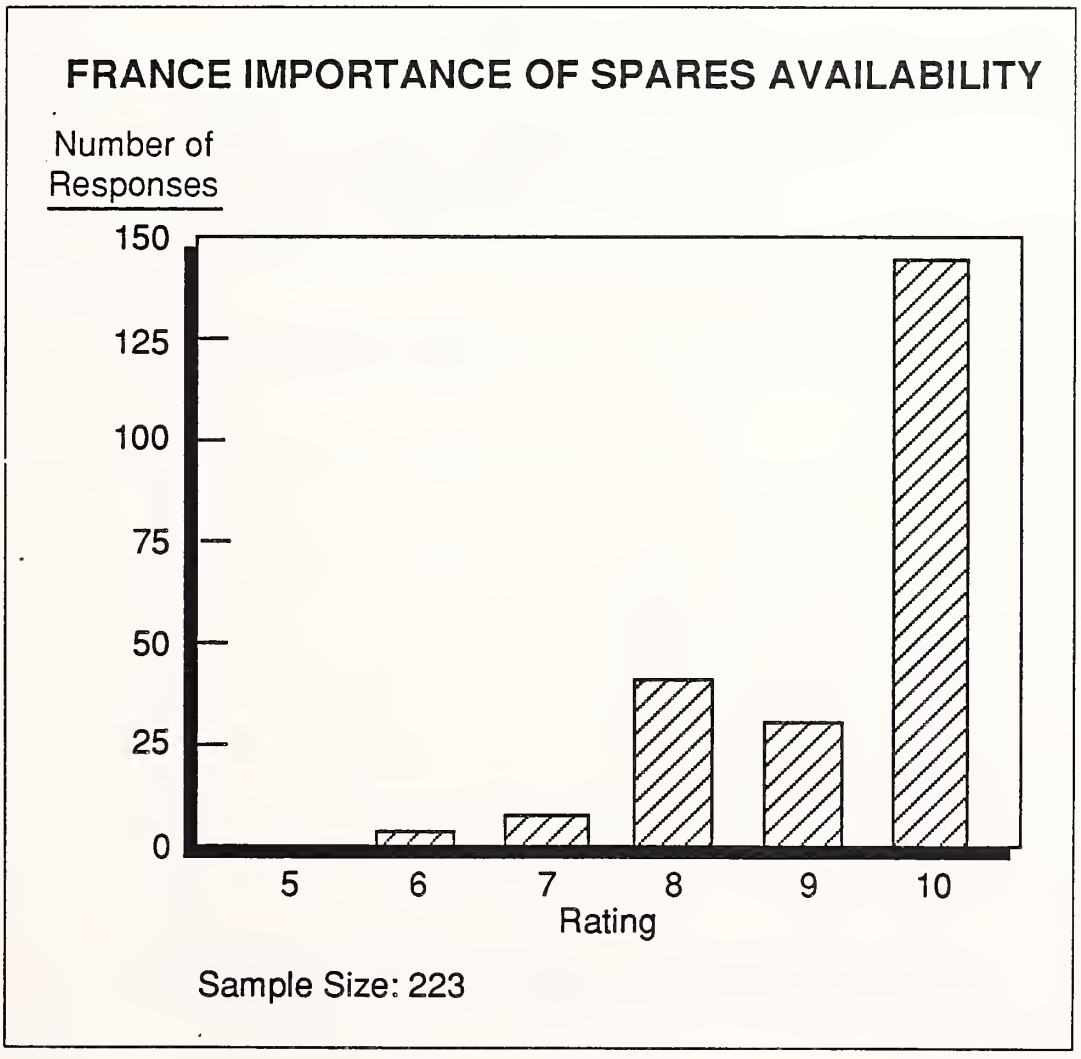
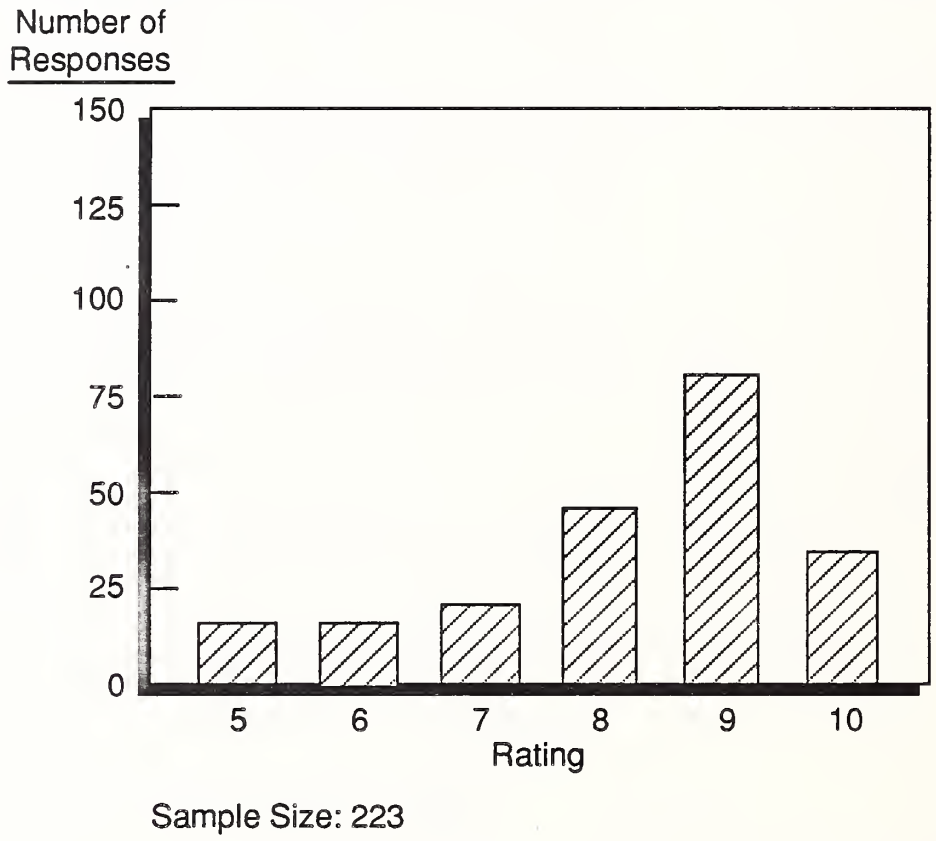


EXHIBIT V-6

FRANCE SATISFACTION WITH SPARES AVAILABILITY



Sample Size: 223

D

Germany

As can be seen from Exhibit V-7, Germany is significantly different from most of the other countries in that there is a reasonably normal distribution about a mean of 8.3, and with a satisfaction index of 0.5—this may well indicate that some sort of equilibrium has been achieved between expectations and delivery.

However, Exhibit V-8 shows a reasonably normal distribution about a mean of 7.8, indicating an undersatisfaction of expectations.

The satisfaction index at 0.5 compares with 0.6 for hardware maintenance as a whole, and with 0.9 for the population mean, a significantly better than average performance.

EXHIBIT V-7

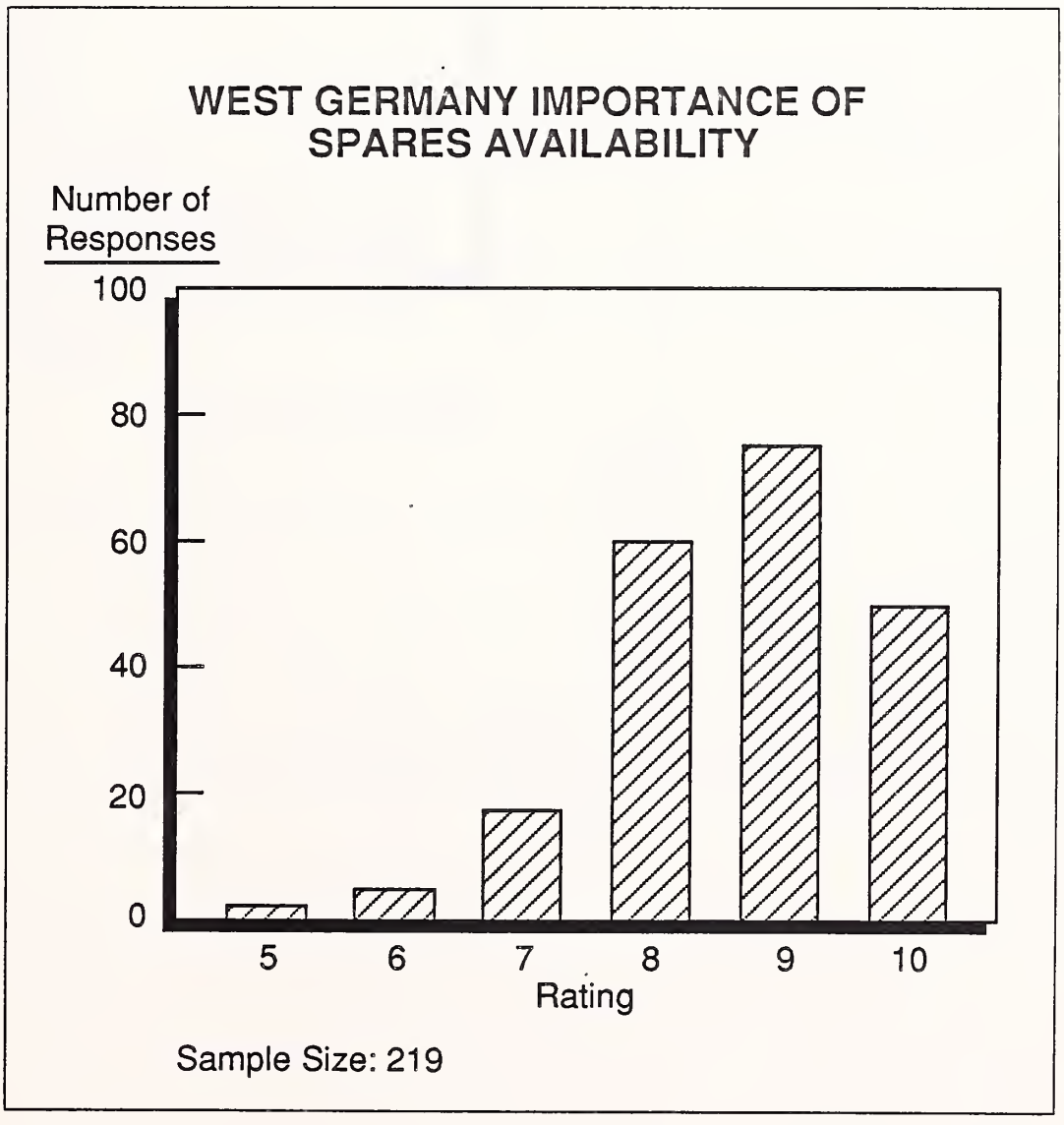
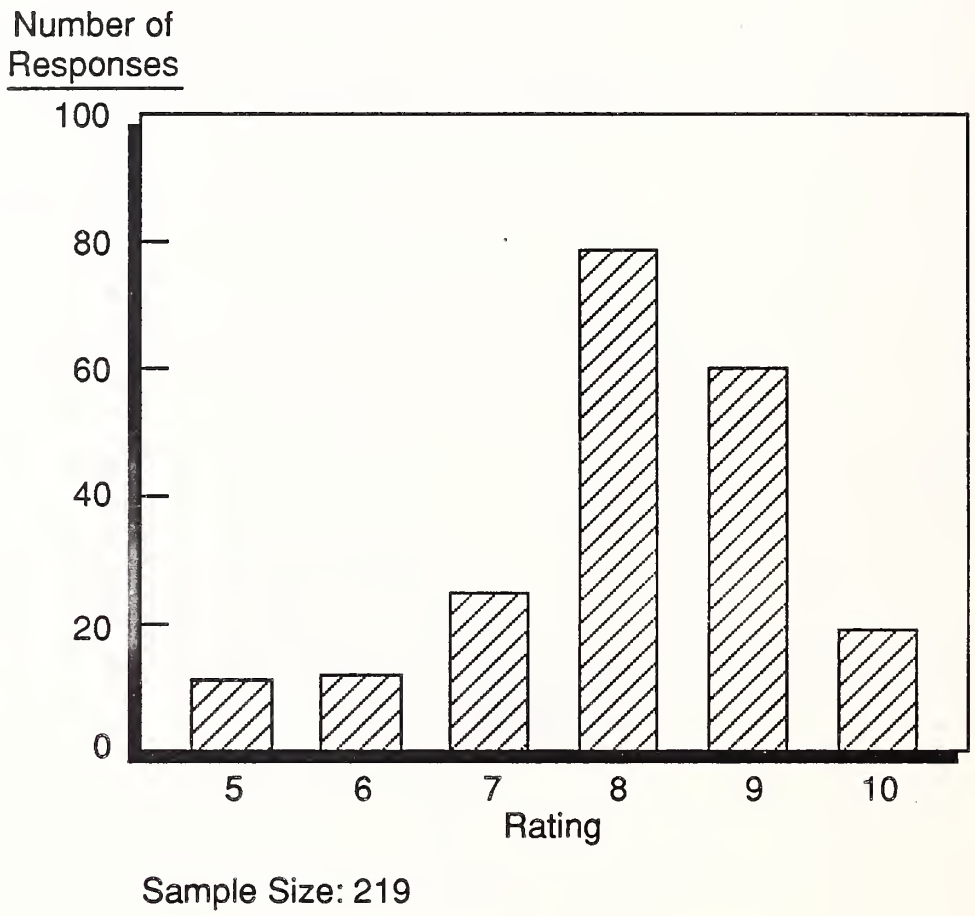


EXHIBIT V-8

WEST GERMANY SATISFACTION WITH SPARES AVAILABILITY



Sample Size: 219

E

Holland

As can be seen from Exhibit V-9, there is a quite heavy skew in importance about a mean of 8.7, but that this skew is abnormal. Again, as with Germany, this skew may indicate an equilibrium between expectations and delivery, but there may also be an element of culture present in the sharp cut-off between the 7 and 8 ratings.

Certainly, as can be seen in Exhibit V-10, there is a reasonably normal distribution but the mean has moved to about 7.9, indicating a significant undersatisfaction of expectations.

The satisfaction index at 0.8 compares with 0.9 for hardware maintenance as a whole, and with 0.9 for the population mean, indicating an average performance.

EXHIBIT V-9

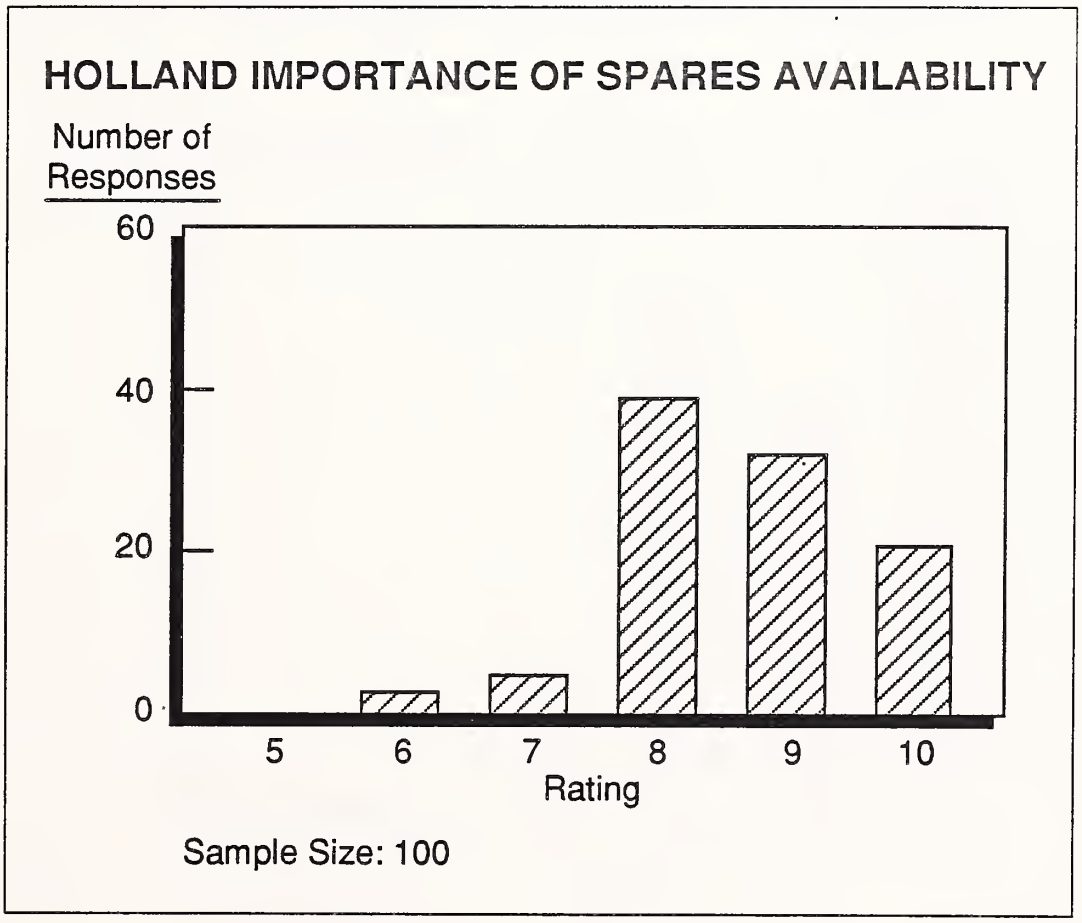
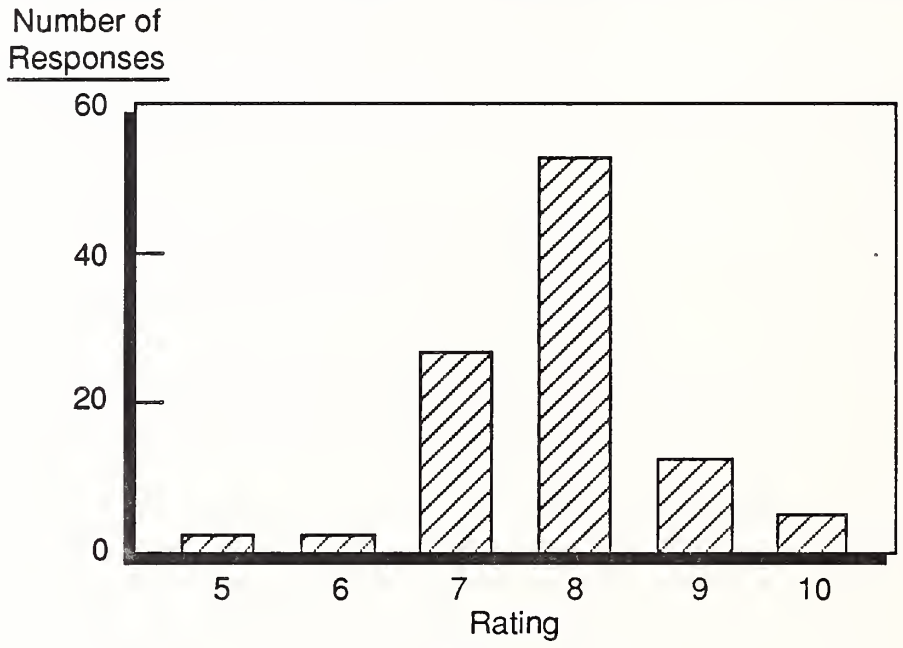


EXHIBIT V-10

HOLLAND SATISFACTION WITH SPARES AVAILABILITY



Sample Size: 100

F

Italy

As can be seen from Exhibit V-11, there is a quite non-normal distribution in importance about a mean of 8.9, and with a satisfaction index of 0.7.

However, Exhibit V-12 shows a more normal distribution about a mean of 8.2, but still with significant skew, and indicating a significant under-satisfaction of expectations.

The satisfaction index at 0.7 compares with 0.9 for hardware maintenance as a whole, and with 0.9 for the population mean, indicating an average performance.

EXHIBIT V-11

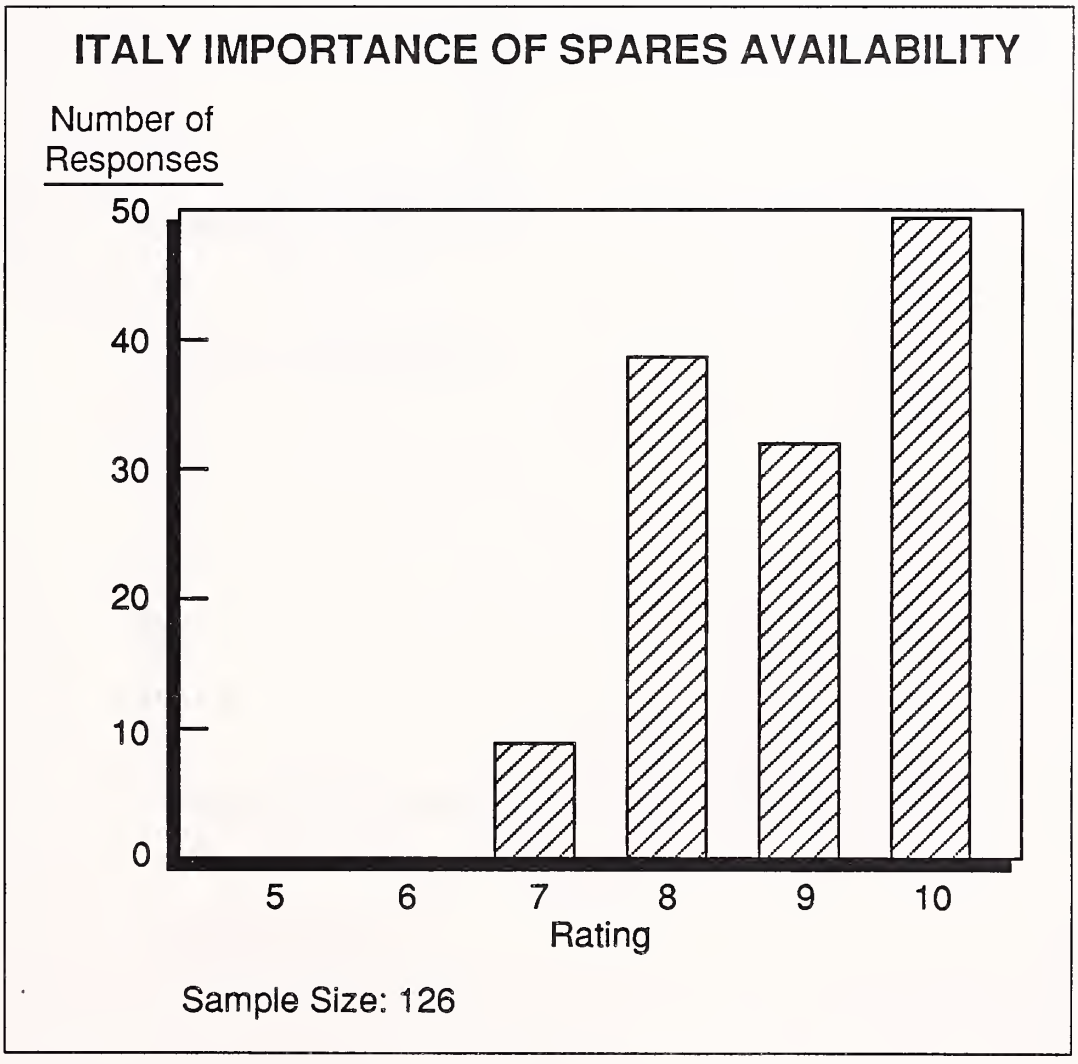
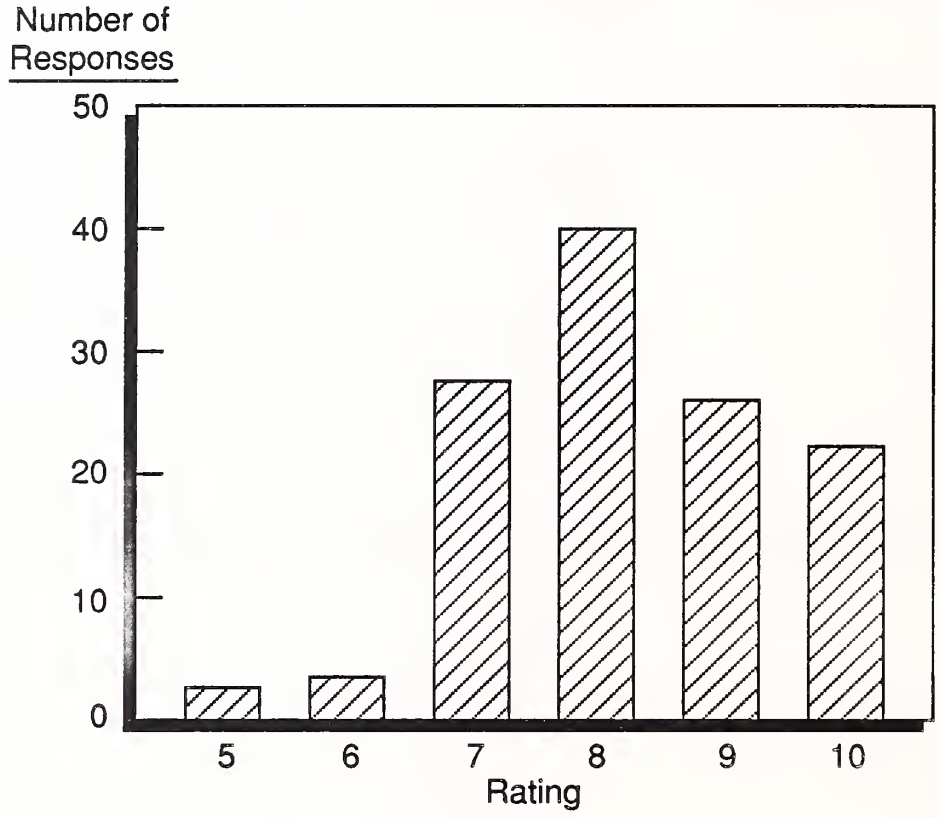


EXHIBIT V-12

ITALY SATISFACTION WITH SPARES AVAILABILITY



Sample Size: 126

G

Norway

As can be seen from Exhibit V-13, there is a quite heavy skew in importance towards the 10 rating, about a very high mean of 9.6, and with a satisfaction index of 1.9 (real dissatisfaction level).

Exhibit V-14 demonstrates very significant undersatisfaction of the high importance rating with a mean of 7.7, and a wide spread of ratings.

The satisfaction index at 1.9 compares with 1.6 for hardware maintenance as a whole, and with 0.9 for the population mean, indicating a much-worse-than-average performance.

EXHIBIT V-13

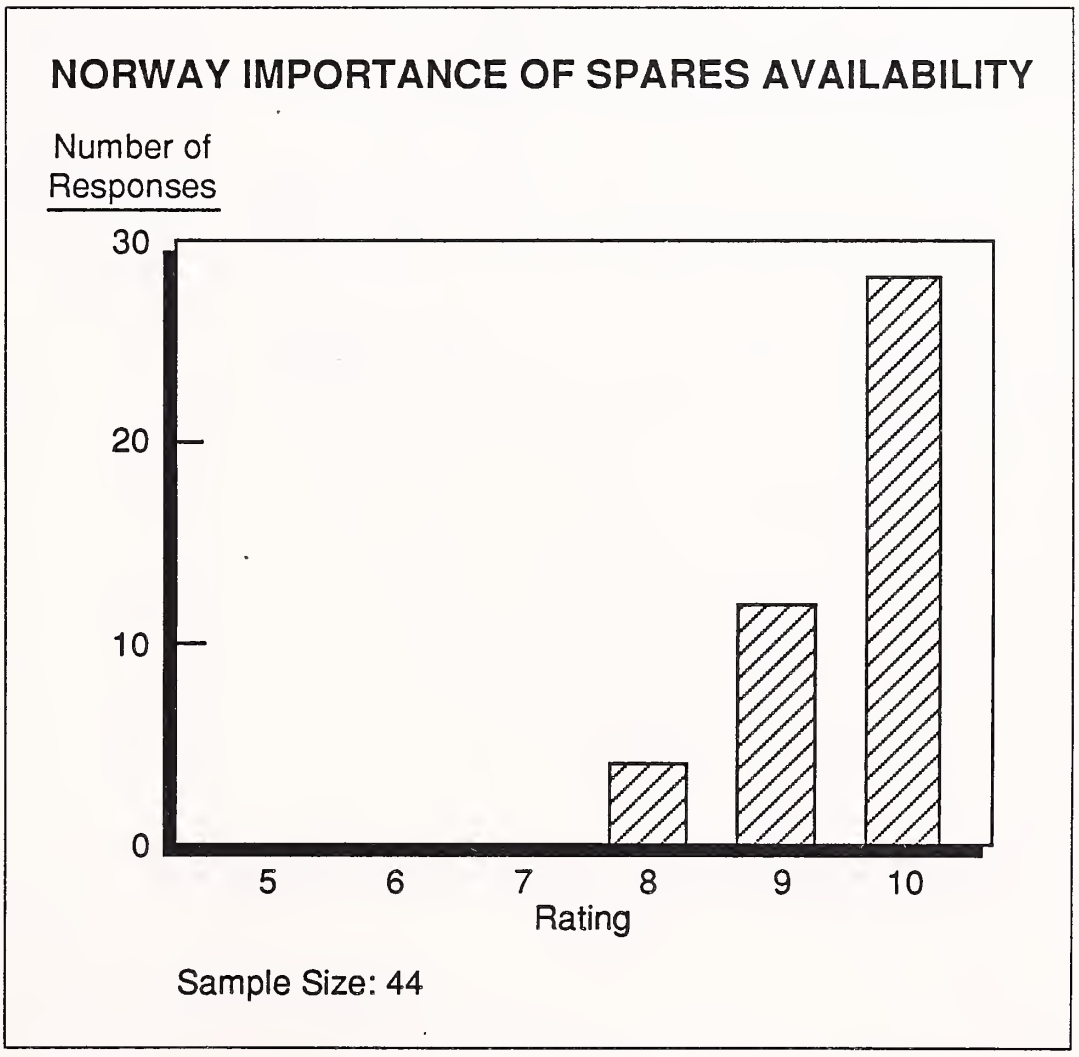
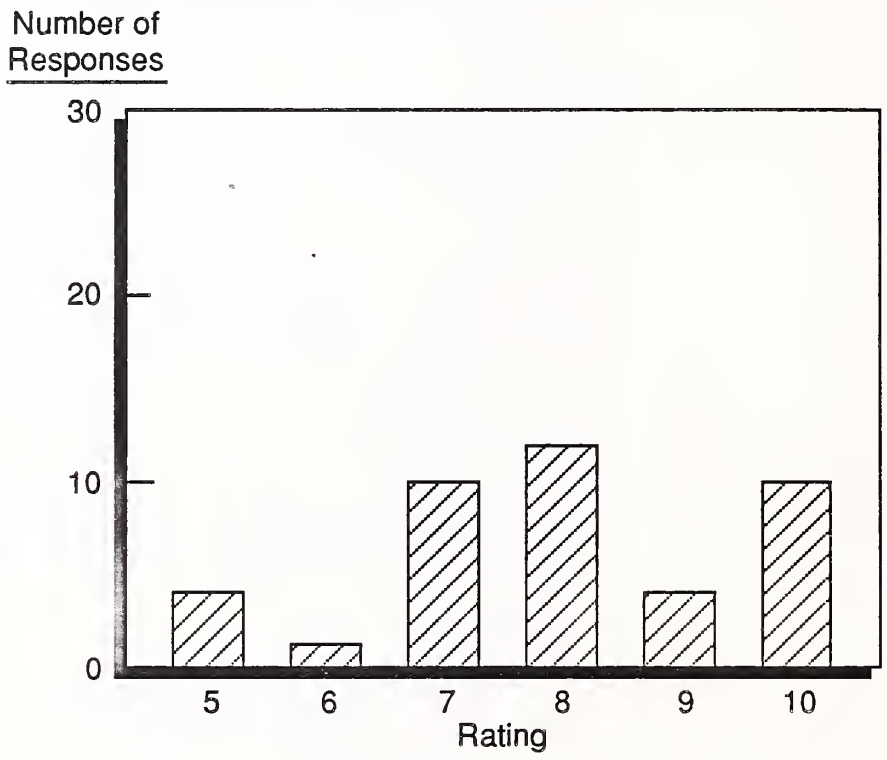


EXHIBIT V-14

NORWAY SATISFACTION WITH SPARES AVAILABILITY



Sample Size: 44

H

Sweden

As can be seen from Exhibit V-15, there is a quite heavy skew in importance towards the 10 rating, with a high mean of 9.3, and a satisfaction index of 0.9.

However, Exhibit V-16 demonstrates a serious undersatisfaction with a heavy fall-off of ratings (about a mean of 8.4).

The satisfaction index at 0.9 compares with 1.1 for hardware maintenance as a whole, and exactly with the 0.9 for the population mean, indicating a slightly worse than average performance.

EXHIBIT V-15

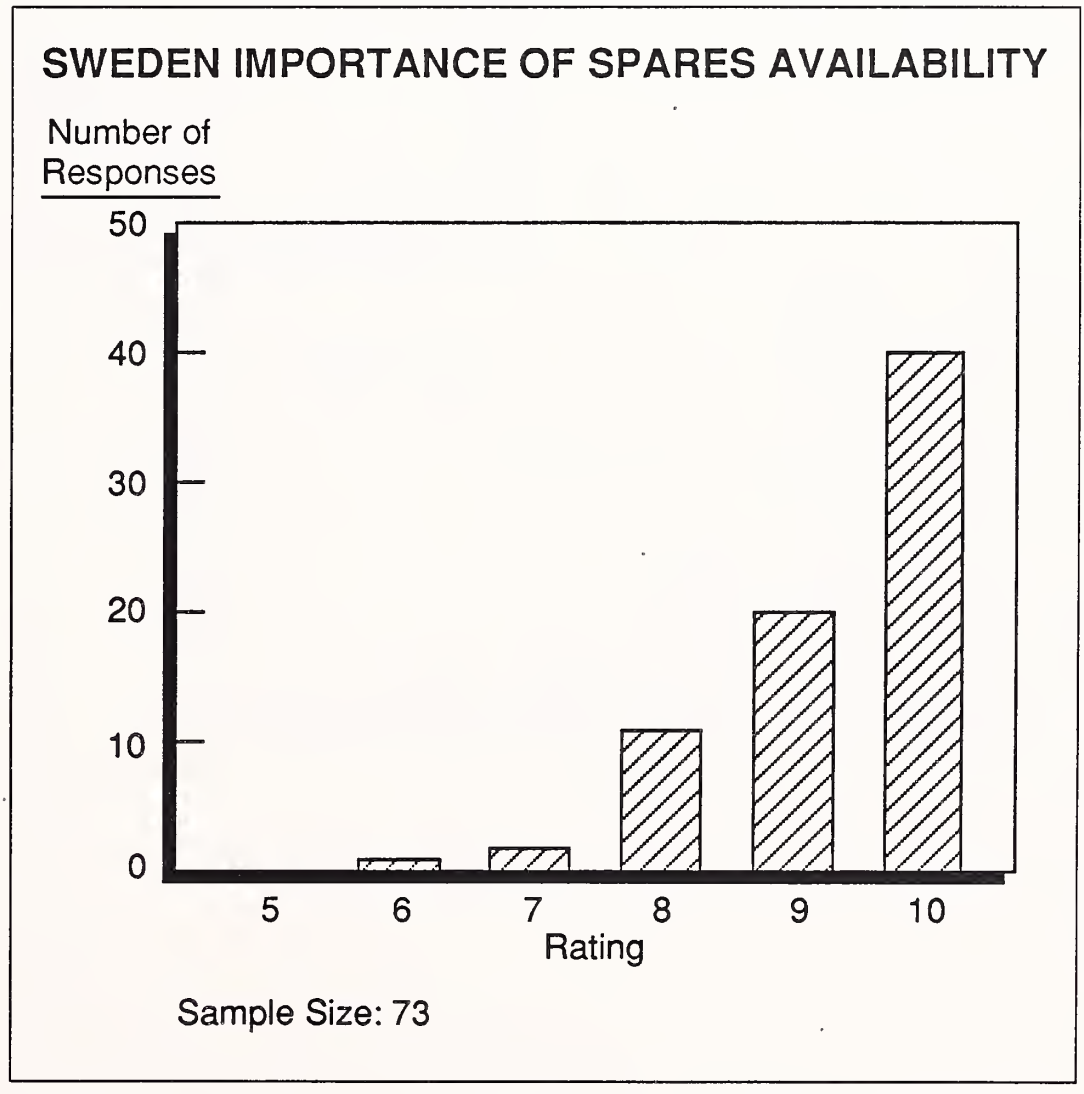
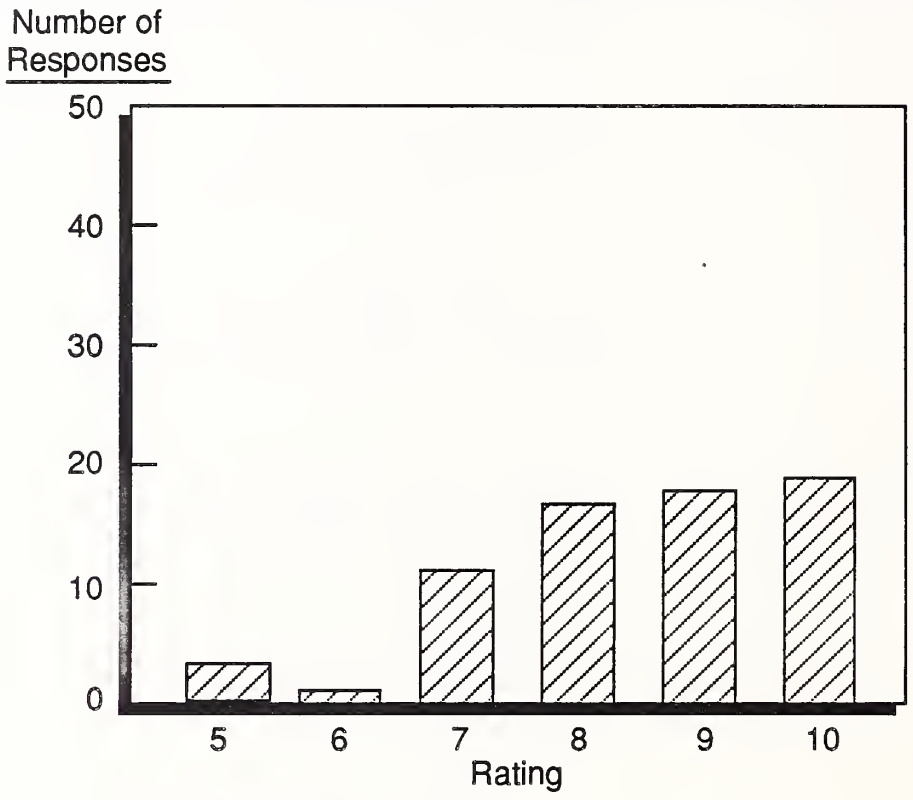


EXHIBIT V-16

SWEDEN SATISFACTION WITH SPARES AVAILABILITY



Sample Size: 73

I

UK

As can be seen from Exhibit V-17, there is a quite heavy skew in importance about a mean of 8.8, with a satisfaction index of 0.7.

Exhibit V-18 shows a more normal, but still skewed, distribution about a mean of 8.1, indicating a significant undersatisfaction of expectations.

The satisfaction index at 0.7 compares with 1.0 for hardware maintenance as a whole, and with 0.9 for the population mean, a marginally worse than average performance.

EXHIBIT V-17

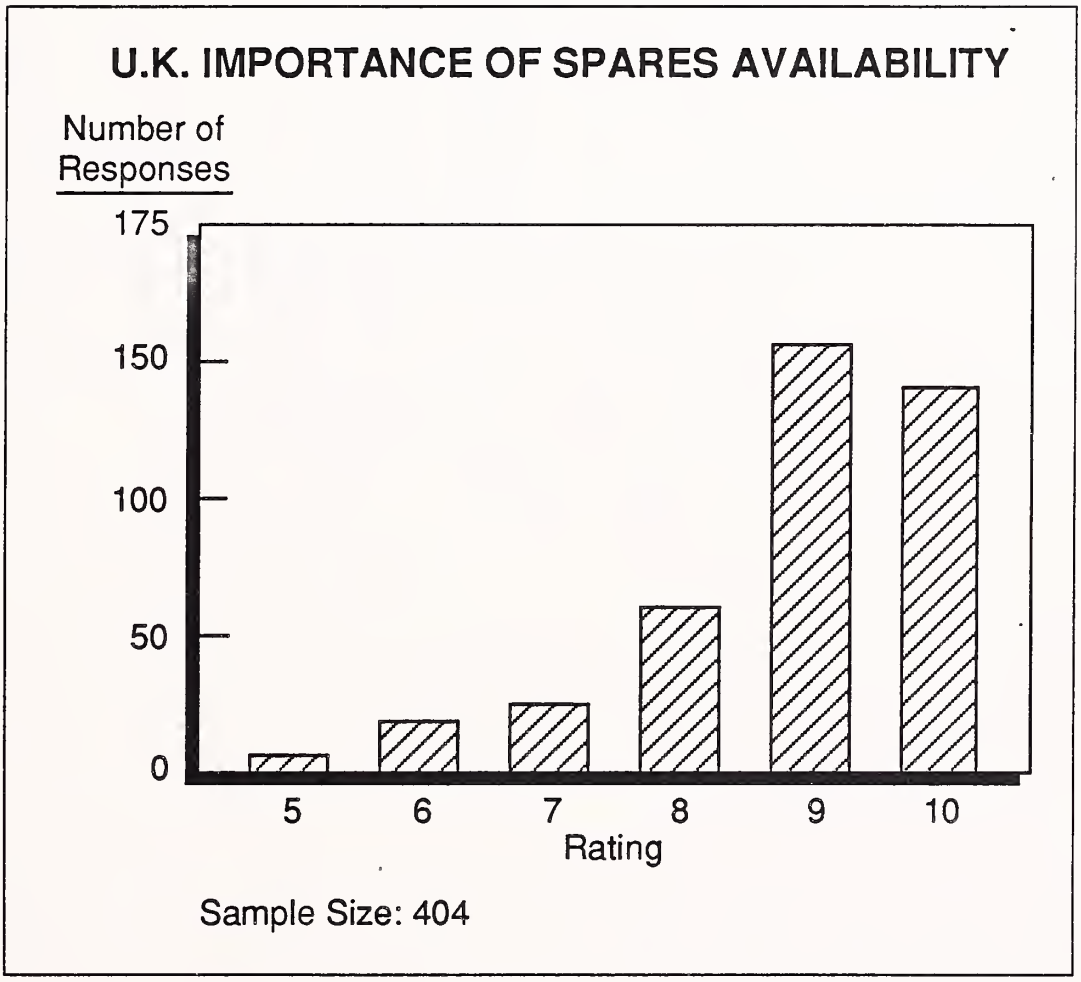
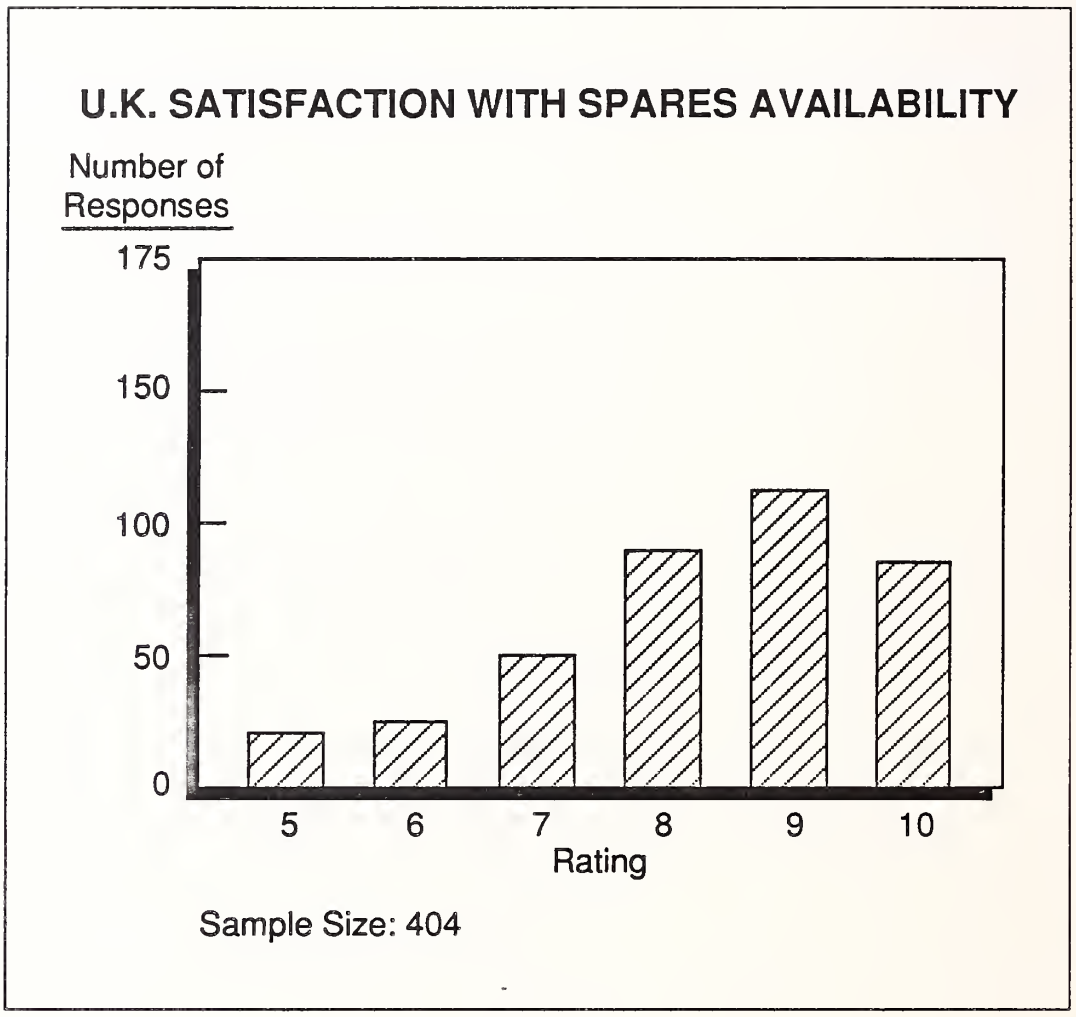
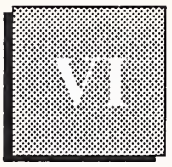


EXHIBIT V-18



VI

Spares Strategy



Spares Strategy

A

Design Policy for the Marketplace, and Spares

All new products are produced to meet a market need and, after the initial launch, competition between vendors refines and differentiates that need to give market segmentation.

However, the same competition does give a measure of uniformity to the design, performance and construction of any hardware or box, and this uniformity extends to the methods of parts replacement.

Hence the design of the product now includes the desirability, or undesirability, of such things as assembly rather than component replacement, customer maintenance and planned obsolescence (in the sense of planned wear or life characteristics leading to total replacement of the part).

The vendor is therefore in a position to plan maintenance and spares strategy at the time of product design and can, by and large, choose how often the field engineer need visit a site to mend or maintain either a CPU or peripheral and, therefore, how many spares need to be carried on inventory to give specific demand satisfaction levels.

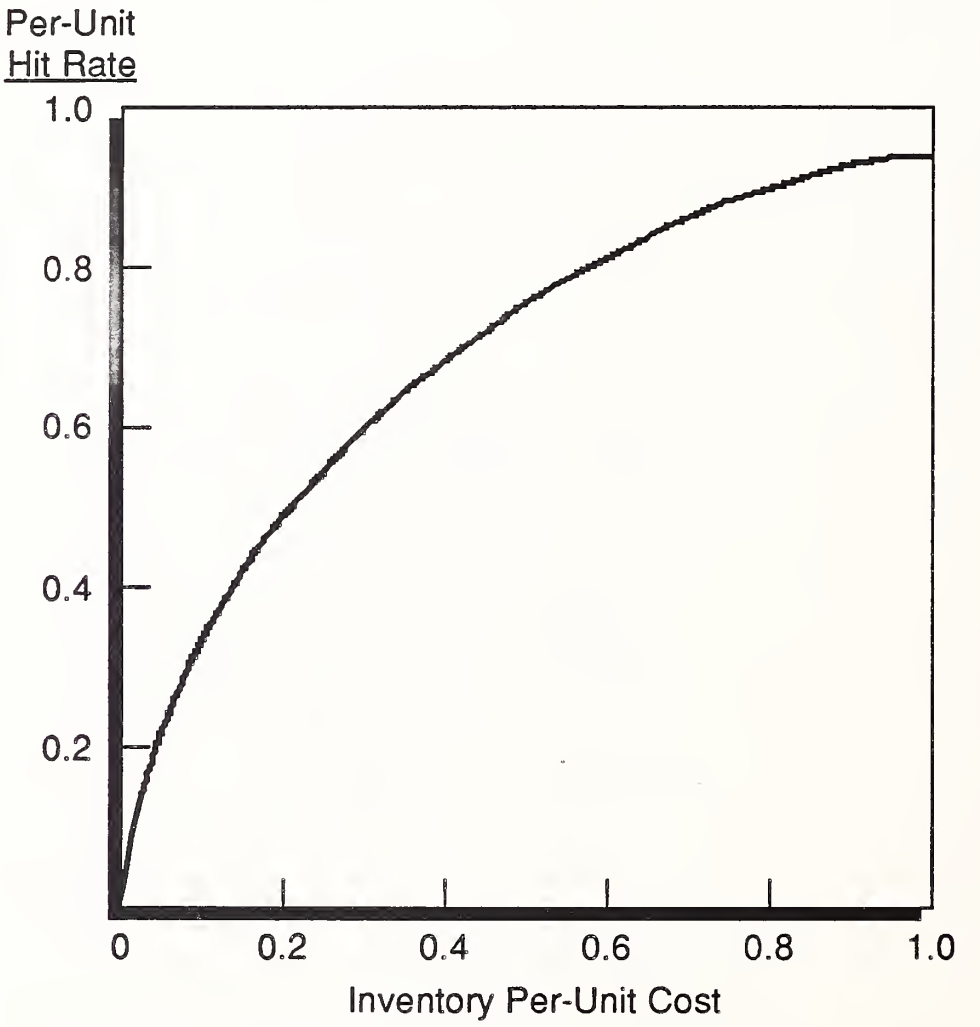
To facilitate practical fulfilment of the above strategy, the data that need to be correct in order to satisfy the above requirements are related to the reliability prediction for each component, asssembly and product.

However, with the establishment of BS5750 or ISO9000 (Good Manufacturing Practice), there is the requirement to feed back to design, from the field or production or wherever, any shortcoming in the predicted performance of the product, so that the discrepancy can be remedied—and this equally applies to the rate of usage of spares and the serviceability of the product.

Hence the shape of the curve of hit rate (percentage of parts available on demand), against cost of inventory to achieve that hit rate, depends critically on the design specification and its implementation, but will approximate to an ogive of the form 1-exp(-kt), where k is a curve constant and t is the per-unit hit rate. Exhibit VI-1 shows a typical shape.

EXHIBIT VI-1

HIT RATE VERSUS INVENTORY COST OGIVE



Note: This is a representation of form only.

Expressions of this form place a very high cost on hit rates of over 95%, and it is necessary to consider other inventory aspects before consolidating the product design specification incorporating the spares strategy.

It should also be noted that one of the strategems available to production material control to increase inventory turn is NOT available to the spares

controller—namely the use of lead time to achieve hit rates within a time frame.

Basically, kitting and shop floor loading times are compressed such that an additional one or two weeks can be used as a demand window to improve the effective hit rate.

However, consideration should be given to the possibility of using a lead time window on (remote) spares stocking orders, as opposed to emergency demands, where times of about 4 weeks may be allowable and would give major benefits in inventory-holding reductions and in effective hit rate.

This raises the point that the proportion of emergency to stocking orders should be targeted, monitored and controlled as an essential ingredient of good spares supply management.

B

Profit on Spares, and the Marketplace

Many companies concentrate a great deal of effort on testing the marketplace to find out is the maximum return on the sale of spare parts without considering the policy aspects.

- Will maximimizing the return bring in marginal competition, which might drive prices below an initial level?
- Will the same effect influence new-product sales?
- Is the inventory carrying cost based on the sale price, and what effect does this have on the company balance sheet?
- Does high carrying cost result in reduced inventory, lower hit-rate, loss of credibility and lost market share?

On the other hand, some companies are known to have neglected the effect of inflation on spares margins, such that the real return has eroded over the years, and it is now going to be difficult to raise the prices to a realistic level without causing intense customer dissatisfaction.

In some cases this is compounded by USA parent companies demanding an uplift on shipped prices before the local European mark-up is added, thus effectively raising the local spares prices or cutting the local margin and perhaps, again, causing some customer dissatisfaction and even subsequent loss of product or service market share.

Very infrequently, it appears, is the return on spare parts formulated (as part of the business plan for the product) in any detail before the actual results start coming in, and any of the factors shown in Exhibit VI-2 could have a substantial effect on the profit arising from the holding of inventory and the subsequent sale of spares.

EXHIBIT VI-2

FACTORS AFFECTING SPARE PARTS RETURNS

- The Turning Point for a High-Spares-Cost, High-Reliability Machine
- The Turning Point for a Lower Spares Cost, Lower Reliability Machine
- The Effect of Low-Cost Spares Together with (Only) Exchange and Repair for High-Cost Units or Assemblies
- Possibility of Fourth-Party Maintenance Giving Greater Profit for the High-Cost Exchange Units
- Customer Perception of How Long Spare Parts Should Last
- Product Introduction Plan Based on Strategic Spares Holdings Such That Multiple Inventories or Long Supply Times Are Avoided

C

Inventory and Hit Rate

One of the most dynamic issues in the supply of spares is the actual cost and holding cost of inventory where there are several players pulling in somewhat different directions:

- executive management, which wants to keep the inventory and holding cost low
- stores management, which wants either to keep it low to meet cost targets, or to keep it high to meet hit rate targets and as a visible power base

- field management, which wants to have a high inventory and a high hit rate
- the customer, who feels there should be a high inventory to give quick spares deliveries

As proposed in a previous section, there need be no plurality of objectives, as long as the strategy is planned as part of the product business plan and there are known and agreed targets for inventory, inventory accuracy, product introduction, holding costs, hit rate and customer satisfaction.

Some companies have tried to avoid this as an issue by creating profit centres in spares supply; however this strategy might generate local profit, but it also generates serious problems related to:

- hit rate and supply
- product competition due to high spares prices
- independance from design giving no incentive for product improvement
- field morale problems due to low hit rates
- optimization of supply side not necessarily in agreement with optimization of the service function.

The above discussion leads to an obvious conclusion that the spares supply function must be an integral part of the overall management activity for the business plan for a product, and must not have conflicting or counterproductive targets.

D

Inventory and the Storage Function

Too little attention is given, in general, to the provision of efficient storage and supply facilities, including the personnel to manage and operate the facility.

In production, a Class A store operating in an MRP environment is expected to have a 98% accuracy in transactions, but many stores operate between the 80% and the 95% levels.

Other stores operate a component classification under the Pareto principle such that transactions on the high-cost Class A items are 98%-or-better correct, but the low-cost Class C items need only be some 85% correct.

Any store should aim for the 98%-and-better category, either by perpetual inventory or by counting each box whenever there is a transaction.

A further class of components that are frequently poorly controlled is consumables (or expensables), which are low-cost or free-issue items.

Again, due to the fact that these items form part of the general overhead on the spares operation, it is essential to target, monitor and control the overall amount of resource allocated to free-issue parts.

Essentially, the revenue and profit-earning capacity of the separate types or classes of components or assemblies should be assessed as part of the product business plan, taking into account the loss of margin occassioned by any given level of possible free-issue (and overhead) demand.

Generally speaking, and except in stores with poor physical control, inaccuracies occur mainly on the parts that move the most; hence the parts that are wanted to give the better hit rate are the ones most likely, in many stores, to be the ones not there.

Hence, for the components that are having most money spent on them, the inaccuracy may be anywhere between 20% and 5%; for some operations, this may be a 20% to 5% loss in money terms. For even a $10 million inventory this could be a substantial sum better used to provide a good hit rate.

It is thoroughly recommended that:

- perpetual inventory is established
- the perpetual inventory team is audited regularly
- the stores are barred to nonstores personnel
- every VDU operator is fully trained and transaction audited (and moved to other work if over 1% inaccurate)

The usage of most parts over their life cycles will normally have been predicted prior to product launch, and this will be backed by subsequent usage rates from field demand.

However, care must be taken to distinguish between 'stocking' orders for remote inventories (i.e., demanded by field staff against future customer demand), and emergency orders for machine-down conditions.

There must be clear policies related to the number of times per year that a part is ordered against the demand rate, thus exposing the store to a stock-out condition, and related to any buffer or safety stock, such that nonurgent stocking orders are not covered in this way.

In the matter of the calculation of reorder levels, it should be noted that the classic EOQ formula is for stable-demand patterns only and, should EOQ still be desired, then a set of different curves for different demands should be generated or programmed.

A far-more-efficient way of optimizing on various parameters, including minimum inventory and high hit rate, is the use of Lagrangian Multipliers (this is a programmable mathematical technique described in the specialist text books).

Consideration should also be given as to whether emergency requests should be taken from production stock, thus allowing reduced spares inventory: with any pattern of such demand, this situation would normally be covered under MRP or via the Master (production) Schedule anyway.

Again, it is the norm to keep the spares store as a separate entity and profit centre, but there would be significant advantages to supplying current spares from the production store, where this is local to the service operation.

Another consideration is the possibility, for both high- and low-usage parts, of having outside suppliers holding the stocks on a call-off basis (the so-called 'stockless' holdings)—the good stores are the ones with low holdings and high hit rates.

Due note should also be taken of the issue revision level problem, whereby designers do not always succeed in making an assembly or PCB 'backwards' compatible. It follows that the spares organization must carry multiple revision levels: this is an avoidable situation but, again, some firms seem unable or unwilling to manage the situation.

It is firmly recommended that:

- Design departments are instructed to make all modifications backwards compatible as a policy.
- Prior (sequenced) modifications are avoided.
- Nevertheless, for audit purposes, modification levels are traceable to machine or product serials.

The above strategies have beneficial effects on stores holdings and on field operations.

Another aspect to be considered is the question of where to get, or who makes, the spare part or assembly. Only where the part or assembly is made to the same specification, with the same implied level of quality control, should nonproduction (internal) sources be used, in order to protect the quality image of the complete (and serviced) product, or even to meet ISO9000 or BS5750.

E

Inventory Turn

The average stock-turn for UK inventories is stated to be of the order of 3.5, and very few organizations achieve over 10. However, there are techniques, some of which have been mentioned above, for achieving between 10 and 20 without too much negotiation within an organization. The benefits are enormous. Exhibit VI-3 details the main factors that good inventory requires, but is merely a summary not in any order of merit or return. The management of spares inventory to achieve low holdings and a good hit rate demands clear strategies and a great deal of effort.

In addition, there is always the problem, unless avoided by the type of strategies discussed above, of slow stock turn parts that are nearly always high cost and high complexity, i.e., long lead time.

Mathematical solutions to the decision process were formulated as long ago as the 1940s for unique coal industry machinery, but the principles for the control of these low-demand parts in particular are shown in Exhibit VI-4.

EXHIBIT VI-3

FACTORS FOR GOOD INVENTORY CONTROL

- Real-Time Inventory System
- Perpetual Inventory
- 98% or Better Transaction Accuracy
- Secure Store
- Professional Stores and Material Management
- Professional Training for All Materials Control Staff
- Spares Strategy at Design Stage
- Current Spares in Product Materials Plan
- Separation and Control of Stocking and Emergency Orders
- Use of Lead-Time Window as Part of the Targeting and Control of Effective Hit Rates
- Appropriate Reorder Model
- Good Product Introduction Plan
- Good Product Phase-Out Plan
- Disposal of Obsolete Stock
- Minimum Inventory of A & B Class Items
- Optimum Inventory of Other Items
- Stockless Inventory
- Strict Control of Remote Stocks
- Exchange and Repair for Expensive Items
- Fourth-Party Maintenance
- Separate 'Used' Stock of Second-Hand/Returned Machines at Written Down Value for Obsolete Parts
- Sale of Service and Parts Rights for Obsolete Machines
- Backwards Compatibility of New Revision Levels
- Standard Costing and Variance Control
- Good Machine Design

EXHIBIT VI-4

CONTROL OF HIGH-COST/LOW-DEMAND SPARES

- Take from the Factory for as Long as the Unit Is in Production
- Set Up an 'Exchange Unit' or 'Repair and Return' Loop
- 'Last Buy' as Few as Possible but Consistent with the Usage Rate to Date and the Planned Product Run-Down
- Consider the Use of Second-Hand Parts Stripped from Returned Machines
- Consider Fourth-Party Maintenance
- Sell the Maintenance Rights with the Relevant Drawings, and Any Remaining Inventory of Units (or Unit Components)

F
Parts Delivery

One other aspect sometimes forgotten in the spares-provisioning cycle is the actual process of getting the parts to the destination in good condition, as well as in a timely manner.

Again, part of BS5750 and ISO9000 is the design and construction of adequate packing for shipped product, and the supply of spares is the supply of product.

Hence, if at the design stage it is planned to spare and provision at a particular level of assembly, then, if that spare is in any way fragile or liable to damage, adequate packing must be specified, made and/or constructed, tested against specification for its protective qualities—and used.

In addition it is as well to have a procedure for checking the contents of any package against a packing note and, in the case of critical or high-cost assemblies, a QA sign off for dispatch.

Otherwise there can be disputes, quite frequently, about condition on arrival, or contents, or revision levels, and this can cost significant inventory.

G
Other Considerations

Hit Rate is sometimes referred to as Service Level and defined as the percentage of order cycles without a stock-out; this definition is somewhat inadequate and in this report it is taken to be the percentage of all demand that a given demand cannot meet (in a given time frame).

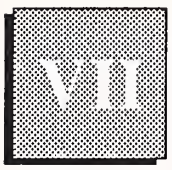
Buffer or Safety Stock is that stock that is ordered above the quantity predicted to be required, in order to cover unpredicted demand levels, known-bad quality or late deliveries.

High-cost items are normally critical items and, by reason of the cost, only few are stocked at any one time; hence they are subject to more frequent orders and more liability to stock-out.

Low-cost items are generally ordered in larger quantities, less frequently, and are hence less liable to stock-out.

Care must be taken, when defining safety stock parameters on automatic computer systems, that the use of safety stock does not, of itself, generate new orders—safety stock should be intended for use.

Summary and Recommendations



Summary and Recommendations

A Spares Availability—Companies

Only Olivetti at 0, Concurrent at 0.1 and ITL at 0.2 had satisfaction indices indicating well-satisfied customers.

The majority of companies had a definite skew towards the 10 rating for importance of spares availability, which was unmatched in the corresponding satisfaction histogram.

In addition, there was very little overall correlation between the satisfaction with spares availability and any of what might be considered the related services, i.e., systems availability, hardware fix-times, overall hardware maintenance or system use.

Hence it would appear that it is not a particular level of service that gives any specific level of satisfaction, but rather a satisfaction of expectations.

The recommendations are:

- Each company should interrogate the correlation data individually to determine if it would be possible to delink customer expectations for spares availability from overall hardware maintenance (and the other relevant aspects), in order to give a degree of freedom in spares supply policy.

- Then increase customer awareness of how good a service for spares availability is provided in relationship with the other factors

It should be specially noted that vendors with good satisfaction overall are sometimes downrated by their customers in spares availability.

B

Spares Availability—Country Perceptions

Germany at 0.5 and Belgium at 0.6 had the best satisfaction indices, even though these are not particularly high: these also matched very well with the indices for overall hardware support.

Denmark at 1.0, France at 1.2 and Sweden at 0.9 had the worst satisfaction indices: in the case of Denmark there was no correspondence whatsoever with the satisfaction index for overall hardware support, but the other two countries matched very well.

The index for Norway was particularly bad at 1.9, which is very close to the real dissatisfaction level, and may be a function of longer distances to site, or remote spares holdings.

Overall there is a good correlation between the satisfaction indices for spares availability and overall hardware maintenance across the countries, and, since this correlation does not hold for individual companies, it would appear that the companies balance out within each country.

- The recommendations for individual companies operating in individual countries are identical to those for individual countries, and detailed in Section A above.

It must be remembered that, apart from different physical attributes of spares supply in different countries, there may also be a cultural effect on expectations and perceptions.

C

Spares Availability—Customer Expectations

Taking individual companies within individual countries there is no strong correlation between satisfaction with spares availability and with overall hardware maintenance, customer views on future vendor performance, system size or system use.

The recommendations are that, apart from one or two companies that do have some apparent correlation:

- Companies should experiment with less-costly services, meanwhile keeping the customer-critical, and more easily satisfied, services more visible.

- Engender better customer satisfaction with spares availability by getting into a closer relationship with customers, and by 'educating' their ideas and perceptions—without putting more resources into spares supply.

D

Design, and Spares Strategy

Spares strategy must be part of the product business plan, and it is essential that the spares strategy, even for the incidence of parts replacement, be evolved together with the design specification—in order that the business plan can be achieved.

Indeed, Good Manufacturing Practice, and good spares supply practice, dictates that the spares policy be decided at the time the business plan is formulated, particularly since a large proportion of the total company profit can come from the maintenance operation.

- It is recommended that the organization, and organizational procedures, are such that the above disciplines form part of the natural plan of events.

E

Market Considerations

It is recommended that, as part of the product business plan, the relationships between product and service images is determined, so that a correct choice can be made for product image, reliability and spares cost.

It is recommended that the relationship of reliability and spares revenue is considered and, by reason of volume, it is determinedwhether a lower cost spares/lower reliability product would produce better revenue/profit than a high-cost spares/high-reliability machine option—or any appropriate permutation.

It is recommended that the rate of obsolescence of product and spare parts should be considered at the design and business plan stage, in order to ensure that no bad news emerges in product midlife.

It is recommended that a formal decision be taken, at the business plan stage, whether to go for head-on penetration policies on maintenance, of which spares is a critical and emotive part, or to differentiate the service in some way that emphasizes the good points of the service being provided, while giving a good return on spares investment.

In order to reduce inventory and get money up front, it is recommended that, dependent upon the strategy being evolved, consideration should also be given to the possibility of selling kits of replacement parts to the customer, in order to save time, and possibly expense, by self-help.

F

Inventory Considerations

Frequently a company lacks a coherent product business plan due to the power play between Marketing, Design, Production, Service and Accounts.

It is the view of INPUT that a proper business plan can only emerge if all the players are targeting the identical objective—otherwise product direction is lost, as is the opportunity to optimise overall returns.

Production stores running under MRP can achieve 98% transaction (and stock) accuracy; there is no reason that a spares store, with fewer transactions, cannot achieve the same or better levels of accuracy, but by using the same techniques.

One thing commonly avoided or missed, particularly when long-standing stores personnel are introduced to new systems, is the adequate training, monitoring and control of such staff. Accuracies of 99% or better are essential, and staff that are not able to meet such standards need to be allocated to less-stringent work.

In general, stores inventories average a 3.5 stock turn but, with the types of policies given in the text of this report, a turn of 10 is 'easily' obtainable, and 20 is possible.

- It is recommended that stores with a turn of 7 or below should initially target 10, and those above 10 should target 20.

In order to meet any business plan it is necessary to have an adequate costing strategy such that the cost and variance come to within 2% each year.

A variance of +2% on an inventory of $10 million with a stock turn of 10 could represent a bottom line loss of $2 million!

- It is recommended that systems, programmes and procedures be implemented that make the running variance visible throughout the financial year to match with the target variance for each month.

N.B.: For standard costing systems it is usual for the variance to be negative (saving) during the first half of the year, and positive in the second half—thus balancing for the year as a whole.

- It is recommended that the method of defining hit rate be examined, in order that the most effective inventory policy may be pursued.