A METHOD FOR DESIGNING IMPROVEMENTS IN ORGANIZATIONS, PRODUCTS, AND SERVICES

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Abstract

A Quality Improvement Priority Matrix (QIPM) may be used for identifying priorities for improving an organization, a product, or a service. This paper reports on the use of the QIPM method by members of the Department of Management Science at The George Washington University and members of the Department of Management at Kazan State University in Kazan, Russia, in 2002. Features of a Department, such as salaries, teaching assistants, computer hardware, etc. (a total of 51 features), were evaluated on the scales of importance and performance. Recent research has significantly improved the method as a way of determining priorities, monitoring progress, identifying consensus or disagreement, and comparing two organizations. This paper discusses additional statistical improvements and ways of presenting the results of statistical analysis. The QIPM method is a way of achieving agreement among a group of people on the most important actions to be taken.

Introduction

The features of an organization, as evaluated by employees, might include salaries, health benefits, office space, secretarial help, and computer equipment. The features of a product, as evaluated by customers, might include price, styling, reliability, and resale value. Assuming an organization wants to improve its performance, where should it focus its attention? How can an organization use limited

resources so as to achieve the greatest return in customer and employee satisfaction?

A Quality Improvement Priority Matrix (QIPM) can be used to determine priorities among features and to monitor performance improvement. Customers or employees evaluate various features of an organization or product or service on two scales: importance and performance. The intent is to identify features that are rated high in importance and low in performance. A Quality Improvement Priority Matrix was first described by the managers at GTE Directories Corporation in 1995. They conducted a customer satisfaction measurement program for determining what was important to their customers, how well the company was performing, and how the company could do better. (Chapman, 1995 and Carlson, 1995)

A similar method called a "strategic improvement matrix" was used by the people from Armstrong Building Products Operations. (Wellendorf, 1996) A QIPM was found to be useful for evaluating the Junior Faculty Development Program by Naoumova and Umpleby (2002). Melnychenko and Umpleby (2001) and Karapetyan and Umpleby (2002) used a QIPM to identify priorities in a University department. Prytula and Umpleby (2004) devised the Importance/ Performance Ratio. Dubina and Umpleby (2006) applied cluster analysis and suggested that standard deviation be used as a measure of lack of agreement.

The aim of this paper is to compare the assessments by faculty members of the Department of Management Science at the George Washington University (GWU), USA, and the Department of Management at Kazan State University (KSU), Russia, and to further develop the QIPM method as a guide for improvement efforts. We define a high priority feature as having high importance and low performance. Naoumova and Umpleby (2004) earlier compared priorities of these Departments, but in their analysis they used simple quantitative methods. In this paper we shall improve the comparison of the features and their priorities by using more advanced statistical techniques. We present the data in Part II. Evaluation and standardization of the measures is made in Part III. Part IV presents and discusses the data in matrix form for the two departments. Parts V and VI compare the priorities of the two departments and show the results of a cluster analysis.

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The Data

Data were collected by means of a questionnaire. The questionnaire covered 51 features. The features included in the questionnaire were issues that had been discussed by the GWU faculty in recent years. The same features were used in the KSU questionnaire in order to make comparisons. The questionnaire was given to management faculty members at both GWU and KSU in 2002. Twenty responses were received from GW faculty, and eighteen from KSU faculty. Faculty members evaluated the importance and performance of each feature of the department. A scale from 0 to 10 was used. On the importance scale 0 means that the feature has no importance at all and 10 means that the feature has a very high importance for the department. On the performance scale 0 means that the department's performance is very poor, whereas 10 means the department's performance is excellent.

Evaluation of Importance and Performance

The scores for each feature were averaged. Descriptive statistics for GWU and KSU are shown in Table 1.

Table 1: Descriptive Statistics for GWU and KSU Importance – Performance

	N	Range	Min.	Max.	Mean	Std. Deviation
Importance (GWU)	51	4.80	4.20	9.00	7.5408	1.25207
Performance (GWU)	51	4.90	3.25	8.15	5.4890	1.18905
Importance (KSU)	51	6.00	4.00	10.00	7.3371	1.84934
Performance (KSU)	51	8.39	.50	8.89	4.3529	2.49989

For all the features the mean value on importance at GWU was 7.54. At KSU the mean value for importance was 7.34. These results imply that the features are considered to be quite important by faculty

members at both universities. The mean scores on performance at GWU and KSU are 5.49 and 4.35, respectively. These scores suggest that corrective actions should be taken in order to improve the functioning of both university departments.

Dispersion is a measure of consensus among the faculty members. A standard deviation of 0 implies that faculty members evaluate a feature the same way. The higher the standard deviation is, the higher are the evaluation differences among the faculty members. GWU standard deviations are 1.25 and 1.19 on importance and performance, respectively. KSU has much higher standard deviations, 1.85 and 2.50 on importance and performance, respectively. In order to compare the evaluation differences we measured the coefficient of variation. It ranges between 0% and 100%. If the coefficient of variation is 0%, this means that there is consensus among faculty members. If its value is 100%, this means that all faculty members differ in their evaluations. The coefficients of variation of GWU and KSU are presented in Table 2.

Table 2: Coefficients of Variation of GWU and KSU

	Coefficient of Variation
Importance (GWU)	16.60%
Performance (GWU)	21.66%
Importance (KSU)	25.21%
Performance (KSU)	57.43%

GWU has higher agreement among faculty members. Or, in other words, differences among KSU faculty members are higher. Table 2 also suggests that the differences on performance are higher than those on importance. Especially note the high values of dispersion on the KSU performance measures.

In order to equalize the level of consensus among faculty members at the two universities we standardized the importance and performance measures. Every feature was divided by the respective standard deviation. Standardized importance and performance measures are presented in Table 3.

Table 3: Standardized Importance and Performance

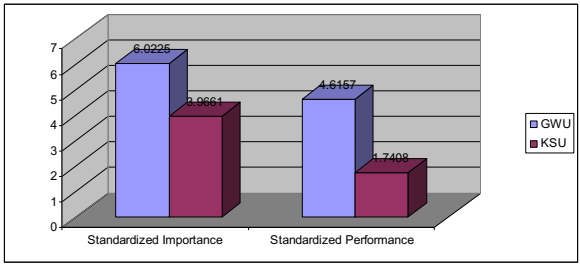
	N	Range	Min.	Max.	Mean	Std. Deviation
Importance Standardized (GWU)	51	3.84	3.35	7.19	6.0225	1.00
Performance Standardized (GWU)	51	4.12	2.73	6.85	4.6157	1.00
Importance Standardized (KSU)	51	3.25	2.16	5.41	3.9661	1.00
Performance Standardized (KSU)	51	3.36	0.20	3.56	1.7408	1.00

Note that standard deviations are equal to one. This means that the evaluations of importance and performance have the same level of consensus among members of the GWU and KSU departments. GWU faculty members found the features to be more important than the members of the KSU department. GWU has a standardized importance mean 1.51 times higher than KSU. The comparison of performance is even more significant. GWU has a standardized performance mean 2.65 times higher than KSU. This indicates that KSU faculty members rate the performance of their department lower than do GWU faculty members. A visual comparison of GWU and KSU standardized importance and performance means is shown in Figure 1.

Quality Improvement Priority Matrix

We used the QIPM as a tool for determining the priority of the features. A QIPM consists of four quadrants. The northeast quadrant contains features with high importance and high performance. The features in this quadrant do not need corrective action. The features in the northwest quadrant have low importance and high performance. Resources of the department should be transferred from the features of this quadrant to features with high importance and low performance. The third quadrant is southwest. The features in it are characterized by low importance and low performance. Using department resources on the features in thisquadrant depends on their importance. The last quadrant is the southeast

Figure 1: GWU and KSU Standardized Importance and Performance Means



quadrant. These features have high importance and low performance. These features have the highest priority for the department. For these features corrective action is necessary. Hence, we focus our attention on the features in this quadrant.

Figure 2 shows the QIPMs for the GWU and KSU departments. The data are non-standardized. Fifteen features are found in the GWU southeast quadrant and nineteen in the KSU southeast quadrant. These numbers suggest that there are many features in both departments that need corrective action.

In order to focus our attention on urgent features we changed the borders of the quadrants. See Figure 3. The new borders are average values of the total GWU and KSU features. The joint GWU and KSU importance average is 7.44, and joint GWU and KSU performance average is 4.92. Six features are found in the GWU southeast quadrant: office security, building physical environment, conference room and other space, secretarial support, department strategic plan and computer laboratories. Nine features are found in the KSU southeast quadrant: travel support, projection equipment, salaries, classroom facilities, copiers, building physical environment, accounts payable, computer hardware and teaching assistants.

Figure 2: GWU and KSU QIPM

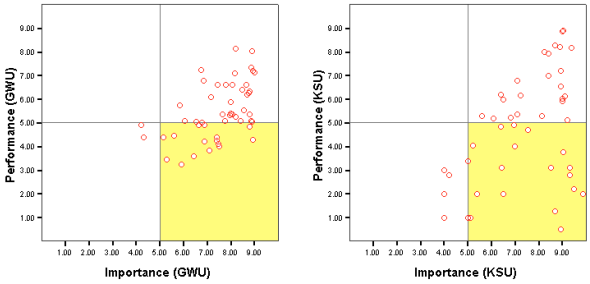


Figure 3: GWU and KSU QIPM Based on Joint Averages

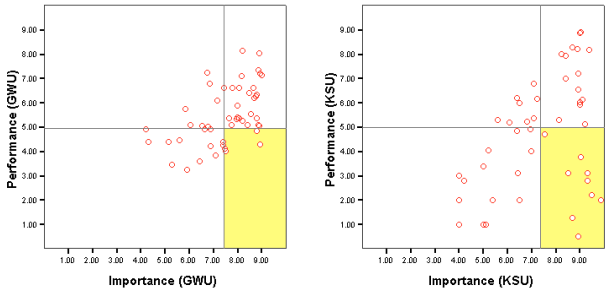
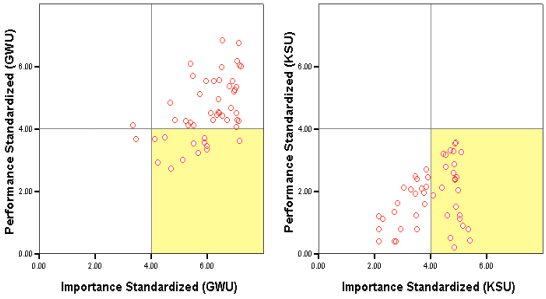


Figure 4 shows the matrices for the GWU and KSU departments based on the standardized values of importance and performance. Standardization is used to achieve the same level of consensus among the members of both departments on the evaluation of importance and performance. However, this approach can be misleading. If the importance and performance scales were reversed, so that 0 was high importance or performance and 10 was low, dividing by standard deviation would raise rather than lower importance and performance scores. To see the impact of standardization compare the coordinates of Figures 2 and 4. Note that the coordinates of the features are shifted from their original positions. The shift in coordinates is proportional to the standard deviations of the

respective importance and performance scales. A higher standard deviation leads to a larger downward shift of the corresponding importance or performance features. In Figure 4 not a single feature at KSU has a high performance score. Standardization by dividing by standard deviation may be more useful when comparing a large number of universities. In this case, comparing just two very different universities, the unstandardized means may be more informative.

Figure 4: GWU and KSU QIPM Based on Standardization



In the QIPM of the GWU department most of the features have high evaluations on the importance scale. Only 2 from all 51 features have low importance. The rest of the features are in the quadrants with high importance. Among them 12 are features in the southeast quadrant. They have high importance and low performance. A list of these priority features is given in Table 4.

The main characteristic of the KSU department is the low performance ratings of the features. There are no features with a high standardized performance evaluation. There were 26 priority features in the southeast quadrant. These are listed in Table 5.

In general, the priorities differ between the GWU and KSU departments. Only 4 features are found to be in the southeast quadrants for both departments: building physical environment, accounts payable, department strategic plan and department organization to implement its strategic plan. Note that the number of priority features of the KSU

department is more than double the number for the GWU department. This result can be explained by the lower average performance evaluations by the KSU faculty members relative to the GWU faculty members. It seems that more work needs to be done to improve performance at KSU than at GWU.

Table 4: GWU Features in the Southeast Quadrant

GWU Priority Features	Standardized Importance	Standardized Performance
Office security	7.15	3.62
Building/ physical environment	5.99	3.36
Dept. organization to implement its strategic plan	5.67	3.23
Dept. strategic plan	5.97	3.45
Help with writing research proposals	4.71	2.73
Use of continuous improvement methods in the Department	5.13	3.01
Conference room and other space	5.91	3.57
Secretarial support	5.91	3.70
Accounts payable	5.5	3.55
Working papers series	4.22	2.92
Course evaluations	4.47	3.74
Social activities	4.12	3.69

Table 5: KSU Features in the Southeast Quadrant

KSU Priority Features	Standardized	Standardized

	Importance	Performance
Funds to support research	4.84	0.20
Travel support	4.83	0.20
Office space for faculty	5.41	0.44
Projection equipment	4.69	0.50
Salaries	5.33	0.80
Classroom facilities	5.14	0.89
Copiers	5.03	1.12
Building/ physical environment	5.03	1.24
Accounts payable	4.60	1.24
Computer hardware	4.89	1.50
Consulting opportunities in area	4.98	2.05
Teaching assistants	4.08	1.88
Dept. organization to implement its strategic plan	4.40	2.12
Computer labs	4.88	2.37
Computer software	4.88	2.40
General ability of students	4.92	2.45
Dept. strategic plan	4.82	2.61
Transparency promotion process	4.84	2.88
Opportunities to work with faculty in other departments	4.54	2.80
Library journal collection	5.08	3.27
Library book collection	4.81	3.29
Opportunities to meet local businessmen and managers	4.54	3.17
Coordination with other depts.	4.70	3.32
Dept. head protects faculty from administrative interference	4.46	3.20
A supportive climate in the dept.	4.89	3.56
Opportunities for academic work with Dept. faculty	4.87	3.55

Ranking the Features

These results define the priorities in the two departments, as judged by their respective faculty members. But department resources are limited. In order to highlight the features where corrective action is most needed we ranked the priorities. For this purpose we used two methods:

an index method and cluster analysis. In this part we describe the index method.

A standardized importance-performance ratio (SIP) is defined as:

$$SIP = \frac{I_s}{P_s}$$

where I_s is standardized importance and P_s is standardized performance. The higher the value of the index the higher the priority that should be given to that feature.

It is important to note that the SIP ratio has one weakness. It gives the same value to features on the same linear distance. For example, a feature with standardized importance 8 and standardized performance 4 has the same priority as a feature with standardized importance 4 and standardized performance 2 (the SIP is 2 in both cases). This is a significant weakness, because one might easily decide that only the first feature has priority. In order to avoid this problem we only ranked features in the southeast quadrant.

In Table 6, we present the five features with the highest priority for the GWU faculty members, according to SIP. The KSU department's top five priority features according to SIP are presented in Table 7. (The features in Tables 4 and 5 are also ranked in order by SIP.)

Table 6: Highest Ranking GWU Features According to SIP Ratio

Rank	GWU Priority Features	SIP
1	Office security	1.977
2	Building/ physical environment	1.781
3	Dept. organization to implement strategic plan	1.756
4	Dept. strategic plan	1.729
5	Help with writing research proposals	1.724

Table 7: Highest Ranking KSU Features According to SIP Ratio

Rank	KSU Priority Features	SIP
1	Funds to support research	24.197
2	Travel support	24.170
3	Office space for faculty	12.289
4	Projection equipment	9.387
5	Salaries	6.631

The Table 6 and 7 rankings show two main differences between the GWU and KSU departments. First, the KSU top priorities are directly related to the improvement of the conditions of the individual faculty members. The GWU top priorities, on the other hand, are mainly concerned with improving the functioning of the department. Second, SIP ratios are much higher in KSU than in GWU. This is a consequence of the low KSU performance scores.

Clustering the Features

We used cluster analysis in order to sort different features into clusters so that the dissimilarity between two features is minimized if they belong to the same cluster and maximized otherwise. The measure of dissimilarity is Euclidean distance. This is the geometric distance in the two-dimensional space, in this case the distance between the features in the space importance - performance. It is computed as follows:

$$\text{distance}(\text{i},\text{p}) = \sqrt{(i_2 - i_1)^2 + (p_2 - p_1)^2}$$

Where i_1 and p_1 are importance and performance of the first feature, and i_2 and p_2 are importance and performance of the second feature. In this method, the distance between two clusters is calculated as

the weighted average distance between all pairs of scores in the two clusters.

We divided the GWU department features into five clusters. The cluster analysis is presented in a working paper by the same authors available at www.gwu.edu/~umpleby/qipm.html. The mean values of each cluster are shown in Table 8. We ranked the clusters according to their SIP ratios. Cluster 1 should have the top priority for the GWU management. This cluster contains only one feature: office security. The next cluster in priority is cluster 2. It contains two features: help with writing research proposals and use of continuous improvement methods in the department. Cluster 3 contains six features: building physical environment, department organization to implement its strategic plan, department strategic plan, accounts payable, conference room and other space, and secretarial support. Figure 5 visually presents the GW priority clusters.

Table 8: GWU Cluster Centers

	Cluster				
	1	2	3	4	5
Importance Standardized (GWU)	7.15	4.92	5.83	4.22	4.3
Performance Standardized (GWU)	3.62	2.87	3.48	2.92	3.72
SIP	1.97	1.71	1.67	1.44	1.15

KSU priorities are divided into seven clusters. The cluster analysis is presented in the working paper at the website cited in the previous paragraph. The mean values of each cluster are shown in Table 9. The highest priority for KSU management should be cluster 1. It contains three features: funds to support research, travel support and projection equipment. Cluster 2 contains three features: office space for faculty, salaries and classroom facilities. The third cluster by priority contains four

features: copiers, building physical environment, accounts payable and computer hardware. The KSU clusters are presented in the Figure 6.

Figure 5: GWU SE Quadrant

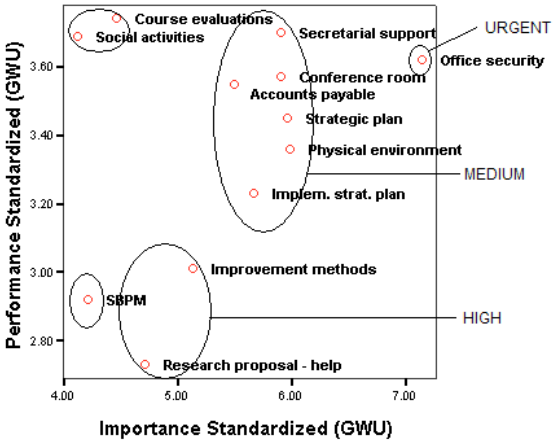
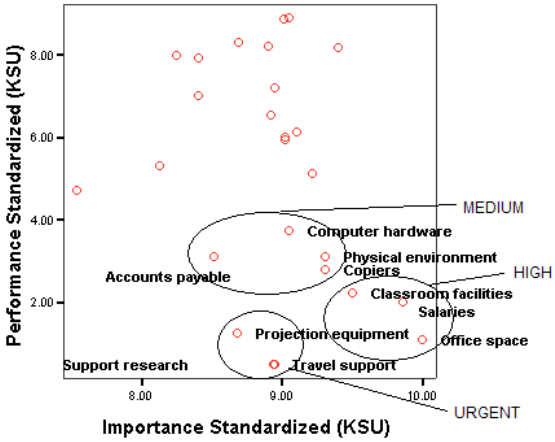


Table 9: KSU Cluster Centers

	Cluster						
	1	2	3	4	5	6	7
Importance Standardized (KSU)	4.79	5.29	4.89	4.24	4.90	4.60	4.87
Performance Standardized (KSU)	0.30	0.71	1.27	2.00	2.38	3.01	3.40

SIP	15.97	7.45	3.85	2.12	2.06	1.53	1.43

Figure 6: KSU SE Quadrant



Conclusion

We used the method of a Quality Improvement Priority Matrix combined with statistical methods in order to determine the priorities of the Department of Management Science at The George Washington University and the Department of Management at Kazan State University and to learn how a QIPM can be used to compare two organizations. We found that priorities differ between the GWU and KSU departments. In addition, after standardization of the measures, the number of priorities (features in the SE quadrant) of the KSU department is more than double the number for the GWU department. This is a consequence of the lower performance ratings given by the KSU faculty relative to the GWU faculty. However, the features used in the study were based on

discussions in the GWU department. If the list of features had come from both the GWU and KSU departments, the results would have been somewhat different.

The paper also experimented with standardization by dividing mean importance and mean performance by the standard deviation to achieve the same level of agreement for the two groups. This procedure seemed to bias the results. So, it should be used carefully. Furthermore, we experimented with clustering the features in the southeast quadrant. This is an alternative means of prioritization to using the importance/ performance ratio. The ratio may be a simpler guide to action. As this and previous papers describing experiments with the QIPM method show, the QIPM is a conceptually simple but surprisingly informative means of prioritizing actions and tracking results.

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