A Comparison of Russian and American Factory Quality Practices

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Pooley, J., & Welsh, D.H.B. (1994). A comparison of Russian and American factory quality practices. *Quality Management Journal*, 1(2), 57-70.

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Abstract:

The shift of the Russian economy toward a market-oriented approach has led to an increasing awareness of Russian product quality problems. To help understand these problems, this article presents the results of a study comparing product quality practices in Russian and American factories. Comparing the results between countries has identified several interesting findings about Russian quality practices. Results from the study indicate that Russian quality problems stem from the way quality is managed at the factories. One reason for this problem is the relative priority that quality receives at Russian factories. Russian factories place more emphasis on schedules and costs and less on quality than U S. factories. Another reason for the Russian quality problem appears to be a function of the types of techniques used to ensure quality. Results from the study show that Russian quality techniques do not provide workers with control over product quality. Adopting quality techniques that enable workers to assess quality performance will improve Russian workers' control and should improve Russian product quality.

Article:

INTRODUCTION

One problem that Russia and the other former republics have inherited from the Soviet Union is low product quality. This is a critical issue for these newly emerging countries because low product quality precludes these countries from participating in international trade. While there appears to be a consensus that former Soviet factories have produced low-quality products, there has been little research on what has caused this problem. The few studies that have explored the causes of low Soviet product quality have focused on the theoretical problems of a centrally planned economy (Fakiolas 1985). While this type of research may help policy makers assess economic systems, it does not help managers in the former republics improve product quality. To improve product quality, these managers need information on how to improve their quality practices. This article fills part of this gap by presenting the results of a study comparing Russian and American factory quality practices.

Specifically, several hypotheses about differences in quality practices between the two countries are tested. To gather data, a sample of Russian and American production workers was surveyed. Results from this study provide empirical evidence about differences in management priorities, use of quality techniques, and levels of product quality between the two countries. Findings from the study show that in each of these areas there are significant differences between Russian and American quality practices.

There are several important reasons to study differences in product quality practices. During the last two decades, American firms have seen product quality become an important competitive

issue (Garvin 1984). On the other hand, the centrally planned economy of the former Soviet Union has isolated most Russian firms from these sorts of environmental changes (Faminsky and Naumov 1990, 43-52). In this context, American firms may serve as an instructive contrast to Russian firms in the practice of quality management. Findings from this study will answer several important questions. First, the study will indicate whether Russia's recent shift to a market economy will solve its quality problems. Second, the study will identify some of the causation areas of quality problems at Russian factories. Third, the study should stimulate research interest in how to improve Russian product quality.

RELEVANT LITERATURE

Findings from several research projects have identified low product quality as a critical problem in the former Soviet Union. Research has examined the quality of Soviet products from both a theoretical and empirical perspective. Most of the theoretical research has focused on why the economic system creates low-quality products. For example, Fakiolas (1985, 51) attributes Soviet quality problems to systematic problems, such as "hasty industrialization and a lack of a creative scientific and enterprising climate." Another study by Roland (1988) theorized that a centralized planning Soviet- type economy could not adequately deal with product quality as industrial products become more sophisticated. In a recent theoretical study, Alexeev (1991) hypothesizes that "storming (producing most of the enterprise's output at the end of the planning period) may be a source of Soviet quality problems Several other recent articles describe low product quality as a problem facing Russian factories (Forker 1991; Vance and Zhuplev 1992; McCarthy and Puffer 1992); however, none of these studies has collected empirical data to test hypotheses verifying the product quality problem or to identify potential causes of this problem.

Several empirical studies have confirmed that the theoretical problem of low Soviet product quality does exist. Most of these studies have focused on confirming low quality as opposed to finding the reasons for it. One example was a study of industrial buyers by Chasin and Jaffe (1979). Another empirical study, by Gorlin (1981), reported that low product quality was a problem with Soviet administrative decisions. A study by Lazer (1986) was a content analysis of the Soviet paper *Pravda*. During the period from 1980 to 1985, low product quality was a recurring theme in *Pravda* articles and editorials.

One question that has yet to receive very much research attention is the impact that political changes in the former Soviet Union may have on product quality. Recent political changes in the former Soviet Union have resulted in a switch, in Russia and some of the other Soviet republics, from a centrally planned to a market-oriented economy. This change raises the following question: Will the shift to a in a market economy solve the low product quality problem that Russia has inherited from the former Soviet Union? An analysis of product quality research suggests that the answer to this question is no. The following discussion describes some of the reasons.

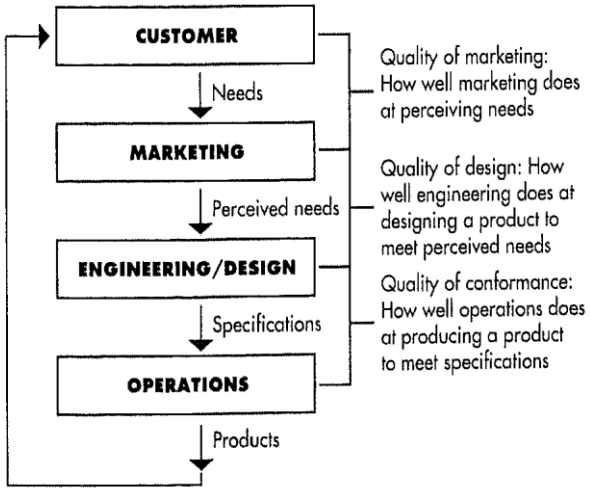
Country-of-origin studies of product quality across market economies is one area of supporting research. Several of these studies have found that product quality varies between countries with market economies. For example, a recent study by Wall, Liefeld, and Heslop (1991) found that country of origin is more important than either price or brand in consumers' assessments of product quality. Finding product quality differences between countries with market economies

indicates that a market economic system does not guarantee high-quality products. Another study supporting this observation compared U.S. and Japanese product quality (Garvin 1986). Garvin found significant differences in the quality of products and quality practices between these two countries.

Another piece of research that suggests that switching to a market economy will not solve Russia's quality problems is the quality cycle framework (Juran 1988a). This framework breaks down product quality into three operational components. Figure 1 shows a schematic of the quality cycle with each of the three components—quality of marketing, quality of design, and quality of conformance.

Conceptually, Russia's shift toward a market economy should result in a direct improvement in the quality of marketing. Under a Soviet-style, centrally planned economy, there is little direct feedback between a firm and its customers. Juran (1988b) has pointed out that this feedback is a critical element in improving product quality. A market economy should give Russian firms direct access to customers and lead to higher quality of marketing.

Figure 1 Quality cycle framework. The quality cycle illustrates the interaction between organizations and their customers. It can be used as a tool to separate quality into different components.



While the shift to a market economy may directly improve the quality of marketing, its impact on the other components of the quality cycle (design and conformance) is less direct. Free-market competition should lead to better designs and conformance; however, empirical evidence in developing countries suggests that improvement in these areas is not automatic. To create quality of design and conformance requires resources—time, education, regulatory assistance, and leadership (Sandholm 1988). This is an important observation for Russia and the other former Soviet republics. The finding suggests that the shift to a market economy will lead to higher quality products if firms have good quality-of-design and -conformance systems. If these systems are inadequate, however, then the shift to a market economy may have little immediate impact on product quality.

Given that the Russian republic is an offspring of the former Soviet Union, most Russian management practices probably carry the legacy of former Soviet practices. In this context, it is

instructive to analyze Soviet quality practices. A summary report, "Quality in Socialist Countries" (Egermayer 1988), describes the quality-of-design and -conformance systems in the former Soviet Union. These systems are also described in Riabov (1990). Both of these authors describe the Soviet model as having two primary components— extensive product certification requirements and a quality management system akin to total quality management. Egermayer (1988) portrays Soviet quality systems as having reached a fairly high level of development. Using Deming's (1986) three-stage life cycle approach to quality management, in which firms start with detecting problems, then move to preventing problems, and finally progress to improving their processes, Egermayer reports that the Soviet system is at a point of development somewhere between prevention and improvement. Riabov (1990) describes the Soviet quality system as very similar to the ISO 9000 quality systems.

Assessing the current state of quality of design and conformance in Russia is a critical link in determining how the shift to a market economy will affect product quality. If Egermayer's description is correct, and Russia's quality-of-design and -conformance practices are adequate, then the shift to a market economy should lead to higher product quality. If, however, Russian firms do not have adequate quality-of-design and -conformance systems, then the shift to a market economy may have little impact on product quality. This discussion highlights the need for empirical research that assesses the current state of Russian quality-of-design and -conformance systems.

Hill and McKay (1988) made an important contribution to understanding the state of Soviet quality-of-design systems. In the late 1980s, Hill and McKay conducted a study comparing Soviet and British state design standards for five products—machine tools, electric motors, automotive products, domestic refrigerators, and cameras. Findings from their study indicated that there were no significant differences in standards (tests and tolerances) between the two countries. These results were consistent with the assertions of former Soviet government officials that the majority of Soviet standards were comparable to international standards, as reported by B. Y Belobragin in Izvestia, 19 March 1986. Results from Hill and McKay's study suggest that Russian quality of design is adequate.

Analysis of the relevant literature suggests that Russian product quality problems hinge on the third leg of Juran's (1988a) quality cycle—the quality of conformance. The shift to a market economy should remedy the quality-of-marketing problem. Hill and McKay's (1988) research indicates that the Soviets have developed product design standards similar to international standards. If Russian firms can make products that conform to their standards, they should be able to produce high-quality products. Using this assessment of the literature, Russian quality research should focus on quality of conformance. If Russian firms can produce products that conform to standards, then the shift to a market economy should eliminate the product quality problem. The works of Egermayer (1988), Riabov (1990), and Sandholrn (1988) all suggest that Russian firms have adequate quality-of-conformance systems. This article reports the results of a study that has empirically tested this hypothesis.

RESEARCH HYPOTHESES

Using the theoretical analysis of the literature review as a framework, this study has tested three main hypotheses about Russian quality-of-conformance practices. The first hypothesis tests the

question of whether Russian factories have a quality-of-conformance problem. To answer this question, the study asked Russian and American factory workers whether they produce high-quality products. The answer to this question should help pinpoint the source of Russian quality problems. If the source is inside the factories, then one would expect Russian workers to believe that they do not produce high-quality products. (Note that using the framework in Figure 1, quality problems inside the factory deal with quality of conformance, whereas quality problems outside the factory deal with quality of design and marketing.) Specifically, this study tests the following hypothesis: Russian and American production workers believe that they produce products at similar quality levels. Rejecting this hypothesis would support the argument that Russian factories have a quality-of-conformance problem.

Assuming that the results indicate that Russian factories have a conformance problem, the next logical step is to identity potential causes of the problem. This study has focused on testing hypotheses about two types of causes. One cause of quality-of-conformance problems is the relative priority that an organization places on quality. For example, an organization that has quality as its top priority should produce high-quality products. Ishikawa (1985) has noted that putting quality as a company's first priority is a cornerstone of Japanese quality practices. There is little evidence on the relative priority (If quality at Russian and/or Soviet factories. There is some empirical evidence on managers' relative priority of cost arid schedules between U.S. and Soviet factories. Lawrence and Vlachoutsicos (1990, 271-287) assert that Soviet managers are more schedule- and less cost-oriented than U.S. managers. Research comparing production workers' observations of these relative priorities accomplishes two goals. First, it verifies Lawrence and Vlachoutsicos' findings, which apply at the worker as opposed to the manager level. Second, it provides evidence on the relative priority of quality between the two countries. Specifically, this study has tested the following hypothesis about the relative priority of product quality at Russian factories: Russian and American factories place equal emphasis on quality, costs, and schedules. Rejecting this hypothesis would suggest that management priorities are one cause of Russia's quality problems.

The final area of potential causes of Russian quality-of-conformance problems lies in the techniques used for detecting and improving product quality. These can have a big impact on an organization's ability to produce high-quality products. For example, Deming (1986) argues that firms that rely on acceptance sampling techniques to detect defects may not be able to find the cause of the defects. Sandholm (1988) states that Soviet factories use techniques to detect and improve quality that are similar to Western models. The Soviet theoretical model uses tools like inspection, statistical process control, and worker involvement to make products that conform to specifications. Results from this study can determine if similarities or differences in quality techniques exist between countries. Specifically, the study has tested the following hypothesis about quality techniques: Russian and American factories use similar techniques to detect and improve product quality. Rejecting this hypothesis would indicate that Russian factories need to adopt and/or emphasize new tools to correct their quality-of-conformance problems.

METHODOLOGY

To test these hypotheses, this study compared American and Russian production workers' observations of quality practices. One reason for using this type of study is that it provides an empirical basis for evaluating Russian quality-of-conformance systems. In theory, as discussed

in the literature review, the Soviet quality-of-conformance model sounds similar to international quality-of-conformance systems. There is, however, almost no empirical information on how either the Soviet or Russian quality-of-conformance systems operate in practice.

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The study's data source was production workers' observations of product quality practices in their factories. Data collection problems in Russia were the primary reason for using this data source. One problem with collecting data was gaining access to managers who were willing to share objective information. Part of this problem may come from the "creative reporting" that Soviet managers used to deal with government pressure (Hill and McKay 1988). Another part of this problem may stem from the cautious Russian culture. Faminsky and Naumov (1990, 43-52) note that caution is part of Russian culture—developed to deal with the dangerous environment. Most of the Russian managers contacted in this study were cautious about sharing information on operating practices. Unfamiliarity with foreigners conducting field research at industrial sites could be another reason for the reticence of Russian managers. Very few foreign researchers have studied Russian management practices in action. For example, a study published in 1990 by Lawrence and Vlachoutsicos (271-287) asserts that theirs was the first field research by U.S. scientists at Soviet industrial sites.

To avoid these sorts of data collection problems, perceptual data were used. Ball (1975,190-195) pointed out that in some circumstances perceptual data are easier to collect than other types of data. Experience from this study supported this contention. While some Russian managers contacted for this study appeared uncomfortable with foreigners studying their factories, most of them consented to sharing perceptual data. Another justification for using this data source was that other cross-cultural quality studies have used it as a data source. For example, Garvin (1986) used production employees' perceptions as a data source in a study comparing Japanese and U.S. quality.

To collect production worker data, a survey instrument consisting of structured statements and a seven-point Likert scale was used. The survey contained three major parts— introduction, statements, and biographical data. The introduction described the survey's purpose and instructions. Each statement had an accompanying horizontal scale. Labels with descriptions (strongly agree/strongly disagree) anchored both ends of the scale. Following the advice of Alreck and Settle (1985), the survey started with the most innocuous statements and saved the most sensitive statements until the end. The biographical section contained information on sex, age, years of education, and years of employment.

Applying several survey design techniques helped the study reduce the risk of bias influencing the results. To reduce the risk of threat bias, the survey's instructions directed respondents not to sign their names and said that the researchers would not release individual responses. Language and terminology differences are another source of bias when conducting surveys between countries and cultures. This study used several techniques to address this problem. To ensure language consistency, one native speaker translated the survey from English to Russian, and another native speaker translated back from Russian to English. To minimize communication

error, the survey limited statements to a maximum of 20 words each. To clarify terminology, the survey included the International Organization for Standardization definition of quality in its instructions (Rothery 1990). Each of these techniques minimized the risk of bias confounding the results of the study.

There are several benefits of using production workers as the data source in a study of quality-of-conformance practices. Of all employees, production workers are the closest to day-to-day factory operations. Many production workers are directly responsible for detecting and solving quality problems. One consequence of this involvement is that production workers are apt to be accurate judges of their company's quality-of-conformance practices. Production workers implement most quality systems and are in a unique position to comment on the effectiveness of these systems. In fact, production workers' observations may be more accurate than those of managerial employees. Production employees directly observe quality practices, whereas managers often only have indirect knowledge.

Surveys were directly administered to a sample of workers at several factories in both countries. The study received a total of 408 usable surveys-180 Russian surveys and 228 U.S. surveys. All of the respondents were production workers at manufacturing factories; managerial personnel were not included in the study. Respondents at each factory were randomly selected to participate in the study; very few respondents, less than 5 percent, did not want to participate. Each of the Russian factories were state enterprises, and all of the U.S. factories were private businesses. Access problems forced the researchers to select a relatively small sample of six Russian factories for the study. Subsequent analysis (in the results section of this article) indicates that there is very little variation in survey results across Russian factories. This finding suggests that even a small sample of Russian factories may be representative. The centralized structure of the former Soviet Union should mitigate the problem of using this relatively small sample of Russian factories. A paper by Riabov (1990) indicates that centralized quality systems still exist in Russian factories. In a centralized system, one would expect that operating practices should not vary across factories, thus limiting the number of factories needed to create a representative sample. The Russian factories represented the following industries: textile, furniture, machine parts, military products, cotton mill, and clothing. The size of the factories ranged from very large, 8000 employees, to relatively small, 100 employees. The factories are in the regions surrounding the major metropolitan areas of Moscow and Kalinin (formerly Tver).

For this study, a slightly larger sample of 10 U.S. factories was selected on a judgment basis. A mix of factories that had characteristics (process layout, type of personnel, number of employees, and so on) similar to the Russian factories was

Table 1 Mean response by country. (1 = Strongly disagree, 7 = Strongly agree)

ABBREVIATED STATEMENT	RUSSIA	UNITED STATES	T STAT	P VALUE
A Level of product quality				
1. When a product leaves my job area, it is a high-quality product.	4.7	5,5	5.5	0.000
2. Our plant manufactures high-quality products.	3.4	5.5	14.0	0.000

B Relative priority of cost, quality, and schedules **3. Meeting the production schedule is the plant's highest priority.**	5.2"	3.9	6.2	0.000
4. Reducing costs is the plant's highest priority.	5.1"	4.0	5.6	0.000
5. Making a high-quality product is the plant's highest priority.	5,0*	5.2	1.1	0.260
6. My supervisor is more concerned with schedule than quality.	4.7	3.2	7.5	0.000
7. Plant production costs are more important than product quality.	3.7*	3.3	2.2	0.030
C. Techniques for detecting/improving product quality **8. I know the plant's quality standards in my job area.**	6.5*	V*	6.3	0.000
9. Part of the plant's quality system is finding the cause behind every quality problem.	5.9*	5.3'	3.1	0.001
10. Production workers need more product quality training.	5.5	5.5	0.1	0.910
11.1 have received enough product quality training.	5.5	3.7'	**-10.2**	0.000
12. Inspectors perform most of the plant's quality checks.	5.1	4.0	9,3	0.000
13. Our plant produces low-quality products because some of my fellow workers do not care about quality.	4.6*	3.3	6.0	0,000
14. My supervisor always looks for someone to blame for qua* problems.	4,4*	2.9	5.0	0.000
15. The plant's quality standards accommodate normal variations that occur in production.	4.0"	4.1*	0.8	0,410
16. Quality inspections occur one day after production in my area.	3.9	3.4	2.1	0,025
17. In the last five years, my plant has improved product quality.	3.8	6.0*	10.9	0.000
18. Our plant has a good system for monitoring product quality.	3.1	4.7	8.5	0.000
19. Because I never have quality problems, an inspector does not check the quality of my work.	2.8*	2.5*	1.4	0.170
20. My job is production; someone else is responsible for quality.	2.2	1,9*	1 . 5	0,133

*ANOVA results indicate similar mean responses across factories within a country at the 0,05 level.

chosen. The surveys were administered during the period from September 1989 to September 1991. This was a period of dynamic political change in the Soviet Union. How these changes impacted this study's findings is unclear. Based on subsequent conversations with Russian workers, the authors believe that political changes to date have had very little impact on quality practices and, by extension, the study's results. U.S. factories in the study are in the states of Washington and Idaho.

To compare survey results between countries, a separate variance two-tailed t test was used. The rationale for using this type of analysis comes from suggestions by Alreck and Settle (1985) and Ott (1989). Alreck and Settle state that the results from a horizontal numeric scale generate interval data. that can be analyzed with parametric statistics. Ott suggests using a separate variance t test when comparing differences in population means with unknown variance. The null hypothesis in the statistical analysis is that worker observations in each country are the

same—hence a two-tailed test. To test the similarity of survey responses across factories within countries, the study used analysis of variance (ANOVA) by factory.

RESULTS AND IMPLICATIONS

Results from the study indicate that there are significant differences in workers' observations of quality practices in the two countries. Table 1 contains a summary of mean values by country of survey statements. The results in Table 1 have been sorted in descending order of the mean Russian response in each category. There are significant differences (at the 0.05 level) between the mean U.S. and Russian response in 15 of the 20 statements in Table 1. In all three categories of survey questions (quality levels, relative priorities, and quality techniques), there are significant differences in mean responses between the two countries.

Results in the first section of Table 1 indicate that product quality levels vary between the two countries. This observation supports a rejection of the first research hypothesis ---- that the quality level rating of Russian and American workers would be equal. Specifically, the study found that U.S. workers are more likely than Russian workers to agree that -their plant produces high-quality products. Statistically significant differences in statements 1 and 2 support this argument. This finding shows that, compared to U.S. factories, the Russian factories in this study have quality-of-conformance Problems If Russian workers had perceived similar or better levels of factory product quality than U.S. workers, then one could have inferred that Russia's quality problems came from outside the factory (quality of marketing or design). One implication of this finding is that switching to a market-oriented economy will not, by itself, solve Russia's quality problems. To solve their quality problems, Russian factories must improve their quality of conformance.

Survey results suggest that one source of Russian quality-of-conformance problems may be the relative priority placed on quality. Comparison of responses between the two countries revealed that Russian factories place relatively more emphasis on schedules and costs and less emphasis on quality than U.S. factories—thus rejecting the second research hypothesis. Statistically significant differences in statements 3 and 4 between the two countries illustrate the first part of this argument—that Russian factories place more emphasis on schedules and costs. Both of these statements show that Russian workers are more likely than U.S. workers to agree that either the production schedule or reducing costs is their plant's highest priority. Results from statements 6 and 7 support the second half of this argument—that Russian factories place relatively less emphasis on quality than U.S. factories. Statistically significant differences in statement 6 show that Russian supervisors are more likely to emphasize the schedule over quality than U.S. supervisors. Results from statement 7 show that Russian workers are more likely than U.S. workers to agree that production costs are more important than quality.

While results from statement 5 in Table 1 do not directly support the second half of the argument, that U.S. factories place relatively more emphasis on quality, a comparison of mean responses for statements 3-5 in each country supports this argument. The mean U.S. rating for statement 5 (5.2), quality is the plant's highest priority, is significantly higher than the mean U.S. responses for statements 3 and 4. This was done using a paired t test (same respondents) at the 0.05 level of significance. This finding suggests that U.S. factories place more emphasis on

quality than on either schedules or costs. Russian mean responses for statements 3-5 are not significantly different. Survey results support the argument that Russian factories place more emphasis on costs and schedules and less on quality than U.S. factories.

Results in the third section of Table 1 suggest that Russian and U.S. workers use different quality techniques— rejecting the third research hypothesis. Of the 12 statements dealing with quality techniques, eight have statistically significant differences in mean values between the two countries. An interesting finding from the results is that, in several areas, Russian workers appear more likely than U.S. workers to understand and use some quality techniques. Statistically significant differences in statements 8, 9, 11, and 16 support this argument. Results from these statements show that Russian workers are more likely than U.S. workers to believe that they

- Know quality standards in their job area
- Recognize the importance of finding the causes for quality problems (a tenet of Deming's (1986) theories)
- Have received enough product quality training
- Have quality inspections that occur within one day of production (a key element of finding assignable cause)

Findings from these statements suggest that some form of quality management is alive in Russia.

While some of the results in the second section of Table 1 suggest that Russian workers use and understand quality techniques, other results indicate shortcomings with Russian quality management. Statistically significant differences in statements 12, 13, 14, 17, and 18 suggest problems with Russian quality management. Some of the problems indicated by these statements include the following:

U.S. workers are more likely to agree that

- Their plant has a good system for monitoring quality
- In the last five years, their plant has improved product quality

Russian workers are more likely to agree that

- Quality problems stem from fellow workers who do not care about quality
- A supervisor is always looking for someone to blame for quality problems
- Inspectors perform most of the plant's quality checks

Results from the first two findings (statements 17 and 18) suggest that Russian workers are less likely than U.S. workers to believe that their plant's product quality system works. This is an interesting finding. Despite the earlier observation that Russian workers are more likely to use some quality techniques, Russian workers still have less faith in their plant's quality systems. This finding indicates that Russian problems stem from the overall approach to managing quality, not the application of individual techniques.

Taken as a group, results on quality techniques in Table 1 suggest that lack of worker control over quality is one overall problem with Russian quality-of-conformance systems. Gryna (1988) states that workers have control over quality if they (1) know what they are supposed to do, (2) know how they are doing, and (3) have the ability to regulate the process. If a firm expects its workers to be responsible for quality, it must give them control. Results from the study suggest that the Russian quality problem centers on the second and third elements of worker control. Statistically significant differences in statements 8 and 11 show that Russian workers are less likely than U.S. workers to have a problem with the first part of control—knowing what they are supposed to do.

Results from statement 12 and 14, however, indicate that Russian workers are more likely than U.S. workers to have problems with the second element of control—knowing how they are doing. The observation from statement 12, that in Russian factories inspectors perform most quality checks, indicates that Russian workers are removed from assessing their own performance. Hence, workers do not know how they are doing. Results from statement 14 also suggest problems with Russian assessment of worker performance. Statistically significant differences on this statement show that Russian supervisors are more likely to search for someone to blame for quality problems. This indicates that supervisors do not know how workers are actually doing.

Results from Table 1 indicate a mixed message on Russian performance on the third element of control—having the ability to regulate the process. On the one hand, statistically significant differences on statements 9 and 16 suggest that Russian quality systems are more likely than those in the United States to find the assignable cause for quality problems. Finding assignable causes is a key element in regulating a process. On the other hand, statistically significant differences in statement 14 suggest that the Russians may have a problem with regulating the process. Results from statement 14 indicate that Russian workers are more likely than U.S. workers to believe that fellow workers are the source of quality problems. If Russian workers have the ability to regulate the process, they should be able to fix this problem.

One additional issue that Table 1 addresses is the uniformity of mean responses across factories in both the United States and Russia. To test the hypothesis, that the mean responses are equal across factories within a country, the study has applied ANOVA. Mean starred responses do not differ across factories within a country at the 0.05 level of significance. The main reason for examining this situation is to see if different Russian factories have similar quality practices. Conceptually, one might expect that Russian factory operating practices, developed under the centralized Soviet

Table 2 Sample biographical data values b country,

SAMPLE ATTRIBUTE	UNITED STATES	Russia
Number of respondents	228	180
Percent men	64	29
Percent women	36	71
Average age (years)	35	32

Average years education	12	10
Average years at factory	6	11
Average years at current job	*4*	8
Percent of employees at the factory for more than five years	53	62
Percent of employees at the factory for five years or less	47	38

economy, might be the same across factories. ANOVA- results in Table 1 show that mean responses are statistically similar in 14 of the 20 statements across Russian factories. Finding similar results across Russian factories from different industries suggests that, in the quality area, the Soviet system did use similar quality systems across industries. Observing similar mean responses across factories suggests that even a small sample of Russian factories may constitute a representative s ample.

Results from the ANOVA show that the effect of Soviet centralization is strong in two of the three areas of the study. Mean responses at Russian factories were similar in four of the five statements dealing with relative priorities. The data indicate that different Russian factories use similar quality techniques—six of the 12 statements had no significant differences in mean responses. U.S. factories show some similarities in mean responses in the quality technique section. Similarities in techniques across U.S. factories may be attributable to the use of similar quality management practices.

Analysis of the survey biographical data indicates that there are some differences in the sample of workers from each country. Table 2 contains a summary of the mean values for different biographical attributes. It shows that the sample of Russian workers has a higher percentage of women than men, while the U.S. sample has a higher percentage of men than women. Another interesting difference is that the average number of years at the current job for Russian workers is almost double that of U.S. workers.

To determine if sample composition influenced the results in Table 1, mean responses by sex or length of employment within each country were compared. For ease of comparison, the study has categorized length of employment into two groups-less than five years and more than five years. Table 3 contains a summary of statements where there are statistically significant differences in mean responses by sex or length of employment. One observation that jumps out from Table 3 is the small number of statements with significant differences by either sex or length of employment. Of the 20 survey statements, only four Russian and one U.S. mean responses have statistically significant differences by either attribute. Other than helping to assess how sample composition affected results by country, the analysis in Table 3 reveals very little interesting information. Perhaps the only item of interest is that none of the U.S. results vary by sex and that three of the Russian results vary by sex. This observation suggests that male and female Russian workers are more likely to have different perceptions of quality practices.

Finding significantly different results by attribute in Table 3 indicates that differences in sample composition may have influenced results between countries. To address this issue, the study has developed a computed mean response by attribute for each statement in Table 3. Computed mean responses are the product of mean response by attribute and the proportional attribute weighting in the contrasting country. Using this weighting procedure eliminates sample composition differences between countries. For example, the Russian computed mean has the same percentage of men and women as the contrasting U.S. mean. To see if differences in sample composition have influenced results between countries, the computed mean response in Table 3 and the contrasting mean response in Table 1 were compared. An example using U.S. mean responses to statement 1 helps illustrate this procedure. The computed mean response for U.S. statement 1

Table 3 Significant differences in mean responses by sex or length of employment.

NO ABBREVIATED STATEMENT	SEX Men	SEX Women	LENGTH OF EMPLOYMENT <Than 5 Years	LENGTH OF EMPLOYMENT >Than 5 Years	P VALUE	COMPUTED MEAN*	U.S. MEAN†	COMPARED RESULTS TO TABLE 1
A. Russian differences								
11. I have received enough product quality training.			4.6	6.1	0.000	5.3	3.7	Same
15. The plant's quality standards accommodate normal variations that occur in production.	1.9	2.8			0.003	2.2	2.5	Same
17. In the last five years, my plant has improved product quality.	4.5	3.5			0.000	4.1	5.0	Same
20. My job is production, someone else is responsible for quality.	3.7	4.6			0.006	4.0	4.0	Same
B. U.S. differences			5.7					
1. When a product leaves my job area, it is a high-quality product.				5.1	0.020	5.47	4.7	Same

Note: significant differences (0.05 level of significance) in mean responses using a two-sided t test. *Computed mean derived from product of mean by category times weighting from contrasting sample. Example in U.S. statement 1 computed mean of 5.47 = (5.7 x 0.62) + (5.1 x 0.38).

Contrasting percentages from Table 2.

†Contrasting mean response from Table 1.

in Table 3 is 5.47. (U.S. mean response by attribute (length of employment) of 5.7 and 5.1 times the Russian percentage of workers in each of these categories is (5.7 X 0.62) + (5.1 X 0.38).) Comparing this computed mean, 5.47, with the contrasting mean in Table 1, the Russian mean of 4.7 generates the same results between countries as Table 1. Comparison of each of the computed means in Table 3 with the contrasting mean in Table 1 leads to the same results between countries. This finding indicates that differences in biographical attributes by country have not affected the results between countries.

CONCLUSIONS

Results from this study have generated groundbreaking empirical evidence that helps answer some important questions about Russian product quality. Results from the first research

hypothesis confirm the observation that there is a quality-of-conformance problem at Russian factories. Survey responses indicate that Russian production workers are less likely than U.S. workers to believe that their plant produces high-quality products. While this finding may seem intuitively obvious to some researchers, there has been very little existing empirical research that has pinpointed Russian or Soviet quality problems to its factories. In fact, some research, for example Egermayer (1988), has suggested that Soviet factories have excellent quality-of-conformance systems. Coupling the results of this hypothesis test with the quality cycle framework suggests that shifting to a market economy, by itself, will not solve the Russians' product quality problem.

To solve their quality problem, Russian factories must adjust their operating practices to produce high-quality products. Results from the second and third hypotheses have identified two areas in which Russian quality practices are significantly different from U.S. practices. The first area is in the relative priority placed on schedules, cast, and quality. Results from the study show that Russian factories place more emphasis on schedules and cost and less on quality than U.S. factories. If Russian factories are going to solve their quality problems, they must place more emphasis on product quality. Another interesting observation about management priorities is that mean survey responses did not significantly vary across Russian factories from different industries—suggesting uniform management priorities as a legacy of the Soviet system. These findings confirm the hypothesis that Soviet factories do not place as much emphasis on quality as they do on costs and schedules. Results from the study confirm Lawrence and Vlachoutsicos'(1990, 271-287) case study observation that Russian factories place more emphasis on schedules but refute their contention that Russian factories place less emphasis on costs. Findings from the study support the conceptual research of Alexeev (1991.) and other economists that one by-product of the Soviet system is more emphasis on meeting schedules and less emphasis on product quality.

The second area of differences in quality practices between the two countries is in the application of quality techniques. A very interesting finding from the study is that, in several areas, Russian workers are more likely than 'CIS. workers to use and understand some quality techniques. When asked to evaluate the overall effectiveness of their quality system, however, Russian workers ranked their system lower than U.S. workers. It appears that one reason that the Russian application of techniques does not work is that the quality system does not give workers control. Results from the study indicate that Russian workers are more likely than U.S. workers to know what they should be doing but are less likely to know how they are actually doing. Removing workers from quality assessment may be one reason that the Russian application of quality techniques does not work as well as the U.S. application.

While limited by the use of perceptual data and a relatively small sample of factories, the study's results are tenable and stimulating. Results from this study have addressed the underlying research hypothesis and found that differences in quality practices exist between the two countries. Analysis of these results has identified several areas of improvement in Russian factory quality practices. This study should serve as a guideline and stimulate more research on how to improve these practices. Future studies should examine a broader sample of factories, provide more detail on the mechanics of Russian quality practices, and evaluate the impact that

political changes have on these practices. Research that helps improve Russian product quality may serve an important role in helping the Russian economy compete in the global market.

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