PRIZREN SOCIAL SCIENCE JOURNAL
VOLUME: 6
ISSUE: 1
JANUARY- APRIL, 2022

ISSN: 2616-387X
DOI: 10.32936/PSSJ

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EFFECT OF CONTINUOUS IMPROVEMENT AND QUALITY DATA AND REPORTING ON INNOVATION PERFORMANCE

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Article history:

Submission 13 December 2021
Revision 21 February 2022
Accepted 28 March 2022
Available online 30 April 2022

Keywords:
Innovation,
Quality Management,
Continuous Improvement,
Quality Data and Reporting,
Structural Equation Modelling.

DOI:
https://doi.org/10.32936/pssj.v6i1.290

Abstract

It is stated that there is no certainty in the literature as to what sort of relationship between Quality Management practices and innovation exists. The literature on the relationship between Continuous Improvement (CI) and Quality Data and Reporting (QDR) -two of the practices related to quality management- and innovation is even more limited. The aim of this study is to determine the relationships between CI and QDR and innovation performance (IP). The data were obtained from the companies with ISO certificate in the manufacturing and service sectors. The model which consists of QDR, CI and IP variables was analysed with the Structural Equation Model. The IP level was above the midpoint as well. It has been seen that CI and QDR have an impact on IP. In addition, it has been determined that QDR has a mediating role in the effect of CI on IP.

1. Introduction

It can be claimed that one of the vital resources that businesses use for competition is innovation. The fact that innovation is one of the key factors in competition has been suggested in Schumpeter's studies (Dobrinsky, 2008). Schumpeter states that the main source of change is innovation, and innovation comes forward through doing things differently in economic life (Sweezy, 1943). According to Hobday (2005), innovation means doing something new in the areas of product, process, service, or within company structures (Çetindamar et al., 2017). According to the EU and OECD, innovation refers, as a process, to “developing an idea into a marketable good or service, a primary or improved form of production or distribution, or a new method of social service”. It describes a new or improved product, method or service that is marketable and occurs as a result of the transformation process (Pekşen, 2019). Therefore, it should be noted that innovation is not the same as invention, but rather commercialized and commercially successful novelties or changes that create value. Innovation is meaningful in terms of the competitiveness of businesses. It can be said that innovation is a very important competitive tool for businesses (Elçi, 2006) and it is the most important element of modern economy. In addition, it can be mentioned that innovation is one of the key elements in creating value (Hurmelinna-Laukkanen et al., 2008).

When it comes to competitive advantage, the concept of quality has sustained its existence for a long time as an important competitive tool. Especially Total Quality Management (TQM) has emerged as an important tool to increase competitiveness since the 1980s (Prajogo & Sohal, 2001).

As quality and innovation are in the frame as two elements that provide competitive advantage, it can also be said that these two concepts are related to each other. There are studies indicating that there is a positive correlation between quality management (QM) practices and innovation within the framework of relationship between quality and innovation.

Flyn et al. (1995) mentions the relations between QM practices and speed of new product development, and Mc Adam et al. (1998) between continuous improvement (CI) and innovation. Kanji (1996), contending that TQM practices help innovation, underlines that achieving business excellence is possible by integrating these two concepts. Another perspective on the relationship between the two variables is that TQM already covers the elements related to innovation, and there are researchers who argue that TQM is innovation in itself (Zairi 1999). Prajogo and Sohal (2001) have summarized the positive and negative arguments in the quality-innovation relationship.

They stated that there may be a positive relationship between some elements of TQM and innovation, while a negative relationship might exist between some others.

Studies on the relationship between QM and innovation have emerged as an interesting and pristine field of study (Prajogo & Sohal, 2001). Studies concerning the relationship between QM and innovations have also intensified especially after the 2000s (Singh & Smith, 2004; Hoang Igel & Laosirihongthong, 2006; Sa´ & Abrunhosa, 2007; Abrunhosa & Sa, 2008; Kim et al., 2012; Bon & Mustafa, 2013).

On the other hand, Singh and Smith (2004) mention the scarcity of studies examining the relationship between quality and innovation, and the discrepancy among the results of existing studies in this area. Similarly, Perez-Arostegui et al. (2013) also mention that, regarding this relationship, the results are complex and there is a lack of empirical studies in the literature. Besides, as to the relationship between QM and innovation, the number of studies carried out in both the service sector and the manufacturing sector is limited. Quality Data Collection and Reporting (QDR), which forms the basis of QM practices in studies, has been included in a limited number of studies (Kim et al., 2012).

In addition, it is stated that CI has a mediating effect on innovation (McAdam et al., 2010). However, the number of studies examining the relationship between CI and innovation performance is limited (Kohlbacher, 2013). Furthermore, the number of studies over this topic is limited in Turkey (Ar & Baki, 2011; Zehir et al., 2012; Karayel, 2017, Pekşen, 2019). For these reasons, the main research question, an answer for which is sought in this research, is "Is there a relationship between CI and QDR, which are QM practices in the manufacturing and service sectors in Turkey, and innovation performance?". The aim of the study, which stems from this research question, is to determine the effect of QM practices, which are tackled as QDR and CI, on innovation performance (IP). In the study, apart from the effect of QDR and CI on IP, it has also been aimed to examine the mediating effect of CI on the effect of QDR on IP. The research continues with the literature section that includes the literature review concerning the relationship between quality and innovation, the methodology section that includes the methodology of the research, the research findings section, the discussion and conclusion sections.

2. Literature

There are many practices in TQM, and some of these practices have come to fore in different studies. In this study, CI and QDR practices of QM and innovation performance concepts were examined.

2.1. Innovation and Innovation Performance

For a better definition of innovation, it is necessary to apprehend different types of innovation. Even though innovation seems to be related to technology, it is not solely comprised of technological progress because innovation can include important additions or radical changes emerging in products, processes or services; and it also appears in the form of thinking or organization (Çetindamar et al., 2017). Therefore, here, technological innovation and non-technological innovation can be seen as two main types of innovation. Non-technological innovations consist of organizational innovation and marketing innovation. Innovation types can also be classified as product innovation, process innovation and service innovation. Another classification can be seen as radical innovation and incremental innovation (Elçi, 2006). Innovation performance can also be measured by innovation types. Some of the innovation performance measures appear in the literature as product innovation and process innovation (Martínez-Costa & Martínez-Lorente, 2008; AlTaweel, 2021) radical product innovation, incremental product innovation, radical process innovation, incremental process innovation, managerial innovation (Kim et al. 2012), service innovation (Hu et al., 2009; Khan & Naeem, 2018), technological innovation (Sciarelli et al., 2020) and overall innovation performance (Goodale et al., 2011).

2.2. QDR

QDR can be defined as the execution of the collection, monitoring, analysis and reporting of quality-related data to achieve quality improvement objectives. QDR is defined as a component or practice of TQM (Gotzamani & Tsiotras, 2001). Just as the quality data mentioned here can be statistical quality control data, it can also be the data about suppliers. It is emphasized that the collection and reporting of quality data is important for identifying problems within the business, solving them and making improvements (Baird et al., 2011). Therefore, QDR has an important place in TQM activities and many QM practices are based on QDR. In addition, QDR is one of the basic elements of the ISO 9001 quality management system. Among the TQM practices, QDR is also included. Kim et al. (2012) examined the effects of TQM practices on product innovation, process innovation and managerial innovation in their study they carried out in manufacturing and service businesses. The indirect effect of QDR on innovation has been observed. They emphasized that other TQM practices are directly or indirectly related to innovation.

2.3. CI

CI can be attributed to the concept of Kaizen introduced by Masaaki Imai and to the small improvements that are continuously made. CI covers the culture of making sustainable and continuous improvements (Dahlgaard et al., 2008). It is stated that CI can be achieved with incremental improvements, and also as radical improvements with an innovative idea or a new technology (Bhuiyan & Baghel, 2005).

2.4. Relationship Between QM Practices and Innovation

According to the results they obtained with the Structural Equation Model (SEM), Hoang et al. (2006) stated in their study that TQM elements are related to the number of new products and the level of novelty, and they affect both. Martínez-Costa and Martínez-Lorente (2008) put forward that TQM practices affect both product innovation and process innovation. In their study they carried out by using SEM, Ar & Baki (2011) examined the effects of organizational elements, which can be counted as TQM elements, on product innovation and process innovation, and they found that while customer orientation and supplier relations affect product innovation, they do not affect process innovation.

Silva et al. (2014) stated that TQM practices have a positive effect on product innovation. Augusto et al. (2014) stated that organizational innovation is not effective on performance, but product innovation and process innovation are effective on performance. Kafetzopoulos et al., (2015) contended that TQM practices affect product and process innovation. Honarpour et al. (2018) mentioned in their study carried out on R&D departments that TQM is related to product innovation and process innovation. AlTaweel (2021) noted in the research on the manufacturing sector that TQM practices affect product and process innovation. Khan and Naeem (2018) stated in their analysis with SEM that quality management practices positively affect service innovation. Pekşen (2019) stated that the level of service innovation differs according to the participation of employees in QM practices.

Abrunhosa & Sa (2008) examined the relationship between TQM practices and technological innovation; and thus, stated that there is a relationship between technological innovation and communication, teamwork and supportive personnel management practices. Karayel (2017) noted that the results of his study on shoe manufacturing sector in Turkey support the relationship between technological innovation and teamwork, communication, and human management, which are elements of TQM.

Singh & Simith (2004) examined the effect of TQM variables on innovation, but no clear finding on the relationship between TQM and innovation could be obtained. McAdam et al. (2010) noted in their study on SMEs carried out by using SEM that TQM and CI have a mediating role in the effect of leadership, human and cultural elements on innovation practice. Zehir, et al. (2012) put forward in their study on manufacturing and service sectors that TQM practices have an impact on innovation performance. Bon et al. (2012) mention in their research on the relationship between TQM and innovation that there is an overall relationship between TQM and innovation. Ooi et al. (2012) stated, in their study conducted about companies with ISO 9001 certificate in the Malaysian manufacturing industry, that process management, personnel management and strategic planning are positively related to innovation. Perez-Arostegui et al. (2013) claimed that QM practices have an indirect effect on innovation performance. Bon and Mustafa (2013) examined the relationship between TQM and innovation in service businesses. Long et al. (2015) determined a positive relationship between TQM and innovation. Zeng et al. (2015) stated that hard quality management practices have an impact on innovation performance, but soft quality management practices do not. Similarly, Sciarelli et al. (2020) stated that hard QM practices and innovation show a partial mediation effect on soft QM-organizational performance relationship.

3. Research

The aim of the research is to investigate the relationship between TQM practices and innovation performance (IP) on businesses in the manufacturing and service sectors. As mentioned before, in previous studies, the impact of various QM practices on various innovation outputs has been examined. Even though there are adequate number of studies concerning the effects of some elements of TQM, the number of studies in literature about the effect of QDR on CI and IP is limited. Therefore, in this study, the relationship between IP and CI activities and QDR was examined.

QDR holds an important position in QM activities and many quality management practices are based on QDR. Therefore, it is expected that QDR will affect such factors as CI. Kaynak (2003) states that QDR has a direct impact on supplier relationship management and process management. Kim et al. (2012) stated that QDR has a direct impact on process management, which is one of the elements of TQM. They have observed that QDR has no direct impact on innovation, but has an indirect one. Therefore, the direct effect of QDR on CI, the effect of QDR and CI on IP, and the mediating effect of CI on IP will be investigated. In this context, the following hypotheses were formed.

H1: QDR has an impact on CI.
H2: QDR has an impact on IP.
H3: CI has an impact on IP.
H4: CI mediates the effect of QDR on IP.

3.1. Methodology

Survey method was used to collect data in the study. Since the subject of the study includes the QM practices, the companies to be selected for data collection are required to have made a certain progress in QM. Therefore, it is thought that it would be beneficial if the companies from which data would be collected have an ISO certificate. Since selecting the companies with ISO certificate will be beneficial in terms of ensuring that the chosen companies have taken a certain path regarding quality, companies with ISO 9001 certificate are selected in similar studies related to the quality-innovation relationship, (Ooi et al., 2012).

The research was carried out on employees of 30 different departments in 47 companies. A total of 771 questionnaires were obtained through convenience sampling method from 30 different departments of 47 different companies with ISO certificate in Istanbul. The analysis unit of the research is business departments. These questionnaires were evaluated on the basis of business department, and 256 different business and department combinations were obtained. Some of these departments were different departments in the same businesses, and others were departments of different businesses with the same or similar names. Since all variables were measured on a departmental basis, the department score for that item was obtained by taking the average of the answers given by the respondents to the items in each department. The total number of departments from which data was received is 256. Thus, the number of data subject to analysis is 256.

For data collection, the scales were obtained from the literature. The QDR scale was obtained from the study of Kim et al. (2012) (QDR1, QDR2, QDR3, QDR4). The scale for CI was obtained from the study of Grandzol & Gershon (1998) (CI1, CI2, CI3, CI4). For both scales, respondents were asked to answer for the department they work for. Both scales are five-point Likert scales (strongly agree:5, strongly disagree:1).

The scale related to innovation performance (IP) was obtained from the study of Goodale et al. (2011). The scale used by Goodale et al. (2011) includes a total of 16 items, eight of which are about how much the department manager attaches importance to these eight items related to innovation, and the other eight is about how satisfied he is with these items. Each respondent was asked how much the department managers attach importance to eight innovation performances and how satisfied they are with these eight innovation performances. Therefore, 8 importance scores and 8 satisfaction scores were obtained. These scores were not used raw. As Goodale et al. (2011) suggested, the answers each respondent gave to satisfaction and importance questions were multiplied, and the result was divided by the importance score. The IP score of each respondent was obtained by the formula (1).

$$IP = \frac{\sum(importance\ score\ x\ satisfaction\ score\ )}{\sum importance\ score} \qquad (1)$$

For these items, as suggested by Goodale et al. (2011), a five-point Likert scale was used (for the importance scale: 1: not important at all, 5: very important; and for the satisfaction scale 1: not satisfied at all, 5: very satisfied). Therefore, the answers will be in the range (1, 5). In order to avoid the multiplication of an unimportant item (1) and the highest satisfaction (5) from getting a high score (1x5=5), or the multiplication of a very important item (5) and of very low satisfaction (1), from getting a high score (5x1=5) while calculating IP, the answers given were coded as (-2, -1, 0, 1, 2) respectively, as suggested by Goodale et al. (2011). Therefore, an innovation performance item with 'no importance at all' is coded with (-2) instead of (1), and an innovation performance item that is 'no satisfied at all' is coded with (-2) instead of (1). The middle point (3) was coded as (0) in the new coding, and the highest importance or highest satisfaction as (2) instead of (5). Then, by taking the average of each individual's IP score calculated with the formula (1) on the basis of the unit they are in, 256 IP scores were obtained for 256 units.

It is stated that the sample size should be at least twice the number of items in the scale, but preferably ten times (Kline, 2011). For Structural Equation Models, it is preferred that the sample size is between 200-500 (Civelek, 2018). From these perspectives, a sample size of 256 is considered to be sufficient. Data collection was carried out through face-to-face survey method between January 2019 and September 2019. SPSS 23 package program and SPSS AMOS package program were used for Data Analysis.

4. Findings

4.1. Descriptive Statistics

The distribution of the units from which data were taken is shown in Table 1 as public sector and private sector and service sector and manufacturing sector. Therefore, while the service sector and the manufacturing sector are close to each other, the private sector has been represented more than the public sector.

Table 1. Sectoral Distribution

Sector	Frequency	Frequency (%)	Sector	Frequency	Frequency (%)
Service	137	53,5%	Public	49	19,1%
Manufacturing	119	46,5%	Private	207	80,9%
Total	256	100%	Total	256	100%

Descriptive statistics of scale items are shown in Table 2. The observed variables are shown in the first column of Table 2. When the mean values in the second column are examined, it is seen that the mean values of items other than IP are between 3 and 4. This situation shows that activities related to CI and QDR are carried out to a certain extent. This is an expected situation since all institutions have ISO certificates. For IP, the mean values are above the midpoint of 0. The last two columns show the values of skewness and kurtosis.

Table 2. Descriptive Statistics of Scale Items

	N	Mean	Standard Deviation	Skewness	Kurtosis
CI1	256	3,8818	,72123	-,982	1,004
CI2	256	3,8872	,68818	-1,204	1,867
CI3	256	3,9572	,59714	-,988	1,680
CI4	256	3,8852	,63361	-,749	,691
QDR1	256	3,9661	,70913	-1,192	2,056
QDR2	256	3,8345	,72543	-,893	,991
QDR3	256	3,8739	,69795	-,935	1,628
QDR4	256	3,9583	,73853	-1,198	1,988
IP	256	,7221	,57843	-,875	1,696

When the obtained kurtosis and skewness values are observed, it is seen that these values are not close to 0. For this, one of the transformations suggested in the literature has been carried out. According to the reflection transformation formula, new value = (the largest old value +1 - the old value), the square root of the new value obtained as the result of the subtraction is taken (Pallant, 2007). Accordingly, the skewness and kurtosis values of the transformed data were between (-0.285, +0.724). Kurtosis and skewness values in this range are accepted by the literature (Tabachnick & Fidell, 2014). In the next part of the study, the analysis was carried out on the transformed data.

First of all, the obtained data were analyzed with the independent sample t-test to determine if they differ according to being in the service sector or being in the manufacturing sector. No difference was observed for QDR (p=0.85), CI (p=0.105) and IP (p=0.166). Then, reliability analysis was performed for the scales.

4.2. Reliability Analysis

Reliability values for each scale were measured with Cronbach's alpha. Obtained reliability values are 0.843 for the CI scale and 0.915 for the QDR scale. These values appear to be appropriate.

4.3. Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA) is an analysis carried out about whether the available data is suitable for a previously discovered structure. CFA examines whether the previously constructed factor structure is appropriate (Meydan & Şeşen, 2015). CFA was carried out using the AMOS program.

In the performed DFA, modification was applied between QDR1-QDR2 items. When the fit indices obtained as a result of CFA were examined, it was obtained as CMIN/df=2.763, CFI=0.967, GFI=0.957, NFI=0.963, NNFI=0.963, RMSEA=0.080, SRMR=0.035, and there appears to be no problem in terms of fit indices (Meydan & Şenen, 2015; İlhan & Çetin 2014).

4.4. SEM Model

The standardized regression coefficients of the items ranged from 0.706 to 0.942. Since the standardized regression coefficients of the items are greater than 0.5, it can be said that there is no problem with validity in this respect. AVE and CR values of the scales are shown in Table 3. Since the AVE value is greater than 0.5, and the CR value, which is desired to be as large as possible, is acceptable to be in the range of 0.6-0.7, there appears to be no problem with validity in this respect (Hair et al, 2014).

Table 3. AVE and CR Values

	CI	QDR
CI	**0,760**	
QDR	0,744	**0,847**
AVE	0,578	0,718
CR	0,845	0,910

Comparing the correlations between latent variables and AVE values gains importance when examining in terms of discriminant validity. The correlations between the latent variables should be less than 0.90 (Kline, 2011), besides, the square root of the AVE value of each latent variable should be larger than the correlation between that latent variable and other variables (Ursavaş et al., 2014). In Table 3, the values on the diagonal are the square root of the AVE value of each latent variable. Correlation coefficients for each latent variable with other latent variables are shown in other cells. As seen in Table 3, the square root of the AVE value for each column and row is the largest value. This case shows that the square root of the AVE value is higher than the correlations between the variables, and thus discriminant validity is ensured.

The structural regression model created after CFA is shown in Figure 1. When the fit indices were examined, it was found that CMIN/df=2.248, CFI=0.979, NFI=0.964, NNFI=0.969, RMSEA=0.070, SRMR=0.035, and there appears to be no problem in terms of fit indices (Meydan and Şeşen, 2015; İlhan and Çetin 2014).

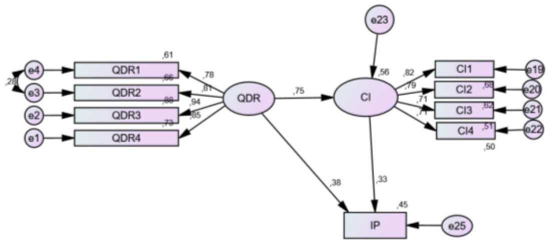

Figure 1. Structural Regression Model

The results obtained in the analysis performed according to the Structural Regression Model are shown in Table 4. Table 4 shows the standardized regression coefficients of the paths between the latent variables.

Table 4. Results of Structural Regression Model

			Coefficient	Standard Error	C.R.	p	Standardized coefficient
CI	<---	**QDR**	0,699	0,062	11,262	0,0001	0,746
IP	<---	**CI**	0,314	0,085	3,692	0,0001	0,330
IP	<---	**QDR**	0,343	0,077	4,458	0,0001	0,385

According to Table 4, all the paths are significant, and all the hypotheses are accepted.

4.5. Mediating Effect of CI

For the effect of QDR on IP, Sobel test was used to determine whether the mediating effect of CI was significant. According to the Sobel test, the mediating role of CI for the effect of QDR on IP is significant (Sobel test statistic 3.51, $p<0.001$).

5. Discussion and Conclusions

There is an ambiguity in the literature regarding the relationship between QM practices and innovation. Accordingly, in this study, the relationship between QDR, CI and IP was examined. The results show that activities related to CI and QDR are carried out to a certain extent. This is an expected situation since all institutions have ISO certificates. For IP, the item averages are above the midpoint of 0. Therefore, IP is also above the midpoint, indicating a certain innovation.

When the structural model is examined, a significant effect of QDR on CI and IP has been observed, and a significant effect of CI on IP was observed. This shows that innovation performance is affected by QDR and CI applications. In the literature, Mc Adam et al. (1998) stated that there is a relationship between CI and innovation. Bon et al. (2012) mention that there is a relationship between TQM and innovation. A significant partial mediation effect of QDR on IP via CI was also observed. McAdam et al. (2010) stated that CI has a mediating effect on innovation performance. Kim et al. (2012) observed the indirect impact of QDR on innovation. Obtained findings are compatible with the literature in this respect. These findings, in reverse, support the view that CI can be achieved with incremental improvements, as well as radical improvements with an innovative idea or a new technology (Bhuiyan & Baghel, 2005).

One of the administrative outputs of the study is that QDR activities have been seen to support both CI and IP. All the companies on which the research was conducted have taken a certain path in terms of quality. It is expected that the companies that have taken a certain path in quality will increase their activities on QDR, which supports CI, and supports IP both directly and through CI. Therefore, activities related to QDR should be increased to support both CI and IP. Collecting and analyzing quality data is useful for generating new solutions and methods.

One of the limitations of the study is that it was conducted among a limited number of companies. Future studies can be carried out on more companies. Another limitation is that only two of the QM applications were selected. The existing model can be expanded by examining other QM applications in new models. The IP measurement methodology used in this study can be used in new studies by associating it with other variables besides QM applications.

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