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Strategic fit strategy formulation: keys to enhancing competitiveness and improving capabilities of a manufacturing unit

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ABSTRACT
The current study aims to explore the relationship between manufacturing metrics or manufacturing performance factors and manufacturing fitness, which establishes the basis for manufacturing strategy. Previous researches on manufacturing strategies and competitive strategies to measure firm performance guided the manufacturers towards further developments. To emphasize these developments, this study continued after the development of strategic fit models by generalizing these models through linear structural relations (LISREL) analysis. Results from hypotheses tests and LISREL analysis found manufacturing metrics are directly linked to firm’s performance. This article found strong relation of availability of materials (AM) to order variation handling (OVH) & order fill rate (OF); OVH, problem handling (PH), & OF to shipment time (ST); and ST to strategic fitness (SF). Identification of affecting metrics and determination of their strength & significance to manufacturing fitness by using this article’s generalized models & firm’s performance determinants is the main significance of this article.

1. Introduction

Though garments industries of Bangladesh improved revolutionary more than four decades ago, the manufacturers couldn’t develop sustainable platform yet due to having a lack to determine how they are capable to utilize resources and to measure how they can be fit for global competitions. Formulation of strategic plans by keeping consistent with manufacturing capabilities is important to be successful in global competitions and to be adjusted with environment changes. Environment gets complexity due to market and technology changing, global market expanding, and increasing uncertainty and complexity in marketing. This continuous marketing complexity compels the firm’s manufacturers to shift manufacturing by efficiency to strategy-based manufacturing where success depends on better performance of manufacturing strategies. Strategies better performance leads the firm toward competitive advantages. Porter (1996) claimed firm’s success linked to manufacturing strategies and its overall strategies that defines...
competitive capabilities achievement and firm’s performance. Emphasizing the advantages of this linkage, manufacturing systems should be designed and developed that results better firm’s performance and customer needs fulfilment (Ward et al., 1994). Firm’s performance depends on how the manufacturers perform on manufacturing strategies. Determination of firm’s performance is vital to the manufacturers since this visualizes their aggregate achievement on manufacturing strategies. Our previous article (Rahman & Rahman, 2019) developed mathematical models for manufacturing fitness (firm’s performance) determination of a manufacturing unit by showing metrics achievement and fitness fluctuation due to metrics achievement variations. Further developments include statistical technique to generalize these models covering cross-industrial quantitative research through this article.

Strategic fitness defines its capabilities to meet external environments and indicates utilizing capabilities of its resources. Firm’s failure to meet its external environment and lack to utilize its resources demand a loss/penalty from the manufacturers which is clearly stated and explained by Rahman and Rahman (2019). This article’s literature reviewing found a strong linkage of manufacturing strategies (cost, quality, delivery, and flexibility) to its performance and determined firm’s manufacturing performance considering manufacturing metrics covering manufacturing strategies. This study focused on statistical analysis of manufacturing metrics and sub-metrics to develop their relationship model to firm’s fitness (firm’s performance) and to generalize the models developed in (Rahman & Rahman, 2019). Measurement of firm’s performance specifies its resources actual utilization and external environment meeting capability. In context of economic condition of Bangladesh, measurement of manufacturing performance of garments industries is undoubtedly a vital issue since its economy is mostly depended on garments sectors and this measurement carries a great contribution for the manufacturers to make them clear about resources utilization and overall performance achievement. Considering this vital issue, we emphasized on the generalization of firm’s performance models through this article where previous researchers analyzed focusing on competitive strategies & firm’s performance/efficiency such as Rahman and Al Amin (2016) aggregated the factors of production efficiency and analyzed their effect, Nuruzzaman (2013) visualized the associated loss/penalty due to late shipment, Ahmed (2009) & Berg et al. (2011) analyzed the growth of drivers, challenges and firm’s performance factors, Banker et al. (2014) investigated the relationship between the strategic positioning and firm’s sustainable performance, Chang et al. (2015) measured the production efficiency by firm’s strategic positioning, Alam and Natsuda (2016) examined the garments industry’s competitive factors, and Alam et al. (2017) investigated the garments export’s determinants. Considering the economic dependency on garments sectors in Bangladesh and its future competitive requirements, the authors of this article were motivated to consider manufacturing units of Bangladeshi garments industries to serve the manufacturers by developing performance evaluation models. To strengthen Rahman and Rahman (2019) developed models, we proceeded to generalize these models by fixing two goals and they are (a) development of relationship diagram among the manufacturing metrics by showing their relation on strategic fitness (firm’s performance) and (b) aggregation of sub-metrics and determination their impact on strategic fitness by linear structural equation analysis (LISREL). To achieve these goals, this article is organized by the following sections: theoretical background in section 2, manufacturing metrics
categorization in section 3, hypotheses proposition among manufacturing metrics in section 4, research method in section 5, results and discussions in section 6, and conclusion and implications in section 7.

2. Theoretical background

Manufacturing environment has become competitive & uncertain and the level of competition & uncertainty is changing continuously. This changing scenario depends on strategy formulation and strategy adaptation with environment changes and this will grow continuously over twenty-first century according to academicians and practitioners (D’Souza & Williams, 2000). To create a platform for global competitions, competitive strategies should be implemented into manufacturing strategies. A link among competitive strategy, manufacturing strategy, and performance was addressed by Vickery et al. (1993) and Zhao et al. (2006). Sustainable competitive advantages are not possible without building linkage between strategy and manufacturing operations by the claim of Porter (1996). He also claimed this linkage as a key of sustainable competitive advantages. Tracey et al. (1999) claimed for the formulation of strategic plans consistent with their capabilities to be successful with global competitions and rapidly changing environments. Manufacturing strategies belongs to the components of business strategies or this is strongly linked to firm’s business strategies (Anderson et al., 1989; Balsam et al., 2011; Cai & Yang, 2014; Hung et al., 2015). The concept of manufacturing strategy became well-known and gained attention to the researchers from the seminal work of Skinner (1969), and this already has become an important tool of corporate strategy. Skinner (1974) described delivery cycles, superior quality and reliability, flexibility in volume changing and low cost as common competitive performance criteria for manufacturing strategy. Wheelwright (1978) identified efficiency, quality and flexibility, dependability as the most important criteria for evaluating manufacturing strategy. Hayes and Wheelwright (1984) delineated cost, quality, flexibility and dependability as four basic competitive priorities. Again, Krajewski and Ritzman (1987) & Sum et al. (2012) delineated cost, higher performance design, consistent quality, due time delivery, and product & volume flexibility as basic operational competitive priorities. From the comprehensive literature review, Avella et al. (2011) & Prester (2013) contended quality, delivery, cost, flexibility, and innovation as most critical competitive priorities. And hence based on this throughout previous literature reviewing, this article defined cost, quality, due time delivery, flexibility as the main components of manufacturing strategy.

Firm’s performance is affected due to the criteria’s fluctuation of manufacturing strategies and competitive strategies. How competitive strategy influences manufacturing strategy and influence on firm performance due to both of manufacturing strategies and competitive strategies had been tested by Amoako-Gyampah and Acquaah (2008), Merschmann and Thonemann (2011), and Jitpaiboon et al. (2016). Manufacturing strategies directly affect firm’s performance and competitive strategies indirectly affect manufacturing strategies. Firm’s competition to exploit their competitive advantages in a specific business to realize their goals is a typology of competitive strategy (Porter, 1980). This typology on competitive strategies included cost leadership and differentiation (Chang et al., 2015) and Amoako-
Gyampah and Acquaah (2008) considered this typology to find out their effect on firm’s performance. This findings showed an effect on firm’s performance. Firms would develop competitive advantages by pursuing these strategies and this would enable to outperform its competitors. However, clear choice of competitive strategies is necessary to earn profits and outperform its competitors (Porter, 1996). Since firm’s performance comes through the success of competitive strategies and manufacturing strategies, determination of this performance (manufacturing fitness) utilizing these strategies carries a contribution to manufacturers. To determine performance achievement of a manufacturing unit, our previous research (Rahman & Rahman, 2019) aggregated manufacturing metrics focusing on a garments manufacturing unit. Aggregated metrics AM, OF, quality perfection (QP), problem handling (PH), OVH, cost performance (CP), and ST includes manufacturing strategies (cost, quality, delivery and flexibility) where AM, OF, PH, and OVH defines manufacturing flexibility. Figure 1 shows the relations of manufacturing metrics to manufacturing fitness and this relationship diagram is the conceptual model of this research work.

### 3. Manufacturing metrics categorization

There are seven manufacturing metrics those were divided into three categories. First category metric (AM) is linked to second category metrics (OF, QP, PH, OVH, & CP). Similarly, the second category metrics are linked to third category metric (ST) and finally the third category metric is linked to strategic fitness (SF) of a manufacturing unit shown in Figure 1 and their relation’s validation with significance results had also been shown in section 5.
4. Hypotheses proposition among manufacturing metrics

4.1. Hypotheses proposition between before manufacturing metrics (BMM) and during manufacturing metrics (DMM)

AM is required before starting the manufacturing and hence this is considered as first category metric. There is a great contribution of AM to overall performance of a manufacturing unit, thereby the manufacturers consider shortage of materials directly affect second category metrics (DMM) (Han, 2009; Jaafreh & Al-abedallat, 2013). Effect of AM to DMM had been analyzed by the previous researchers such as Rahman and Al Amin (2016) analyzed the effect of AM to PH, CP, and OF. Again, Tracey et al. (1999) & Swink et al. (2005) analyzed the effect of manufacturing practices to cost efficiency/performance (CP), process flexibility (PH & OVH) and (QP). Based on the findings through previous researches, this research considered AM direct effect on DMM and therefore it proposed the following hypotheses.

H1a: Order Variation Handle (OVH) is positively related to Availability of materials (AM)

H1b: Problem Handling (PH) is positively related to Availability of materials (AM)

H1c: Quality Perfection (QP) is positively related to Availability of materials (AM)

H1d: Cost performance (CP) is positively related to Availability of materials (AM)

H1e: Order Fill Rate (OF) is positively related to Availability of materials (AM)

4.2. Hypotheses proposition among DMM

Previous researchers showed an internal linkage among the metrics of second category such as M. Tracey et al. (1999) showed a relation between quality of products and order fill rate. Roth and Miller (1992), Handfield and Pagell (1995), and Tracey et al. (1999) showed a relation between product quality and delivery time/shipment time. Moreover, they also determined their effect on overall performance of a manufacturing unit. Considering these relations among DMM, this research proposed the following hypotheses.

H2a: Problem Handling (PH) is positively related to Order Variation Handle (OVH)

H2b: Quality Perfection (QP) is positively related to Problem Handling (PH)

H2c: Cost Performance (CP) is positively related to Quality Perfection (QP)

H2d: Order Fill Rate (OF) is positively related to Cost Performance (CP)
4.3. **Hypotheses proposition between DMM and after manufacturing metrics (AMM)**

The manufacturing metric (ST) of third category (AMM) is linked to its previous categories metrics and also linked to manufacturing fitness which is the determinant of manufacturing overall fitness (Mondal et al., 2017; Surana et al., 2005; Swafford et al., 2006). Due time shipment gives the evidence of proper handling of previous metrics and it motivates and encourages the employees for the better performance & growth of an organization (Rahman & Rahman, 2019; Swink et al., 2005), thereby senior management suggested the manufacturers to keep a focus on ST. Based on the evidences from the previous researches, this research proposed the following hypotheses.

H3a: Shipment Time (ST) is positively related to Order Variation Handle (OVH)

H3b: Shipment Time (ST) is positively related to Problem Handling (PH)

H3c: Shipment Time (ST) is positively related to Quality Perfection (QP)

H3d: Shipment Time (ST) is positively related to Cost Performance (CP)

H3e: Shipment Time (ST) is positively related to Order Fill Rate (OF)

Hypotheses among the metrics of different categories with their relationships had been integrated and visualized in Figure 1. The strength of these hypotheses had also been analyzed in the following sections with a summarization result represented in Table 2 and finally visualized in Figure 3.

4.4. **Hypothesis proposition between AMM and SF**

As SF is directly related to due time shipment/due time delivery (ST), it defines the overall performance of a manufacturing unit (Rahman & Rahman, 2019). Better performance of the previous metrics results better performance of SF (Rahman & Rahman, 2019) so management should give more importance to previous metrics prior to third category metric (Jaafreh & Al-abedallat, 2013). The strategy of getting better fitness creates an environment of more developed systems and more empowered employees (Ebrahimi & Sadeghi, 2013) and hence this research also proposed another hypothesis linking firm’s performance.

H4a: Strategic Fit (SF) is positively related to Shipment Time (ST)

It is necessary to verify the relationship diagram shown in Figure 1 by regression and correlation analysis whether all the hypotheses are valid. This analysis determines how strongly two variables are linearly related and this analysis also reduces model complexity. Regression analysis finds the statistical relation between two variables rather than theoretical analysis (Teo, 2014). Initially we proposed 14 hypotheses (H1a-H1e, H2a-H2d, and H3a-H3e) among three categories manufacturing metrics and considered another hypothesis H4a defining a relationship between shipment time (ST) and strategic fitness (SF).
5. Research method

5.1. Systematic empirical research approach

This section represents an adoption of systematic empirical research approach suggested by Cai and Yang (2014) to determine metrics significance on manufacturing fitness shown in Figure 2. This figure showed the sequences not only to verify of metrics hypotheses validity but also to determine metrics and sub-metrics significance on manufacturing fitness/firm’s performance.

5.2. Metrics relationship model development

5.2.1. Sampling and data collection

Proposed hypotheses were tested with a sample of Bangladeshi garments manufacturing firms and these firms has become an ideal location for studying manufacturing strategy. Our sample frame consists of more than 5500 garments industries that earn more than 75% of total foreign currencies in each year. Reputed 100 industries were selected for our research study those have more than 700 manufacturing units. For this study, a questionnaire set was prepared added in appendix section requiring total number of orders and metrics failures from the month January to June, of 2018. Questionnaire set was mailed to 543 managers and engineers including: Industrial Engineers, Assistant Production Managers, Operations/Manufacturing Managers, and Production Managers. At first, they were telephoned and solicited for their kind cooperation. After mailing the questionnaire set, the respondents were called repeatedly to remind them to fill out and return their evaluations. 353 evaluations were received with 65% response rate.

5.2.2. Scale reliability and construct validity

Scale reliability was tested by calculating Cronbach alphas and constructs, such as BMM, DMM, AMM, and SF were measured and excluded by multi-item, formative scales. Scales exhibiting Cronbach alphas greater than.6 defines sufficiency for exploratory work and support vertical validity to represent scales constructs (Cai & Yang, 2014). Factor analyses were employed for each scale to test unidimensionality and found evidence of single latent constructs. Varimax rotation in principal component analyses were used and found emerging of single factor from factor analysis for each scale with sizable loading factor (> .6),

![Figure 2. Research protocol.](image-url)
GFI = 0.931, and AGFI = 0.892 shown in Table 4 and Figure 5. Thus unidimensionality is established and the scales exhibit nomological and theoretical validity. Table 2 and Figure 3 present t-value, β value, ρ value, and r-value of the constructs measured by Likert-type scale.

5.2.3. Regression analysis
Regression analysis finds the linear relationship between dependent and independent variables and correlation analysis measures its strength. Multiple regression analysis tests the validity of a hypothesis. Test of effect of mediating constructs (OVH, PH, QP, CP, OF, and ST) on dependent construct (SF) verifies equations 2–3, and effect of exogenous constructs (AM) on mediating constructs also verifies equation 1. Significant regression coefficient verifies these equations positively. Verification of these equations, and hypotheses validation was carried out on the basis of the findings (r-values) using the Table A1 data set included in the appendix section summarized in Table 2.

From the summarized results shown in Table 2, six hypotheses were rejected and another nine hypotheses were accepted on the basis of t-values, β values, and Pearson correlation coefficient (r) values. r-value defines the strength of a hypothesis and this strength level is determined by Evans et al. (1996) suggested scale shown in Table 1.

Results from the above analysis summarized in Table 2 provide sufficient results to develop metrics relationship model showing their hypotheses strength and Figure 3 is the developed model which verified initially considered model shown in Figure 1.

5.3. Hypotheses validity analysis
Table 2 shows the statistical verification of the proposed model shown in Figure 2. t-value and ρ value judges the statistical significance of the theorized relationships (hypotheses), and the hypotheses are positively significant in the case of t-value above 2.00. t-value and ρ value
provides hypotheses acceptance/rejection strength at 5% significance level (α = 0.05). From Table 2, hypotheses H1b, H1 c, H1d, H2d, H3 c, and H3d were rejected since their t-value, and ρ value didn’t provide sufficient strength for their acceptance. On the other hand, hypotheses H1a, H1e, H2a, H2b, H2 c, H3a, H3b, H3e, and H4a were accepted since their t-value, and ρ value provided sufficient strength for acceptance. From the ρ values (ρ < 0.05) and t-values (t value > 2.00) of H1a & H1e for a garments manufacturing unit, we can say that availability of materials (AM) has strong contribution to OVH & OF. It means BMM (AM) is linked to DMM (OVH & OF) and the metrics of during manufacturing will be fluctuated/influenced with the shortage of AM. Again, the ρ values (< 0.05) and t-values (> 2.00) for the hypotheses of H3a, H3b, & H3e without H3 c & H3d defined their strong contribution to ST. Besides this strong linkage of DMM to AMM, the ρ value (< 0.05) and t-value (> 2.00) of H4a also indicated strong linkage of SF to ST.

### Table 1. Hypotheses strength with correlation value (r).

| Correlation value (r) | Hypotheses strength |
|-----------------------|---------------------|
| 0.00–0.19             | Very weak           |
| 0.20–0.39             | Weak                |
| 0.40–0.59             | Moderate            |
| 0.60–0.79             | Strong              |
| 0.80–1.00             | Very strong         |

### Table 2. Validation results of proposed hypotheses.

| Relationship Hypotheses | t value | β value | Significance at | Equations | Hypotheses strength |
|--------------------------|---------|---------|-----------------|-----------|---------------------|
| Impact of AM to DMM      |         |         |                 |           |                     |
| AM → OVH H1a            | 5.411   | 0.122   | p < 0.01        | Eq.1      | OVH capability is strongly related to AM |
| AM → PH H1b             | 1.825   | 0.021   | p > 0.10        |           | PH capability is weakly related to AM   |
| AM → QP H1c             | 1.326   | 0.018   | p > 0.10        |           | QP is weakly related to AM              |
| AM → CP H1d             | 0.532   | 0.007   | p > 0.10        |           | CP is very weakly related to AM         |
| AM → OF H1e             | 13.72   | 0.188   | p < 0.01        |           | OF is very strongly related to AM       |
| Impact among DMM        |         |         |                 |           |                     |
| OVH → PH H2a            | 15.44   | 0.191   | p < 0.01        |           | PH is very strongly related to OVH       |
| PH → QP H2b             | 6.29    | 0.179   | p < 0.01        |           | QP is strongly related to PH             |
| QP → CP H2c             | 6.82    | 0.149   | p < 0.01        |           | CP is strongly related to QP             |
| CP → OF H2d             | 0.51    | 0.005   | p > 0.10        |           | OF is very weakly related to CP          |
| Impact of DMM to ST     |         |         |                 |           |                     |
| OVH → ST H3a            | 8.50    | 0.154   | p < 0.01        | Eq.2      | ST is very strongly related to OVH       |
| PH → ST H3b             | 6.21    | 0.204   | p < 0.01        |           | ST is strongly related to PH             |
| QP → ST H3c             | 1.75    | 0.027   | p > 0.10        |           | ST is weakly related to QP               |
| CP → ST H3d             | 1.25    | 0.007   | p > 0.10        |           | ST is weakly related to CP               |
| OF → ST H3e             | 9.00    | 0.167   | p < 0.01        |           | ST is very strongly related to OF        |
| Impact of ST to SF      |         |         |                 |           |                     |
| ST → SF H4a             | 8.29    | 0.186   | p < 0.01        | Eq.3      | SF is very strongly related to ST        |
5.4. Analysis of sub-metrics significance on firm’s performance

From Figure 3, firm’s manufacturing performance/strategic fitness (SF) is influenced by the performance of ST. Again, ST achievement is influenced by the performance of DMM (OVH, PH, QP, CP, OF), and their achievements are also influenced by the performance of AM. Statistical verification of this influence among different categories metrics by their sub-metrics, and verification of manufacturing strategies influence on firm’s performance is necessary. For this verification, this article integrated manufacturing sub-metrics by reviewing literatures and picking up manufacturer’s opinions shown in the first column of Table 3.

5.4.1. Item generation and scale development

The list of metrics and sub-metrics with their proper definition was presented to the manufacturers of garments industries. The questionnaire set was interactive, easy and relevant so that the reader can understand easily. They were requested to add or drop sub-metrics if they feel necessary or redundant/unnecessary. Finally, the aggregated set of metrics and sub-metrics with the related questionnaire were discussed and evaluated with academic experts of supply chain and logistic, operations management and manufacturing technologies. Then, the evaluated questionnaire set was mailed to the manufacturing experts of few garments industries such as Fakir Apparels Ltd., Liz Fashion Ltd., FCI BD Ltd., Epyllion Group, and SQ Birichina Ltd to take their consent. After receiving their positive consent, items generated in the first column of Table 3 was selected as final for the significance analysis.

Five point (1–5) Likert scale was used to evaluate the questionnaire set where 1–2 = low importance, 2–4 = moderate importance, and 5 = most importance.

5.4.2. Pilot study

A pilot study was conducted among the targeted respondents. About 180 executives (manufacturing managers/assistant managers, supply chain managers/assistant managers, merchandizing managers/assistant managers, facility/plant managers/assistant managers, materials managers/assistant managers etc.) were mailed for the evaluation. 61 responses were received and that was the sample for pilot study. The sample size 61 is large enough for the pilot study stage (Hair et al., 1995). The sample adequacy was measured with the help of Kaiser-Meyer-Olkin (KMO) adequacy measurement which determines the appropriateness of factor analysis (Kaiser, 1970). In this case, factor analysis was appropriate.

5.4.3. Scale development for BMM, DMM and AMM

Table 3 shows the purified results of manufacturing sub-metrics by using corrected-item total correlations (CITCs) and Cronbach alphas (α) provided by SPSS®. The items those does not strongly contribute to Cronbach alpha (Cronbach, 1951) were eliminated/dropped down and the results after elimination is shown in Table 4. This table shows the list of retained items. The retained items were carried for the further calculations those indicated sound construct validity.

16 items were dropped out from Table 3 as they have less than 0.5 CITC value. Before proceeding to Table 4, we discussed with senior management/management experts and manufacturers of garments industries. They gave positive consent and inspired us for the
Table 3. CITCs and reliabilities of the manufacturing metrics after purification (n = 353).

| Item                                      | CITC  | Cronbach’s α for the retained items |
|-------------------------------------------|-------|-------------------------------------|
| **Before manufacturing metrics (BMM)**    |       |                                     |
| Availability of materials (AM)            |       |                                     |
| AM1: Storing all the materials before starting the order | 0.699 | α = 0.747                           |
| AM2: Collecting the remaining materials for that case when there is not available 100% materials but order has been started | 0.706 |                                     |
| AM3: Availability of all the accessories  | 0.744 |                                     |
| AM4: Send the list of materials in the cutting department and stores of the associated orders with a good lead time | 0.215 |                                     |
| **During manufacturing metrics (DMM)**    |       |                                     |
| Order fill rate (OF)                      |       |                                     |
| OF1: Availability of all materials        | 0.698 | α = 0.708                           |
| OF2: Workers and employees performance    | 0.759 |                                     |
| OF3: Production time                      | 0.685 |                                     |
| OF4: Automated machine instead of manual machines | 0.206 |                                     |
| OF5: Supervising                          | 0.070 |                                     |
| Quality perfection (QP)                   |       |                                     |
| QP1: Availability of all materials        | 0.076 | α = 0.763                           |
| QP2: Pre-production activities (Dying, washing, printing and cutting) | 0.738 |                                     |
| QP3: Materials quality                    | 0.828 |                                     |
| QP4: Workers and employees performance    | 0.876 |                                     |
| QP5: Quality inspection by quality control department | 0.711 |                                     |
| QP6: Automated machines instead of manual machines | 0.639 |                                     |
| QP7: Supporting the operators by helpers  | −0.158|                                     |
| QP8: Post production activities (Ironing, Embroidery and printing) | 0.709 |                                     |
| Problem handling (PH)                     |       |                                     |
| PH1: Availability of all materials        | 0.275 | α = 0.703                           |
| PH2: Automated machines                   | 0.740 |                                     |
| PH3: Skilled operators and workers         | 0.604 |                                     |
| PH4: Proper power supply                  | 0.137 |                                     |
| PH5: Differentiate the production lines according to order size and product item | 0.708 |                                     |
| PH6: Sufficient expert technician         | 0.313 |                                     |
| Order variation handle (OVH)              |       |                                     |
| OVH1: Availability of all materials       | 0.109 | α = 0.719                           |
| OVH2: Differentiate the production lines based on order size and product item | 0.762 |                                     |
| OVH3: Production in a single time         | 0.679 |                                     |
| OVH4: Don’t start the another order by breaking the running order | 0.602 |                                     |
| OVH5: Maximum production for different orders by not changing the existing layout (if possible) | 0.421 |                                     |
| Cost performance (CP)                     |       |                                     |
| CP1: Availability of all materials        | 0.140 | α = 0.838                           |
| CP2: Skilled operator                     | 0.923 |                                     |
| CP3: Automated machines                   | 0.763 |                                     |
| CP4: Try to avoid overtime schedule       | 0.595 |                                     |
| CP5: Avoid subcontracting production system | 0.770 |                                     |
| CP6: Training programs among the operators on production techniques | 0.287 |                                     |
| CP7: Due time shipment                    | 0.763 |                                     |
| After manufacturing metrics (AMM)         |       |                                     |
| Shipment time (ST)                        |       |                                     |
| ST1: Order fill rate                      | 0.651 | α = 0.746                           |
| ST2: Quality perfection                   | 0.322 |                                     |
| ST3: Problem handling                     | 0.688 |                                     |
| ST4: Order variation handle               | 0.604 |                                     |
| ST5: Cost performance                     | 0.162 |                                     |
| ST6: Complete the production in time      | 0.633 |                                     |
| ST7: Time interval between the production time and shipment time | 0.629 |                                     |
| Strategic fit (SF)                        |       |                                     |
| SF1: Shipment time/delivery time          | 0.373 | α = 0.726                           |
| SF2: Utilization of maximum manufacturing capabilities | 0.709 |                                     |
| SF3: Best performance based on their capabilities | 0.679 |                                     |
| SF4: Earning maximum FOB                  | 0.244 |                                     |
| SF5: Better growth of the organization    | 0.512 |                                     |

*aItem dropped*
next proceedings. Based on the value of Cronbach alpha (α), the manufacturing metrics were prioritized/ranked sequentially shown in Table 4.

5.4.4. LISREL analysis and structural modeling
Figures 4 and 5 show the restatement of the model shown in Figure 3. The items (AM1, AM2, and AM3) from the scale development were utilized as the direct indicators of the exogenous latent variable of BMM. Composite scores for the factors OF, QP, PH, OVH

Table 4: Factors, loading, and reliabilities of the manufacturing metrics after factor analysis (n = 353).

| Item          | KMO-0.709 | KMO-0.761 | KMO-0.807 | KMO-0.703 | α for retained items |
|---------------|-----------|-----------|-----------|-----------|---------------------|
| AM1           | 0.887     |           |           |           | 0.917               |
| AM3           | 0.875     |           |           |           |                     |
| AM2           | 0.745     |           |           |           |                     |
| OF2           | 0.916     |           |           |           | 0.945               |
| OF1           | 0.894     |           |           |           |                     |
| OF3           | 0.850     |           |           |           |                     |
| QP3           | 0.927     |           |           |           | 0.934               |
| QP4           | 0.884     |           |           |           |                     |
| QP2           | 0.814     |           |           |           |                     |
| QP8           | 0.776     |           |           |           |                     |
| QP5           | 0.756     |           |           |           |                     |
| QP6           | 0.687     |           |           |           |                     |
| PH6           | 0.826     |           |           |           | 0.880               |
| PH2           | 0.817     |           |           |           |                     |
| PH3           | 0.677     |           |           |           |                     |
| OVH2          |           | 0.870     |           |           | 0.869               |
| OVH4          |           | 0.737     |           |           |                     |
| OVH3          |           | 0.657     |           |           |                     |
| CP2           |           |           | 0.874     |           | 0.927               |
| CP7           |           |           | 0.868     |           |                     |
| CP5           |           |           | 0.839     |           |                     |
| CP3           |           |           | 0.759     |           |                     |
| CP4           |           |           | 0.704     |           |                     |
| ST3           |           |           |           | 0.848     | 0.866               |
| ST1           |           |           |           | 0.801     |                     |
| ST7           |           |           |           | 0.648     |                     |
| ST4           |           |           |           | 0.627     |                     |
| ST6           |           |           |           | 0.539     |                     |
| SF2           |           |           |           | 0.777     | 0.845               |
| SF5           |           |           |           | 0.701     |                     |
| SF3           |           |           |           | 0.662     |                     |
| Eigen value   | 2.586     | 2.705     | 4.536     | 2.442     | 3.879               |
|               |           |           |           | 2.379     | 3.296               |
|               |           |           |           |           | 2.290               |
and CP were shown as the observable indicators of the endogenous latent variable, DMM. The composite measures were calculated by summing the individual scores for each item in a dimension and then dividing by the number of items. For example, the responses to OF1, OF2, and OF3 were summed and then divided by three to determine the composite measure of OF. Pearson product-moment correlation coefficient (r) predicts validity of a relationship. Figure 4 shows a relationship among the metrics. Composite measures of the metrics were constructed and then submitted to SPSS® to determine Pearson product-moment correlation coefficient (r). The coefficient value of BMM to DMM is 0.942, DMM to ST (AMM) is 0.881 and ST to SF is 0.843 and these

Figure 4. Significance of AM to DMM, DMM to AMM and AMM to SF.

Results:

GFI = 0.931
AGFI = 0.892
n = 353

Figure 5. Significance of sub-metrics to DMM, DMM to ST, and ST to SF.
coefficient are significant at $\alpha = 0.05$. This indicated validity possible relationship among manufacturing metrics.

Manufacturing metrics OF, PH, & OVH have strong contribution to ST and QP, & CP has weak contributions that is shown in Figure 5. The goodness-of-fit index (GFI) is used to evaluate the fitness of the models tested. GFI provides a measure the ranging from 0 to 1. The GFI value near to 1 justifies a ‘good’ model (Dillion & Goldstein, 1984). The GFI for this model is 0.931 and goodness-of-fit index adjusted (AGFI) for the degree of freedoms is 0.892 which was also good. Both of them evaluate the fitness of this model.

6. Results and discussions

This study formulated strategic fit model for the garments industries to enhance competitiveness and to improve capabilities through this article. The correlation among the metrics linked to strategic fitness (Rahman & Rahman, 2019) guided to model development among manufacturing metrics. Correlation diagrams assisted to develop a relationship diagram (see Figure 3). This relationship diagram opens an insight to the management to proceed to be competitive strategically since results of Figure 3 will assist them by thinking and achieving of manufacturing fitness. This proposition on manufacturing fitness enables them to be competitive strategically by accomplishing competitive goals. To accomplish competitive goals, manufacturing strategies should be aligned with firm’s competitive strategies. Skinner (1969) and Anderson et al. (1989) examined the alignment between manufacturing strategies & competitive strategies and this alignment had been verified by several studies (e.g. Ward & Duray, 2000). This alignment helps to understand how manufacturing capabilities should be adjusted to achieve firm’s objectives.

The relationship diagram shown in Figure 3 linked among the metrics and this linkage provides an evidence toward better firm’s performance by conducting manufacturing and operational strategies successfully. The managers will be benefited finding out this linkage between firm’s performances and manufacturing strategies. Swamidass and Newell (1987), Ward et al. (1994), and Vickery et al. (1993) found a linkage between operation strategies and business performances. Based on firm’s growing performance and financial performance, Swamidass and Newell (1987) also found a positive significant relation between production flexibility and aggregated performance measurement. Besides Swamidass and Newell (1987), Chandra et al. (2005) also found a positive relation between production flexibility and financial performance. Relation between flexibility and growth performance were also found by their researches. They found performance growth is positively related to market routing and volume flexibility whereas production flexibility is negatively related. Again, covariance between competitive strategy and production competence with business performance was found by Vickery et al. (1993).

Significance analysis among the aggregated sub-metrics showed their strength on manufacturing fitness. Elimination of low weighted sub-metrics and retain of most weighted sub-metrics (see Table 4 and Figure 4) strengthened more the developed relationship model shown in Figure 3 and provided its more accuracy. Significance diagram of metrics and sub-metrics (Figure 4) also justified and generalized the concept of manufacturing fitness uncovered by Rahman and Rahman (2019). This article claimed manufacturing fitness depends on manufacturing practices and this carries better
contribution to firm’s performance which is also supported by Swink et al. (2005), Swink et al. (2007), and Amoako-Gyampah and Acquaah (2008) examined the relations between manufacturing strategies and competitive strategies and their influence on firm performance. They showed manufacturing strategies add details to implement competitive strategies. Strength of manufacturing strategies (delivery, flexibility, low cost, and quality) to manufacturing capabilities and its fitness also supported by Boyer and Lewis (2002).

Developed relationship diagram (see Figure 3) and significance diagrams (see Figures 4 and 5) open the management’s insights to adaptive usage of resources without sacrificing their targeted fitness. Manufacturing flexibility or flexible manufacturing systems are aligned with adaptive resources usage supported by Zhou and Wu (2010) and this also enables to respond quickly dynamically with environment changes (Nadkarni & Narayanan, 2007; Schreyögg & Sydow, 2010) where Anand and Ward (2004) & Kortmann et al. (2014) showed the results of fit, flexibility and performance in manufacturing to cope with dynamic environment. Flexibility in manufacturing systems without sacrificing manufacturing fitness will appear as a strategy to the manufacturers where previous studies (Beach et al., 2000; Vokurka & O’Leary-Kelly, 2000) suggested alignment of manufacturing flexibility with environmental conditions linking among business strategy, manufacturing strategy, and organizational performance (Gupta & Lonial, 1998).

7. Conclusion and implications

This study fulfilled its objectives by verifying proposed hypotheses and developing structural modelling by LISREL analysis for manufacturing metrics linked to manufacturing fitness (firm’s performance). Synthesizing manufacturing strategies, this article generalized models for manufacturing fitness defining its parameters which is supportive to firm’s performance. This strategy will assist the manufacturers to take firm’s managerial and operational decisions. Synthesized results from vast literatures on manufacturing strategies will help the managers to be more effective, strategic, and adaptive. This study contributed to open management insights and foresights effectively to achieve more strategic fitness. Previous article (Rahman & Rahman, 2019) provided the concept of manufacturing fitness, strategic target, target achievement and loss/penalty due to failing to meet security level and its findings also showed the management an effective list of metrics. But this article analyzed statistically aggregating list of sub-metrics for the previously aggregated metrics and also visualized the managers a strong linkage of sub-metrics to manufacturing fitness. Propositions and findings of this research will help the management to be preventive and aware to tackle loss/penalty due to failing to achieve security level and this will also help the management functions to make adjustments needed to react to environmental changes without significance sacrifices to firm performance. Firm’s managers will be benefited to create national/global competitive platform where their strategies will be supported by the propositions and findings of this research. This also supports and assists the managers toward more strategic fitness and creates an ability to respond to production process change and its uncertainty, to adjust quickly to any change like production, process, quality, delivery and cost change, to cope with
environment and circumstance change or instability, and to tackle little penalty/loss due to delivery, cost, and firm’s performance.

Second independent large-scale survey, employment of conformity methods, and competitive strategies can be included in future researches to verify scale. Consideration of only one large-scale survey and determination of manufacturing strategies related to firm’s performance not taking into account competitive strategies are the limitations of this article. Items trait, hypotheses test and variance using LISREL should be evaluated with alternative measurement scales. Manufacturing fitness is essential to the manufacturers and hence development of valid and reliable scale would be an important contribution.

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## Appendix

### Table A1. Aggregation of number of orders and metrics failures from January to June, 2018 for different garments industries.

| Name of Garment Industries | Effect of category 1 metrics to category 2 (Effect of BMM to DMM) | Among the metrics of category 2 |
|---------------------------|---------------------------------------------------------------|---------------------------------|
|                           | Couldn’t control OVH due to lack of AM | Couldn’t achieve PH due to failure of PH | Couldn’t achieve QP due to failure of QP | Couldn’t achieve CP due to failure of CP | Couldn’t meet OF due to failure of CP |
|                           | Couldn’t meet QP due to lack of AM | Couldn’t meet CP due to lack of AM | Couldn’t meet OF due to lack of AM |
|                           | Couldn’t control PH due to lack of AM |
| Name of Garment Industries | Months in 2018 | Total order |
|---------------------------|----------------|-------------|
| Fakir Apparels Ltd. (Unit 4) | January | February |
|                           | March | April |
|                           | May | June |
| Young one (Dhaka EPZ) | January | February |
|                           | March | April |
|                           | May | June |
| Fakir Apparels Ltd. (Unit 5) | January | February |
|                           | March | April |
|                           | May | June |
| LIZ Fashion Ltd. | January | February |
|                           | March | April |
|                           | May | June |
| FCI (BD) Ltd. (Dhaka EPZ) | January | February |
|                           | March | April |
|                           | May | June |

Pearson correlation coefficient (r)
## Name of Garment Industries

| Name of Garment Industries | Months in 2018 | Total order | Couldn’t meet ST due to failure of OVH | Couldn’t meet ST due to failure of PH | Couldn’t meet ST due to failure of QP | Couldn’t meet ST due to failure of CP | Couldn’t meet ST due to failure of OF |
|---------------------------|---------------|-------------|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|-------------------------------------|
| Fakir Apparels Ltd. (Unit 4) | January       |             |                                      |                                      |                                      |                                      |                                     |
|                           | February      |             |                                      |                                      |                                      |                                      |                                     |
|                           | March         |             |                                      |                                      |                                      |                                      |                                     |
|                           | April         |             |                                      |                                      |                                      |                                      |                                     |
|                           | May           |             |                                      |                                      |                                      |                                      |                                     |
|                           | June          |             |                                      |                                      |                                      |                                      |                                     |
| Young one (Dhaka EPZ)     | January       |             |                                      |                                      |                                      |                                      |                                     |
|                           | February      |             |                                      |                                      |                                      |                                      |                                     |
|                           | March         |             |                                      |                                      |                                      |                                      |                                     |
|                           | April         |             |                                      |                                      |                                      |                                      |                                     |
|                           | May           |             |                                      |                                      |                                      |                                      |                                     |
|                           | June          |             |                                      |                                      |                                      |                                      |                                     |
| Fakir Apparels Ltd. (Unit 5) | January       |             |                                      |                                      |                                      |                                      |                                     |
|                           | February      |             |                                      |                                      |                                      |                                      |                                     |
|                           | March         |             |                                      |                                      |                                      |                                      |                                     |
|                           | April         |             |                                      |                                      |                                      |                                      |                                     |
|                           | May           |             |                                      |                                      |                                      |                                      |                                     |
|                           | June          |             |                                      |                                      |                                      |                                      |                                     |
| LIZ Fashion Ltd.          | January       |             |                                      |                                      |                                      |                                      |                                     |
|                           | February      |             |                                      |                                      |                                      |                                      |                                     |
|                           | March         |             |                                      |                                      |                                      |                                      |                                     |
|                           | April         |             |                                      |                                      |                                      |                                      |                                     |
|                           | May           |             |                                      |                                      |                                      |                                      |                                     |
|                           | June          |             |                                      |                                      |                                      |                                      |                                     |
| FCI (BD) Ltd. (Dhaka EPZ) | January       |             |                                      |                                      |                                      |                                      |                                     |
|                           | February      |             |                                      |                                      |                                      |                                      |                                     |
|                           | March         |             |                                      |                                      |                                      |                                      |                                     |
|                           | April         |             |                                      |                                      |                                      |                                      |                                     |
|                           | May           |             |                                      |                                      |                                      |                                      |                                     |
|                           | June          |             |                                      |                                      |                                      |                                      |                                     |