Strategic fit: model development and fitness analysis of a manufacturing unit

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ABSTRACT

Though Bangladesh is one of the largest garments manufacturing country in the world and there happened revolutionary changes more than four decades ago, they couldn't achieve sustainable platform yet. The failure to achieve up to the requirement level for the competitive capabilities/manufacturing metrics is the common phenomenon for the manufacturers. Even there is an alarming issue that the manufacturers yet don't know how they are affected by these failures and also can't measure how much they are statistically fit. By being motivated from manufacturer's failure, we worked on a manufacturing unit of a garments industry where we aggregated manufacturing metrics and determined how the manufacturers are affected by the failure of these metrics. This research work will conclude by proposing few models with their mathematical and graphical explanation. By using these models, the manufacturers will be able to determine their strategic fitness, security level, and associated loss/penalty.

1. Introduction

The links among competitive strategy, manufacturing strategy, and performance are addressed by Vickery, Droge, and Markland (1993). Again, Porter (1996) claimed that a proper link between strategy and manufacturing operations is a key to developing sustainable competitive advantage. To cope with global competition and rapidly changing environment, organizations must formulate strategic plans that are consistent with their capabilities and manufacturing strategies (Tracey, Vonderembse, & Lim, 1999). Expanding global competition, rapidly changing markets and technology, and increasing complexity and uncertainty are creating a new competitive environment (Bayus, 1994). These changes are causing manufacturing firms to carefully examine a shift from industrial systems driven by efficiency to strategy-based manufacturing systems where success depends on high-quality products, better customized (Doll & Vonderembse, 1991; Goldhar, Jelinek, & Schlie, 1991; Hayes, Wheelwright, & Clark, 1988; McCutcheon, Raturi, & Meredith, 1994; Roth, 1996; Skinner, 1986). High quality, reliability, timely delivery, enhanced customer service, rapid new product
introduction, flexible systems, and efficient capital deployment are the primary sources of competitive advantages (Skinner, 1986).

Success depends on close and careful linkages between a firm’s manufacturing strategy and its overall strategy. These linkages help to guide decisions about how manufacturing technologies and strategies are applied, which achieve competitive capabilities and ultimately indicate how well firms will perform (Porter, 1996; Skinner, 1969). The design of manufacturing systems should focus on developing competitive capabilities that satisfy customer needs and improve performance (Ward, Leong, & Boyer, 1994).

Strategic fit means the meeting of the organizational external environment (requirements or demands to organization by buyers or customers) with their resources and capabilities (Amoako-Gyampah et al., 2008; da Silveira et al. 2010; Karim, Smith, Halgamuge, & Islam, 2008; Swink, Narasimhan, & Kim, 2005; Swink, Narasimhan, & Wang, 2007; Wagner, Grosse-Ruyken, & Erhun, 2012). This strategy executes the organizational capability and indicates how much the organization utilizes its resources and its capabilities (Anand et al., 2004; Brown, Squire, & Blackmon, 2007; Dubey, Gunasekaran, & Chakrabarty, 2015; Gonzalez, Quesada, & Mora-Monge, 2012; Gonzalez-Benito et al., 2014). In the case of a garment industry, the organizational performance is mostly depended on its manufacturing units (Chowdhury, Ali, & Rahman, 2006; Haider, 2007). The present situation of garments sectors requires more competitive capabilities and better performance. To compete with the competitive world, the manufacturers should know about manufacturing metrics, manufacturing fitness, and how these metrics affect manufacturing fitness. Strategic fit evaluates the current performance of an organization/industry. This is necessary to evaluate how the organization is capable to achieve its external demands. To evaluate these organizational capabilities, this paper developed few models of strategic fitness. For the evaluation of strategic fitness, we aggregated manufacturing metrics and worked on manufacturing unit 4 of Fakir Apparels Ltd. This unit has six manufacturing lines (16, 17, 18, 19, 20, and 21) and the management of this unit only deals with the orders of buyer TOM TAYLOR, WOOL WORTH, PRIMARK, H&M, C&A, and SOliver.

To determine strategic fitness, and to show the effect of manufacturing metrics on fitness, we fixed two goals/objectives and they are (a) strategic fitness, security level, and loss/penalty calculation of unit 4 and (b) their (strategic fitness, security level achievement, and loss/penalty) model development for a manufacturing unit of a garments industry. This article is organized into six sections for the completion of its objectives and the organization is background study and concept development of manufacturing fitness in Section 2, research methodology in Section 3, unit 4 result analysis in Section 4, development of strategic fit model in Section 5, and discussion and conclusion in Section 6.

2. Background study and concept development of manufacturing fitness

It is necessary to discuss in brief the previous literatures on the relevant topics prior to proceeding the concept of manufacturing fitness. There are many research articles on the ready-made garments (RMG) sectors related to performance factors where they showed how performance factors affect the manufacturing efficiency. Rahman & Amin (2016) analyzed that problems in a production line such as raw materials problems, accessories problems,
production-related problems (machine problems, order variation problems, sewing problems, etc.) decreased the efficiency of a production line where availability of materials (AM), order variation handling capability, and problem handling capability are considered as performance factors (manufacturing metrics) of a production line. Nuruzzaman (2013) showed that failure to due time shipment/late shipment is associated with loss/penalty. Wong, Boon-Itt, and Wong (2011) examined delivery, production cost, product quality, and production flexibility as four factors of operational performance and these factors reflect the four key capabilities of a local firm (Schmenner & Swink, 1998). From the production literature, internal integration of the performance factors enables better coordination of production capacity to improve production flexibility (Sawhney, 2006) and delivery performance (Droge, Jayaram, & Vickery, 2004). These theoretical arguments had been supported by numerous studies which demonstrate positive associations between internal integration and process efficiency (Saeed, Malhotra, & Grover, 2005; Swink et al., 2007), delivery performance, and quality performance (Swink et al., 2007). Tracey et al. (1999) considered quality of products, order fill rate (OF), order cycle time, order/shipment time, and delivery frequency as competitive capabilities during linking technology and strategy to create competitive capabilities and improve performance. Upton (1994) contends that firms must match with these manufacturing systems capabilities to their competitive priority in order to be successful. Brown et al. (2007) and Amoako-Gyampah et al. (2008) showed the contribution of manufacturing strategy and competitive strategy on firm’s manufacturing performance. Again, Porter (1996) claimed that a proper link between strategy and operations is a key to developing sustainable competitive advantage.

From the previous study, we can summarize that OF, quality perfection (QP), AM, problem handling/manufacturing flexibility, order variation handle (OVH), cost performance (CP), and shipment time/delivery time are the competitive capabilities/manufacturing metrics for a manufacturing unit. Previous studies also indicated contribution to manufacturing metrics is the firm’s performance, since firm’s performance is directly related to the performance of manufacturing metrics. Again, metrics performance fluctuates firm’s overall fitness (performance).

The authors of this article are interested to determine this fluctuation of manufacturing fitness by determining strategic achievement compared to strategic capabilities with graphical representation (fit zone/unfit zone). A simple question ‘what is strategic fit zone/unfit zone?’ may arise at first. The zone that represents the requirement fulfillment/requirement achieved compared to its capabilities can be defined as fit zone and the remaining zone can be called as unfit zone. For an example, Figure 1 is the graphical representation of strategic fitness of a manufacturing unit, there are $n$ manufacturing metrics and they are M1, M2, M3, M4, .......Mn. Each metric has a target which is determined by the management team according to their capabilities. Figure 1(a) shows strategic capabilities (targeted) and achievement, and Figure 1(b) shows the fit zone and unfit zone of that unit.

To calculate strategic fit this research selected, a manufacturing unit of Fakir Apparels Ltd. Organizational fitness depends on all units of an organization. Here, we selected only one unit (unit 4) and determined the fitness of this unit. In a similar way, it is possible to determine the fitness of all units of an organization/industry. From where, it is possible to determine the overall fitness of an organization/industry. If there are $n$ manufacturing metrics of a manufacturing unit in an industry, strategic fitness can be determined by the following proposed equation.
This paper also compared this fitness to its security level/lowest tolerance level. Since the metrics are related with the manufacturing fitness, this means manufacturer’s profit/loss is related with the ups and downs of the metrics. For this reason, the manufacturers should strictly follow a security level for each metrics. The more metrics achievement above the security level, the more satisfactory fitness to the manufacturers. Below the security level, the metric will be associated with a loss/penalty from the strategic achievement. How much a manufacturing unit achieved the security level can be calculated easily by the following proposed equation.

\[
\text{Strategic fit} = \frac{\left( \sum_{i=1}^{n} A_p(b_i) \times W_m(i) \right)}{\left( \sum_{i=1}^{n} S_p(b_i) \times W_m(i) \right)} \times 100\% \\
= \left[ \frac{\left( \sum_{i=1}^{n} \frac{M_i(\text{Strategic Achievement})}{M_i(\text{Strategic Capability})} \right)}{n} \right] \times 100\%. 
\]

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\[
\text{Security level} = \sum_{i=1}^{n} M_{\text{max}}(\text{Strategic point})_i \times S_L(i) \times W_m(i), 
\]

\[
\text{Security level achievement} = \left[ \frac{\left( \sum_{i=1}^{n} A_p(b_i) \times W_m(i) \right)}{\left( \sum_{i=1}^{n} M_{\text{max}}(\text{Strategic point})_i \times S_L(i) \times W_m(i) \right)} \right] \times 100\% . 
\]

3. Research methodology

This section represents a methodology to calculate the strategic fitness of a manufacturing unit that is shown in Figure 2. This figure shows the sequence for the determination of manufacturing fitness, security level, and also associated loss/penalty of a manufacturing unit.
3.1. Aggregation of manufacturing metrics

This section aggregated the metrics for garments manufacturing industries based on the literature review that is shown in the first and second column of Table 1. The manufacturing capabilities vary depending on variation of order (Majukwa, Haddud, & Liu, 2016). Manufacturers set a strategic target based on the manufacturing capabilities. Again, strategic targets depend on their capabilities and previous experiences (Hayes & Pisano, 1996; Islam, Bagum, & Rashed, 2012). The manufacturing unit 4 also has the different capabilities, targets, and security level determined by the management team that are shown by the third, fourth, and fifth columns of Table 1.

3.2. Metrics weight calculation by Fuzzy AHP method

Fuzzy logic is a suitable method for simulating decision-making procedure. To proceed through Fuzzy AHP, 30 professional’s opinions (opinions of production managers of different garments industries) were collected through a questionnaire. The questionnaire was sent to more than 100 production managers of different garments industries through mailing and we received only 30 professional’s responses. Common linguistic terms were used in the questionnaire. To analyze their opinions, converting the qualitative terms into quantitative terms is required. It is not possible to make mathematical operations on linguistic values directly. This is why the linguistic scale must be converted into fuzzy scale. The triangular fuzzy conversion scale given in Table 2 adopted from Chang (1996) was used to evaluate the models of this paper.

The questionnaire added in appendix section (Appendix A) was provided to more than 100 professionals to get the comparison matrix (Table 3) which is the first step of the analysis built by taking the arithmetic mean of their evaluations.

\[
\text{Normalized weight matrix, } W = \begin{bmatrix}
  w_{OF} \\
  w_{QP} \\
  w_{AM} \\
  w_{PH} \\
  w_{OVH} \\
  w_{CP} \\
  w_{ST}
\end{bmatrix} = \begin{bmatrix}
  0.1895 \\
  0.1349 \\
  0.1571 \\
  0.1664 \\
  0.1416 \\
  0.0957 \\
  0.1148
\end{bmatrix}
\]

The matrix W shows OF, problem handling (PH), and AM have comparatively more weight among the seven manufacturing metrics. This (W) also indicates that these three metrics are
Table 1. Manufacturing matrices with strategic target.

| Manufacturing metrics                  | Research articles                                                                 | Manufacturing capabilities                      | Strategic target                        | Security level |
|----------------------------------------|----------------------------------------------------------------------------------|-----------------------------------------------|----------------------------------------|----------------|
| Order fill rate (OF)                   | Wheel Wright (1984); Tracey et al. (1999); Majukwa et al. (2016)                 | Completely filled (100%)                      | Order filling target:                  | 100% 100%      |
|                                        |                                                                                  | Partially filled (80%-99%)                    |                                        |                |
|                                        |                                                                                  | Partially filled (50%-79%)                    |                                        |                |
|                                        |                                                                                  | Partially filled (<50%)                       |                                        |                |
|                                        |                                                                                  | Failed to delivery                            |                                        |                |
| Quality perfection (QP)                | Noble (1995); Tracey et al. (1999); Ward and Duray (2000); Zhou et al. (2010) | High                                           | Quality perfection fulfillment according to the buyer’s requirements: | 100% 85%       |
|                                        |                                                                                  | Moderate                                       |                                        |                |
|                                        |                                                                                  | Low                                            |                                        |                |
| Availability of materials (AM)         | Haider, M. Z. (2007); Islam et al. (2012); Karmaker and Saha (2016).              | Availability of all materials                  | Availability of materials to start the production of an order:  | At least 90%  At least 80% |
|                                        |                                                                                  | Not availability of all materials (<100%)     |                                        |                |
| Problem handling/manufacturing flexibility (PH) | Swamidass and Newell (1987); Gerwin (1993); Noble (1995); Hayes and Pisano (1996); Gupta and Lonial (1998) | High                                           | Problem solving ability with high performance: | 100% 100%      |
|                                        |                                                                                  | Moderate                                       |                                        |                |
|                                        |                                                                                  | Low                                            |                                        |                |
| Order variation handle (OVH)           | Wheel Wright (1984); Ward and Duray (2000); Majukwa et al. (2016); Zhou and Wu (2010) | High                                           | Order variation handle ability with high performance: | At least 90%  At least 80% |
|                                        |                                                                                  | Moderate                                       |                                        |                |
|                                        |                                                                                  | Low                                            |                                        |                |
| Cost performance (CP)                  | Swamidass and Newell (1987); Noble (1995); Hayes and Pisano (1996); Ward and Duray (2000); Zhou and Wu (2010) | High                                           | Cost performance ability with high performance: | At least 95%  At least 85% |
|                                        |                                                                                  | Moderate                                       |                                        |                |
|                                        |                                                                                  | Low                                            |                                        |                |
| Shipment time/delivery time (ST)       | Swamidass and Newell (1987); Noble (1995); Tracey et al. (1999); Ward and Duray (2000) | Due time shipment                              | Due time shipment:                      | 100% 100%      |
|                                        |                                                                                  | Late shipment                                  |                                        |                |
more important for a manufacturing unit. On the other hand, OVH, QP, shipment time (ST), and CP have comparatively lower weight. For the explanation of lower values of these metrics, the management replies that their performance is depended on the performance of OF, PH, and AM.

3.3. Calculation for strategic fitness, security level achievement, and associated loss/penalty

3.3.1. Data collection

Table 4 is the summary of order details of unit 4 of Fakir Apparels Ltd. for six months from July to December of 2016. This shows there are due time production 29, late production 4, and late shipment 1 (in December). When the manufacturers fail to fill the order quantity by extending the production time more than two or three times, that results in late shipment. In September, November, and December, there are 1, 1, and 2 late productions, respectively. The management teams succeeded to achieve their production target by extending the production time once, that resulted in late production but not late shipment (September, November, and December). But another order in December resulted in late shipment.

3.3.2. Weight scale

To determine strategic manufacturing fit, it is necessary to develop a weight scale for the manufacturing metrics. Scale may vary for the case of manufacturing units of other industries. According to the manufacturer’s suggestions and explanations of unit 4 of Fakir Apparels Ltd., we developed a scale that ranges from 0 to 5. Their suggestions and explanations had been summarized in the below Table 5. This table also incorporates the views of researchers with manufacturer’s suggestions and explanations.

| Linguistic scale | Triangular fuzzy scale | Triangular fuzzy reciprocal scale |
|------------------|------------------------|----------------------------------|
| Just equal       | (1,1,1)                | (1,1,1)                          |
| Equally important| (1/2,1,3/2)            | (2/3,1,2)                        |
| Weakly more important| (1,3/2,2)            | (1/2,2/3,1)                      |
| Strongly more important| (3/2,2,5/2)       | (2/5,1/2,2/3)                    |
| Very strongly more important| (2,5/2,3)         | (1/3,2/5,1/2)                    |
| Absolutely more important| (5/2,3,7/2)        | (2/7,1/3,2/5)                    |

Table 3. Integrated pairwise comparison between main criteria.

| Criteria | OF                | QP                | AM                | PH                | OVH               | CP                | ST                |
|----------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| OF       | (1,1,1)           | (0.75,1.25, 1.75) | (2.25, 2.75, 3.25)| (1, 1.5, 2)      | (0.47, 0.63, 1.06)| (0.75, 1.25, 1.75)| (1.75, 2.25, 2.75)|
| QP       | (1,1,1)           | (0.75, 1.25, 0.5, 0.69, 1.17)| (1, 1.5, 2)      | (1.25, 1.75, 2.25)| (0.45, 0.58, 0.83)|                    |
| AM       | (1,1,1)           | (1.75, 2.25, 2.75)| (0.37, 0.45, 0.58)| (0.75, 1.25, 1.75)| (2.25, 2.75, 3.25)|                    |
| PH       | (1,1,1)           | (1.75, 2.25, 2.75)| (0.37, 0.45, 0.58)| (0.75, 1.25, 1.75)| (1.75, 2.25, 2.75)|                    |
| OVH      | (1,1,1)           | (1.75, 2.25, 2.75)| (0.37, 0.45, 0.58)| (0.75, 1.25, 1.75)| (2.25, 2.75, 3.25)|                    |
| CP       | (1,1,1)           | (1.75, 2.25, 2.75)| (0.37, 0.45, 0.58)| (0.75, 1.25, 1.75)| (2.25, 2.75, 3.25)|                    |
| ST       | (1,1,1)           | (1,1,1)           | (0.75, 1.25, 1.75)| (1.75, 2.25, 2.75)|                    | (1,1,1)           |
Table 4. Summary of order details from the month July to December.

| Months | Due time production | More than 80\% material availability | More than 60\% material availability | Late production | Late shipment | Production stopped due to lack of raw materials | Order continued to the next month |
|--------|---------------------|--------------------------------------|--------------------------------------|-----------------|--------------|-----------------------------------------------|---------------------------------|
| July   | 5                   | 1                                    | 1                                    | 1               | 5            | 1                                             | 5                               |
| August | 6                   | 1                                    | 1                                    | 1               | 3            |                                               | 3                               |
| September | 5              | 1                                    | 1                                    | 1               | 5            |                                               | 5                               |
| October | 4                  | 1                                    | 1                                    | 2               | 5            |                                               | 5                               |
| November | 6                | 1                                    | 1                                    | 6               |              |                                               |                                 |
| December | 3                | 2                                    | 1                                    | 6               |              |                                               |                                 |

Table 5. Weight scale set according to researcher and senior management explanation.

| Manu. metrics | Manufacturing capabilities | Wd   | Researcher and senior management explanation |
|---------------|---------------------------|------|---------------------------------------------|
| OF            | Completely filled (100\%) | 5    | Management prefers to give the most importance (5) when order is fulfilled in time since this helps for due time shipment. For this reason, they gave the most importance value (5) for due time shipment. Again, failure to due time production sometimes fails to due time shipment and this demands a great penalty/discount for the manufacturers (Roth & Miller, 1992; Rahman & Al Amin, 2016; Sampaio, Carvalho, & Fernandes, 2016; Mondal, Rahman, Sanoar Hosin, & Sarkar, 2017). Hence, they preferred to give no importance (0) for late order fill i.e. late production and late shipment. |
|               | Partially filled (80%-99\%) | 0    |                                             |
|               | Partially filled (50%-79\%) |      |                                             |
|               | Partially filled (<50\%) |      |                                             |
|               | Failed to delivery |      |                                             |
| ST            | Due time shipment | 5    |                                             |
|               | Late shipment | 0    |                                             |
| AM            | Availability of all materials | 5    | Management preferred to give weight value (5) for availability of 100\% materials, (3) for availability of >80\% materials and (1) for availability of >60\% materials at the beginning of an order. |
|               | Not availability of all materials (<100\%) | 3    |                                             |
|               |                                           | 1    |                                             |
| QP            | High | 5    | "Quality" or "quality performance" is a controversial construct for a variety of conceptual and empirical reasons (Soares, Soltani, & Liao, 2017) and the quality performance depends on quality management practices (Soltani & Wilkinson, 2010; Uluskan, Joines, & Godfrey, 2016) and better problem handling capabilities. The better problem solution helps the management for their industries for good quality control capabilities (Taylor, 1995; Gereffi, 1999; Bair & Gereffi, 2001; Sila, Ebrahimpour, & Birksklo, 2006; Azar, Kahamali, & Taghavi, 2010). For this reason, the management gave the maximum weight value (5) for good quality and good problem handling, moderate weight value (3) for moderate quality and moderate problem handling and poor weight value (1) for low quality and low problem handling. |
|               | Moderate | 3   |                                             |
|               | Low | 1    |                                             |
| PH            | High | 5    | Management preferred to give maximum weight value (5) for good order variation. When management fails to solve order variation or show poor performance to solve order variation this causes the failure of order shipment and due time production (Roth & Miller, 1992; Masud, 2010; Mohan Kathuria, 2013; Nuruzzaman, 2013; Rahman & Al Amin, 2016; Mondal et al., 2017). Hence, they gave low weight value (1) for moderate order variation capabilities and no weight (0) for low order variation capabilities. |
|               | Moderate | 3   |                                             |
|               | Low | 1    |                                             |
| OVH           | High | 5    | There is a great importance of cost performance for a manufacturing unit (Schmalensee, 1989; Arauz & Suzuki, 2004). The management preferred to give the maximum weight value (5) for the good or high cost performance, moderate weight value (1) for average cost performance and no weight value (0) for low cost performance. Because they think that the cost performance is directly related with the organizational profit. |
|               | Moderate | 1   |                                             |
|               | Low | 0    |                                             |
Here,

\[
W_d = \text{Scaleweight}
\]

The manufacturer works for the achievement of most important value (5) by setting 100% strategic target so that they can achieve the maximum strategic point. For example, the manufacturers of unit 4 always tried to fulfill 100% order quantity (100% OF) by the due time so that they could achieve the maximum strategic point 165 (33 due time production*most important weight value, 5) for OF. But they failed 4 times that resulted 145 points. The partial production or interruption in the production sometimes stops a running production and compels for the next month production and this is a reason against strategic target (Biswas, 2015; Ferdousi, 2009; Rahman & Amin, 2016).

3.3.3. Calculation of strategic point and achieved point for OF, AM, and ST
Since AM has a direct effect on OF and ST (Rahman & Al Amin, 2016; Wagner et al., 2012), the failure of AM will cause the failure of OF and ST. From Table 6, due time OF failed 4 times and due time shipment failed 1 time due to insufficient AM (>80% even >60%) This is one of the causes of failure for the achievement of 100% strategic fit. The fall of strategic point for the metrics OF, AM, and ST had been calculated and shown in Table 6.

3.3.4. Calculation of strategic point and achieved point for QP, PH, OVH, and CP
The remaining four metrics (QP, PH, OVH, and CP) with their achievement level (high, moderate, and low) had been shown in Table 7. Since QP, PH, OVH, and CP are related to each other (Berg, Appelbaum, Bailey, & Kalleberg, 1996; Rahman & Al Amin, 2016; Wagner et al., 2012), it sometimes becomes very difficult for the manufacturers to achieve the highest weight value always for all of them.

### Table 6. Calculation of strategic point and achieved point for OF, AM, and ST.

| Manu. metrics | Manufacturing Capabilities                                      | Weight | No. of orders | Strategic point | Achieved point | Total achieved point | Security level |
|---------------|----------------------------------------------------------------|--------|---------------|-----------------|-----------------|----------------------|---------------|
| Order fill rate (OF) | Due time order fill (due time production) | 5      | 29            | (33*5)*1.0      | 145             | 145*1.0              | 165*1.0       |
|                | Late order fill (late production) | 0      | 4             | 0               | 0               | 0                    | 0             |
| Availability of materials (AM) | Availability of 100% materials at the beginning of order | 5      | 29            | (33*5)*.90      | 145             | 153*90               | 165*.80       |
|                | Availability of >80% materials at the beginning of order | 3      | 2             | 148.5           | 6               | 137.7                | 132           |
|                | Availability of >60% materials at the beginning of order | 1      | 2             | 2               | 2               | 2                    | 2             |
| Shipment time (ST) | Due time shipment | 5      | 32            | (33*5)*1.0      | 160             | 160*1.0              | 165*1.0       |
|                | Late shipment | 0      | 1             | 165             | 0               | 160                  | 165           |
When the manufacturers fail to handle order variation, they fail to achieve better quality and ultimately fails to achieve better CP (Wagner et al., 2012).

### 3.3.5. Fitness, security level achievement, and loss/penalty calculation of unit 4

Table 8 shows the aggregated strategic points, achieved points, and also security level for all manufacturing metrics. From this Table 8 and Figure 3, we can see that only one manufacturing metric (AM) is above the security level and others are below the security level. That means the manufacturers succeeded to maintain the security level for only one manufacturing metric (AM) during the production period from July to December 2016. Here, a total strategic point is 159.281 and total achieved point is 130.232, i.e., strategic fitness 130.232/159.281 = 81.76% and security level achievement 87.15% (130.232/149.435). We can visualize the strategic fit/unfit zone in Figure 4.

This result was shown to the manufacturers of unit 4 of Fakir Apparels Ltd. and they gave their positive consent to these results. From their positive consent, we inspired to develop a conceptual and mathematical model of strategic fit of a manufacturing unit. Section 5 shows a conceptual model and few mathematical models for the determination of manufacturing fitness.

### Table 7. Calculation of strategic point and achieved point for QP, PH, OVH, and CP.

| Manufacturing Metrics | QP | PH | OVH | CP |
|-----------------------|----|----|-----|----|
| High                  | 13 | 18 | 18  | 23 |
| Mod.                  | 19 | 13 | 12  | 10 |
| Low                   | 1  | 2  | 3   | 0  |

| Scale value (weight)  | 13 | 19 | 1  | 18 |
| Sum of achieved Point | 123| 131|102 |125 |
| Possible highest strategic point | 165*1.0 = 165 | 165*1.0 = 165 | 165*1.0 = 165 | 165*1.0 = 165 |
| Strategic point       | 165*1.0 = 165 | 165*1.0 = 165 | 165*0.90 = 148.5 | 165*0.95 = 156.75 |
| Achieved point        | 123*1.0 = 123 | 131*1.0 = 131 | 102*0.90 = 91.8 | 125*0.95 = 118.75 |

### Table 8. Calculation of strategic fit.

| Types of point | OF  | AM  | ST  | QP  | PH  | OVH | CP  | Total point |
|----------------|-----|-----|-----|-----|-----|-----|-----|-------------|
| Strategic point | 165 | 148.5 | 165 | 165 | 165 | 148.5 | 156.75 | 1113.75 |
| Achieved point  | 145 | 137.7 | 160 | 123 | 131 | 91.8  | 118.75 | 907.25  |
| Security level  | 165 | 132 | 165 | 140.25 | 165 | 132 | 140.25 | 1139.25 |

| Metrics weight | 0.1895 | 0.1571 | 0.1148 | 0.1349 | 0.1664 | 0.1416 | 0.0957 |
| Strategic point | 31.267 | 23.329 | 18.942 | 22.258 | 27.456 | 21.027 | 15.000 | 159.281 |
| Achieved point  | 27.477 | 21.632 | 18.368 | 16.592 | 21.798 | 12.998 | 13.421 | 149.435 |
| Point differences | 3.79 | 1.697 | 0.574 | 5.666 | 5.658 | 8.029 | 3.636 | 29.049 |
| Security level  | 31.267 | 20.737 | 18.942 | 18.919 | 27.456 | 18.691 | 13.421 | 149.435 |
| Security level sustainability | Break | Sustain | Break | Break | Break | Break | Break |
| Strategic fitness (SF) | 130.232/159.281 = 0.8176 | Security level achieved | 130.232/149.435 = 0.8715 |
| i.e. 81.76% | Loss/penalty from achievement | (81.76–71.26)% = 10.50% |
| Net achievement | 0.8176*0.8715 = 71.26% | |

(Ferdousi, 2009; Geršak, 2002). When the manufacturers fail to handle order variation, they fail to achieve better quality and ultimately fails to achieve better CP (Wagner et al., 2012).
4. Unit 4 result analysis

This paper focused on manufacturing unit 4 of Fakir Apparels Ltd. for the calculation its overall achievement such as strategic fitness, security level, security level achievement, net achievement, and loss/penalty. Table 9 shows the summary of overall achievement of this unit. Summarization results from Table 9 and Figure 5 make us clear that the overall achievement of unit 4 is not good. Only one metric is above the security level within seven metrics. That means the manufacturers faced loss/penalty for six metrics within seven metrics which demanded a big penalty for the manufacturers. The manufacturers are far behind

Table 9. Achievement summary for manufacturing unit 4.

| Criteria       | Metrics above security level | Metrics below security level | Strategic fit/unfit zone | Security level achievement | Net achievement | Loss/penalty |
|----------------|------------------------------|------------------------------|--------------------------|---------------------------|-----------------|--------------|
| Achievement    | 1/7                          | 6/7                          | 81.76%                   | 87.15%                    | 71.26%          | 10.50%       |
(18.24%) from their strategic achievement, and the loss/penalty furthermore reduces their net achievement by 50%.

5. Development of strategic fit model

5.1. Conceptual model of strategic fitness

Previous sections show the details calculation of all processes to determine strategic fitness of a manufacturing unit. These calculations can be summarized and visualized by the following six stepped conceptual model represented by Figure 6.

5.2. Mathematical model of strategic fitness, security level achievement, and loss/penalty

Step 1 (Aggregating all the manufacturing metrics)

In this step, manufacturers have to aggregate all the manufacturing metrics for a manufacturing unit. This paper shows that there are seven \((n = 7)\) manufacturing metrics for a garments manufacturing industry and they are AM, OF, QP, PH, OVH, CP, and ST.

Step 2 (Set a weight scale for the metrics)

The manufacturers have to set a weight scale after aggregating the manufacturing metrics. The manufacturers of Fakir Apparels Ltd. preferred to set a scale ranging 0–5 and also preferred to give different values for different metrics based on their capabilities and metrics importance.

Step 3 (Calculation of strategic point and achieved point for each metric)

Strategic point,

\[
S_{p(b)i} = N \times Wd(\text{max}) \times \text{strategic target (}).
\]

Achieved point,
Step 1
Aggregating all the manufacturing metrics
n = 1, 2, 3, ...... , n

Step 2
Developing a weight scale for these metrics
e.g. (0-3, 0-5, 0-7 etc.)

Step 3
Calculate strategic point for each metrics, \( S_{p(b)l} = \frac{N \times Wd(max)}{C3} \times \text{strategic target(%)} \)
Calculate achieved point for each metrics, \( A_{p(b)l} = \{n1 \times Wd(ac) + n2 \times Wd(ac) + \ldots + nn \times Wd(ac)\} \times \text{strategic target(%)} \)

Multiplying strategic & achieved point by the metrics normalized weight \( W_m(l) \)

Step 4
Calculate strategic point for each metric,
\( S_{p(aT)} = \sum_{i=1}^{n} \frac{S_{p(b)l}}{W_m(l)} \)

Step 5
Calculate achieved point for each metric,
\( A_{p(aT)} = \sum_{i=1}^{n} \frac{A_{p(b)l}}{W_m(l)} \)

Total strategic point for all metrics,
\( S_{p(aT)} = \sum_{i=1}^{n} S_{p(b)l} \times W_m(l) \)

Total achieved point for all metrics,
\( A_{p(aT)} = \sum_{i=1}^{n} A_{p(b)l} \times W_m(l) \)

Step 6
Strategic fit (SF)
\( = \frac{A_{p(aT)}}{S_{p(aT)}} \times 100\%

Figure 6. Conceptual model of strategic fitness.

\[ A_{p(b)l} = \{n1 \times Wd(ac) + n2 \times Wd(ac) + \ldots + nn \times Wd(ac)\} \times \text{strategic target(%)}, \]

where \( N = \text{Total number of orders and N = n1 + n2 + \ldots + nn} \)
\( Wd(max) = \text{maximum scale weight,} \)
\( Wd(ac) = \text{achieved scale weight.} \)

For an example, Strategic point for OF,
\( S_{p(b)l} = N \times Wd(max) \times \text{strategic target(%) } = 33 \times 5 \times 1.0 = 165. \)

And achieved point for OF,
\( A_{p(b)l} = \{n1 \times Wd(ac) + n2 \times Wd(ac) + \ldots + nn \times Wd(ac)\} \times \text{strategic target(%) } \\
= (29 \times 5 + 4 \times 0) \times 1.0 = 145. \)
The management can aggregate total strategic point and achieved point before multiplying by the metrics weight \((W_m)\).

**Total strategic point,**

\[
S_{p(bT)} = \sum_{i=n}^{i=1} S_{p(b)i}
\]

\[
= S_{p(b)1} + S_{p(b)2} + \ldots \ldots \ldots + S_{p(b)7}
\]

\[
= S_{p(b)AM} + S_{p(b)OF} + \ldots \ldots \ldots + S_{p(b)ST}.
\]

**Total achieved point,**

\[
A_{p(bT)} = \sum_{i=n}^{i=1} A_{p(b)i}
\]

\[
= A_{p(b)1} + A_{p(b)2} + \ldots \ldots \ldots + A_{p(b)7}
\]

\[
= A_{p(b)AM} + A_{p(b)OF} + \ldots \ldots \ldots + A_{p(b)ST}.
\]

**Step 4 (Calculate strategic point and achieved point by multiplying, \(W_m\) for each metric)**

In this step, strategic point and achieved point had been calculated by multiplying the strategic point and achieved point with its corresponding normalized weight \((W_m)\). Strategic point,

\[
S_{p(a)i} = S_{p(b)i} \times W_{m(i)}.
\]

Achieved point,

\[
A_{p(a)i} = A_{p(b)i} \times W_{m(i)}.
\]

For an example, strategic point for OF,

\[
S_{p(a)OF} = S_{p(b)OF} \times W_{m(OF)} = 165 \times 0.1895 = 31.267.
\]

Achieved point for OF,

\[
S_{p(a)OF} = S_{p(b)OF} \times W_{m(OF)} = 165 \times 0.1895 = 31.267.
\]

**Step 5 (Aggregating the strategic point and achieved point for all metrics)**

The strategic point and achieved point for the metric OF are 31.267 and 27.477, respectively. By the similar way, we can determine the strategic point and achieved point for all manufacturing metrics and this step aggregating these points for all manufacturing metrics.

Total strategic targeted point,

\[
S_{p(aT)} = \sum_{i=1}^{i=n} S_{p(b)i} \times W_{m(i)}.
\]
For unit 4, \[ S_p(aT) = \sum_{i=1}^{7} S_p(b_i) \cdot W_m(i) = 159.281. \]

Total strategic achieved point,

\[ A_p(aT) = \sum_{i=1}^{n} A_p(b_i) \cdot W_m(i), \]

For unit 4, \[ S_p(aT) = \sum_{i=1}^{7} S_p(b_i) \cdot W_m(i) = 159.281. \]

**Step 6** (Determination of strategic fitness)

From the aggregated values of total strategic point and achieved point, we can determine the strategic fitness of a manufacturing unit. For unit 4 of Fakir Apparels Ltd., total strategic point and achieved point are 159.281 and 130.232, respectively. The strategic fitness of the unit 4 can be determined by the following Equation (1).

\[
\text{Strategic fitness (SF)} = \left( \frac{A_p(aT)}{S_p(aT)} \right) \times 100\% \\
= \left( \frac{\sum_{i=1}^{n} A_p(b_i) \cdot W_m(i)}{\sum_{i=1}^{n} S_p(b_i) \cdot W_m(i)} \right) \times 100\% \\
\]

Again,

\[
SF = \left[ \frac{\sum_{i=1}^{n} A_p(b_i) \cdot W_m(i)}{\sum_{i=1}^{n} S_p(b_i) \cdot W_m(i)} \right] \times 100\% = \left[ \frac{\sum_{i=1}^{n} M_i(\text{Strategic Achievement})M_i(\text{Strategic Capability})}{n} \right] \times 100\% \\
= \frac{130.232}{159.281} \times 100\% = 81.76\%. \tag{1}
\]

Equation (1) is the mathematical model of manufacturing fitness that evaluates the fitness of a manufacturing unit. By using this model, we got 81.76% fitness for unit 4. The manufacturers also can evaluate security level and security level achievement by using the Equations (2) and (3), respectively.

\[
\text{Security level} = \sum_{i=1}^{n} M_{\text{max}}(\text{Strategic point})(i) \cdot S_L(i) \cdot W_m(i) \tag{2}
\]

For unit 4, \[ \text{Security level} = \left[ \sum_{i=1}^{7} M_{\text{max}}(\text{Strategic point})(i) \cdot S_L(i) \cdot W_m(i) \right] \]

\[ = 149.435 \]
Security level achievement = \[ \left( \frac{\sum_{i=1}^{n} A_{p(b)i} \times W_{m(i)}}{\sum_{i=1}^{n} M_{\max\text{(Strategic point)}(i)} \times S_{L(i)} \times W_{m(i)}} \right) \times 100\% \]  (3)

For unit 4, Security level achievement = \[ \left( \frac{\sum_{i=1}^{n} A_{p(b)i} \times W_{m(i)}}{\sum_{i=1}^{n} M_{\max\text{(Strategic point)}(i)} \times S_{L(i)} \times W_{m(i)}} \right) \times 100\% \]
= \[ \frac{130.232}{149.435} = 87.15\% \]

where \( S_{L} = \) Security level(in percentage).

Since the manufacturers couldn’t achieve 149.435 point, they couldn’t achieve 100% security level. They only achieved 87.15% security level. This lack of security level decreases the strategic achievement. From the below Equation (4), manufacturers of unit 4 acquired only 71.26% achievement. The penalty due to lack of security level achievement can also be calculated by using Equation (5).

Net achieved = \( SF \times \) Security level achievement
= \[ \left( \frac{\sum_{i=1}^{n} A_{p(b)i} \times W_{m(i)}}{\sum_{i=1}^{n} S_{p(b)i} \times W_{m(i)}} \right) \times \left[ \frac{\sum_{i=1}^{n} A_{p(b)i} \times W_{m(i)}}{\sum_{i=1}^{n} M_{\max\text{(Strategic point)}(i)} \times S_{L(i)} \times W_{m(i)}} \right] \times 100\% \]
= 81.76% \times 87.15%
= 71.26%.

Loss or penalty = Net loss from achieved revenue

\[ \left( \frac{\sum_{i=1}^{n} A_{p(b)i} \times W_{m(i)}}{\sum_{i=1}^{n} S_{p(b)i} \times W_{m(i)}} \right) \times \left[ \frac{\sum_{i=1}^{n} A_{p(b)i} \times W_{m(i)}}{\sum_{i=1}^{n} M_{\max\text{(Strategic point)}(i)} \times S_{L(i)} \times W_{m(i)}} \right] \times 100\% \]
= 81.76% – 71.26% = 10.50%
(4)

6. Discussion and conclusion

One of the main contributions to this research work is aggregated of manufacturing metrics/competitive strategies those had been used in the previous researches separately. For example, Amoako-Gyampah and Acquaah (2008) examined the relationship between manufacturing strategy and competitive strategy and their influence on firm performance. They also found significant and positive relationships between competitive strategy and the manufacturing strategies of cost, delivery, flexibility, and quality. The findings also indicate that quality is the only manufacturing strategy component that influences performance. Their results further showed that although competitive strategy does not directly affect firm performance, it does so indirectly through quality. Gupta and Somers (1996) showed the effect of manufacturing flexibility on
organizational performance. Strategic flexibility supports the adaptive use of resources (Zhou & Wu, 2010), and thus, the ability to quickly respond to dynamically changing environments (Nadkarni & Narayanan, 2007; Schreyögg & Sydow, 2010). Chang, Yang, Cheng, and Sheu (2003) investigated the practice of manufacturing flexibility in small-and medium-sized firms. Swink et al. (2007) aggregated four types of strategies and showed the effect on manufacturing plant performance and their results provide implications for manufacturing managers who seek to design integration policies and associated resource deployments. Anand et al. (2004) & Kortmann, Gelhard, Zimmermann, and Piller (2014) showed the results of fit, flexibility, and performance in manufacturing to cope with the dynamic environment. Goyal, Netessine, and Randall (2012) found the relationship between flexibility and demand correlation. Kazan, Özer, and Çetin (2006) found the effect of quality and cost flexibility on financial performance. Vickery et al. (1993), found covariance between competitive strategy and production competence with business performance. In their study of firms in the textile industry, Williams, D’Souza, Rosenfeldt, and Kassaee (1995) found a relationship between competitive strategy and manufacturing strategy and also between manufacturing strategy and performance. Gupta and Lonial (1998) linked among business strategy, manufacturing strategy, and organizational performance.

Here, this research has focused on fitness of a manufacturing unit, and for this purpose, we aggregated all the manufacturing metrics. It is already clear to us that manufacturing fitness is depended on its associated all metrics. From the results of unit 4, fall of metrics reduces the fitness gradually. For this reason, they achieved only 81.76% fitness. Besides this, six metrics within seven failed to achieve the security level and this demanded a big loss/penalty (10.50%) which was deducted from their achievement. That resulted only 71.26% achievement for the manufacturers. So, this makes us clear that the manufacturing fitness fell due to the fall of its metrics, and this proved that manufacturing fitness is depended on its metrics. This achievement will fluctuate by the fluctuation of its metrics achievements. Now we can give this message to the manufacturers that they have to emphasize on the achievement of each manufacturing metric to prevent this fall of achievement. We also uncovered a new concept strategic fit with mathematical and graphical explanation in the field of manufacturing industries that covers strategic fitness, security level, and loss/penalty of a manufacturing unit. We hope this will create an inspiration among the manufacturers to find out those causes by which the metrics are far below the security level and also the strategic targeted level. This will also create an awareness among them to take corrective actions and preventive solutions against these adverse balances to meet the maximum fitness.

Finally, this paper creates a scope of further research to develop the fitness model for the units of other manufacturing industries like manufacturing units of plastic industries/furniture industries/food and beverage industries, etc., based on their manufacturing strategies and metrics. And the limitation of this paper is the effect of unusual issues like political violence, ups and downs of global/national economic, social value changing, and technology changing had not been considered. Further developments are being in our ongoing research to clarify the problem using statistical technique and to generalize the model covering cross-country and cross-industrial quantitative research.
Disclosure statement

No potential conflict of interest was reported by the authors.

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**Appendix A. Questionnaire forms used to facilitate comparisons of manufacturing metrics**

**QUESTIONNAIRE**

Read the following questions and put the check marks (√) during comparison between two metrics. If you prefer that the left-sided metric is more important compared to right-sided metric, put the check mark at the left side of ‘Equal’ importance under the preference level that you prefer. Again, if you prefer that the right-sided metric is more important compared to left-sided metric, put the check mark at the right side of ‘Equal’ importance under the preference level that you prefer.

**QUESTIONS**

With respect to the overall goal ‘prioritization of the manufacturing metrics’,

Q1. How important is *order fill rate (OF)* when it is compared with *quality perfection (QP)*?

Q2. How important is *order fill rate (OF)* when it is compared with *availability of materials (AM)*?

Q3. How important is *order fill rate (OF)* when it is compared with *problem handling (PH)*?

Q4. How important is *order fill rate (OF)* when it is compared with *order variation handle (OVH)*?

Q5. How important is *order fill rate (OF)* when it is compared with *cost performance (CP)*?

Q6. How important is *order fill rate (OF)* when it is compared with *shipment time (ST)*?
Q7. How important is quality perfection (QP) when it is compared with availability of materials (AM)?
Q8. How important is quality perfection (QP) when it is compared with problem handling (PH)?
Q9. How important is quality perfection (QP) when it is compared with order variation handle (OVH)?
Q10. How important is quality perfection (QP) when it is compared with cost performance (CP)?
Q11. How important is quality perfection (QP) when it is compared with shipment time (ST)?
Q12. How important is availability of materials (AM) when it is compared with problem handling (PH)?
Q13. How important is availability of materials (AM) when it is compared with order variation handle (OVH)?
Q14. How important is availability of materials (AM) when it is compared with cost performance (CP)?
Q15. How important is availability of materials (AM) when it is compared with shipment time (ST)?
Q16. How important is problem handling (PH) when it is compared with order variation handle (OVH)?
Q17. How important is problem handling (PH) when it is compared with cost performance (CP)?
Q18. How important is problem handling (PH) when it is compared with shipment time (ST)?
Q19. How important is order variation handle (OVH) when it is compared with cost performance (CP)?
Q20. How important is order variation handle (OVH) when it is compared with shipment time (ST)?
Q21. How important is cost performance (CP) when it is compared with shipment time (ST)?
Table A1. Comparisons among the metrics.

| Questions | Metrics | Absolutely more important | Very strongly more important | Strongly more important | Weakly more important | Equally important | Just equal | Equally important | Weakly more important | Strongly more important | Very strongly more important | Absolutely more important |
|-----------|---------|---------------------------|------------------------------|-------------------------|----------------------|-------------------|-----------|-------------------|------------------------|-------------------------|-------------------------|--------------------------|
| Q1        | OF      | QP                        |                              |                         |                      |                   |           |                   |                        |                        |                         |                           |
| Q2        | OF      | QP                        |                              |                         |                      |                   |           |                   |                        |                        |                         |                           |
| Q3        | OF      | PH                        |                              |                         |                      |                   |           |                   |                        |                        |                         |                           |
| Q4        | OF      | OVH                       |                              |                         |                      |                   |           |                   |                        |                        |                         |                           |
| Q5        | OF      | CP                        |                              |                         |                      |                   |           |                   |                        |                        |                         |                           |
| Q6        | OF      | CP                        |                              |                         |                      |                   |           |                   |                        |                        |                         |                           |
| Q7        | QP      | AM                        |                              |                         |                      |                   |           |                   |                        |                        |                         |                           |
| Q8        | QP      | PH                        |                              |                         |                      |                   |           |                   |                        |                        |                         |                           |
| Q9        | QP      | OVH                       |                              |                         |                      |                   |           |                   |                        |                        |                         |                           |
| Q10       | QP      | CP                        |                              |                         |                      |                   |           |                   |                        |                        |                         |                           |
| Q11       | QP      | ST                        |                              |                         |                      |                   |           |                   |                        |                        |                         |                           |
| Q12       | AM      | PH                        |                              |                         |                      |                   |           |                   |                        |                        |                         |                           |
| Q13       | AM      | OVH                       |                              |                         |                      |                   |           |                   |                        |                        |                         |                           |
| Q14       | AM      | CP                        |                              |                         |                      |                   |           |                   |                        |                        |                         |                           |
| Q15       | AM      | ST                        |                              |                         |                      |                   |           |                   |                        |                        |                         |                           |
| Q16       | PH      | CP                        |                              |                         |                      |                   |           |                   |                        |                        |                         |                           |
| Q17       | PH      | ST                        |                              |                         |                      |                   |           |                   |                        |                        |                         |                           |
| Q18       | PH      | CP                        |                              |                         |                      |                   |           |                   |                        |                        |                         |                           |
| Q19       | OVH     | CP                        |                              |                         |                      |                   |           |                   |                        |                        |                         |                           |
| Q20       | OVH     | ST                        |                              |                         |                      |                   |           |                   |                        |                        |                         |                           |
| Q21       | CP      | ST                        |                              |                         |                      |                   |           |                   |                        |                        |                         |                           |