

# Performance effects of factory-within-a-factory designs

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## Abstract

Organisationally and physically separating operations activities into different factories-within-a-factory is a widely ignored research field in operations management. We empirically investigate the relationship between the degree of focus and the performance of a factory-within-a-factory. Despite suffering from small sample size, the results indicate that focus is positively associated with financial performance only. Furthermore, a separate organisational structure positively moderates the focus-performance relationship. Surprisingly, physical separation through separate buildings or otherwise has no significant moderating effect. Same applies for other means of separation.

**Keywords:** Factory focus, factory-within-a-factory, performance

## Introduction

Factory focus is a “cornerstone in manufacturing strategy literature” (Hallgren and Olhager, 2006, p. 3864). Its main argument is that a factory dedicated to a strategically defined and narrowly set manufacturing task achieves higher financial and operational performance than unfocused factories (Richardson et al., 1985; Skinner, 1974; Vokurka and Davis, 2000). According to Skinner, establishing several focused factories instead of keeping a big multipurpose factory without such focus might not be desirable for different reasons. Thus, he proposed to decentralize activities in factories-within-a-factory (FWF) (Skinner, 1974). Doing so is associated with the organisational structuring of a factory into several semi-autonomous manufacturing units through organisational and physical separation along their manufacturing tasks. As a result, multiple units with higher levels of focus are obtained (Skinner, 1974; Hill, 2008; Miltenburg, 2008; Sheu et al., 2012).

Some researchers addressed the FWF design issue through simulation (e.g. Sheu et al., 2012; Sheu and Krajewski, 1996) or descriptive research (Ruwe and Skinner, 1987). The latter findings illustrate how the case company separated an existing factory into two

FWF. Furthermore, associated performance benefits are reported. Yet, generalisability of the findings regarding different structural organisation possibilities of FWF could not be drawn. The prior findings provide simulation results indicating how several product lines can be grouped into homogeneous product clusters to form FWF. While those findings help defining which products are to be grouped together in one FWF, it does not further specify how the organisational structure of the respective FWF is to be defined.

To sum up, it remains mostly unclear, which kinds of structural separation can be applied and how their relation to performance is. In other words: It is to be investigated which parts of the operations apparatus must be separated in order to delineate an organisational separation of different manufacturing tasks, and where can two FWF stay connected without risking severe performance restrictions.

It is the overall objective of this paper to test whether or not different means of separating an operations into different factories-within-a-factory moderate the relation between focus and performance. The following research question will be answered in this paper: Is the focus-performance relation moderated by different means of separation?

We motivate our research with the shortcoming of focus literature to further specify how the generally prescribes FWF as an adequate structural solution to achieve focus can be realised. The remainder of this paper is structured as follows: First, a brief review of the body of literature on the focused factory and FWF is presented, including the hypotheses derived from previous research. Second, the applied research methodology is introduced, presenting the measure used as well as details regarding data collection and evaluation. Third, results of the quantitative analyses are presented, followed, fourth, by their discussion. We close this paper with a conclusion before we present the references.

## **Literature review and hypotheses**

### *Definition of focus and FWF*

A focused factory is a factory having a limited task precisely defined by its competitive strategy (Skinner, 1974). A factory-within-a-factory then is defined as a factory within a factory that is “both organisationally and physically separated” (Skinner, 1974, p. 121).

This paper follows the definitions of the concept of manufacturing focus developed and analysed by Pesch (1996), Bozarth (1993), Schroeder and Pesch (1994), and Bozarth and Edwards (1997). Accordingly, the FWF is considered to be focused if it has a clear manufacturing task derived from the corporate strategy, which limits the demand put on production.

### *Focus and performance*

Previous studies addressed the relationship between focus and performance with either the whole factory (e.g. Vokurka and Davis, 2000) or a manufacturing or work cell (e.g. Bozarth and Edwards, 1997; Shafer and Oswald, 1996) as their unit of analysis. That research is mainly concerned with hypothesis testing, especially investigating focus-performance relations to test whether or not focus leads to superior performance. Both, operational and financial performance have been investigated as dependent variables.

A higher degree of focus is expected to have a positive influence on the operational and financial performance of a FWF. This postulated effect follows the initial arguments of Skinner (1974) and the findings of Richardson et al. (1985), Bozarth and Edwards (1997), Vokurka and Davis (2000) and others. Consequently, the first hypothesis deduced from literature reads:

*H1:* A higher degree of focus in a factory-within-a-factory has a positive effect on the performance of the factory-within-a-factory.

### *FWF design*

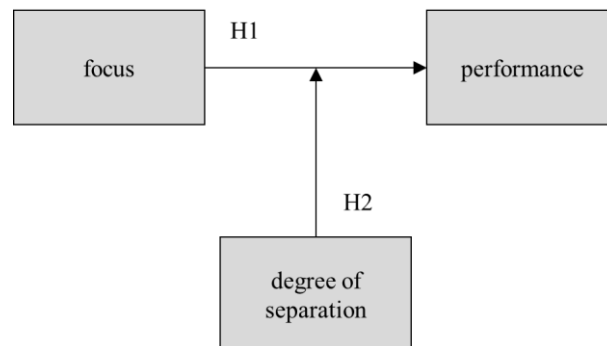
While the original definition argues in favour of a complete organisational and physical separation of two FWF, other researchers have argued that resource considerations must be taken into account to prevent duplication of costly resources. They argue that *net benefits* of focus must be identified (Sheu and Krajewski, 1996). Similarly, Huckman (2009) views FWF design not as a polar decision of allowing either too much or too little interaction among the FWF co-located in one factory. Rather, the benefits and costs of sharing certain resources must be considered. Therefore, it is concluded that two FWF might be separated regarding one resource whilst they may share another one. With different resources available for either sharing or separation, multiple means of separating a FWF result.

Means of organisational and physical separation are thus presumed to play a moderator role on the relationship between focus and the performance of the FWF. Based on the original idea of the focus concept, a higher degree of separation of a FWF is expected to have a positive influence on the focus–performance relationship, whereas a lower level of organizational and physical separation is expected to have a negative influence on the relationship between focus and performance. The second hypothesis reads as follows:

*H2:* The effect of focus on performance is moderated by the degree of organizational and physical separation of the factory-within-a-factory.

### *Conceptual model*

From the literature a conceptual model presented in figure 1 is derived. The presented constructs are used to operationalize the model, using the hypotheses to express relations between the variables.



*Figure 1 - Conceptual model*

## **Research methodology**

### *Data Collection*

The main goal of this analysis is to empirically investigate the focus-performance relation for the FWF and how the degree of separation moderates this relation. Hence, the targeted unit of analysis is the FWF. Plant managers were asked to fill out the survey. In cases where the plant consisted of multiple FWF, data for the largest FWF was collected.

Only companies in the manufacturing industries (SIC codes 10 to 33) were chosen for data collection. Plant managers from Germany, Austria, Switzerland, and Liechtenstein were contacted and asked to fill out the questionnaire. Data was collected via an online survey using *unipark* of *questback*. Plant managers were looked up on LinkedIn and were subsequently contacted via their corporate email-addresses, researched from the companies' website. Over the course of one month, starting in the beginning of January

2016, a total of 424 plant managers were contacted. Due to initially low response rates, one reminder was sent out after two weeks to the then already contacted plant managers. In total, 90 responses were generated, resulting in an overall response rate of 21%.

The introduction of the questionnaire was designed to identify whether or not the plant was organised in FWF. Of the 90 responses, 56 (62.2%) indicated to use the FWF concept. This led to an overall response rate of 13%. Information in the three main categories *degree of focus*, *separation*, and *performance* of the FWF relative to its primary competitors was collected. Table 1 gives an overview of the sample.

*Table 1 - Sample overview*

| <b>Country</b>     | <b>n</b>  | <b>%</b>   | <b>Industry</b>   | <b>n</b>  | <b>%</b>   | <b>FTE</b>  | <b>n</b>  | <b>%</b>   |
|--------------------|-----------|------------|-------------------|-----------|------------|-------------|-----------|------------|
| Germany            | 35        | 62         | Metal products    | 10        | 18         | 1-99        | 4         | 7          |
| Switzerland        | 12        | 21         | Food              | 6         | 11         | 100-249     | 10        | 18         |
| Austria            | 2         | 4          | Machinery         | 6         | 11         | 250-499     | 14        | 25         |
| Others/Unspecified | 7         | 13         | Chemicals         | 5         | 60         | 500-749     | 8         | 14         |
|                    |           |            | Electrical equip. | 4         | 7          | 750-999     | 2         | 4          |
|                    |           |            | Motor vehicles    | 4         | 7          | >999        | 12        | 21         |
|                    |           |            | Others            | 21        | 38         | Unspecified | 6         | 11         |
| <b>Total</b>       | <b>56</b> | <b>100</b> |                   | <b>56</b> | <b>100</b> |             | <b>56</b> | <b>100</b> |

### *Measures*

Where possible, existing measures from the focus literature were used. Since literature did not provide a suitable measure for identifying a single FWF within a factory, a new measure had to be developed.

FWF: Similar to Vokurka and Davis (2000) a definition was presented to the respondents. It followed the original definition of a FWF according to Skinner (1974). The text was as follows: “A plant within a plant (or factory within a factory) is a physically and organizationally separated entity within a production site. It is equipped with its dedicated facilities in order to focus on the fulfilment of its individual and clearly defined manufacturing task, which is derived from the corporate strategy and marketing plan. It has its particular work-force management approaches, production control, organization structure and so forth.” Following Bozarth and Edwards (1997) it was chosen not to validate the application of the concept in a binary way, as that might be too simplistic. Instead, respondents were asked how much they agree that their plant is organised using the FWF to separate production activities with different requirements and tasks on a Likert-scale from 1 (strongly disagree) to 7 (strongly agree).

Degree of focus: The degree of focus of the largest FWF was measured using agreement to statements based on the focus definitions and concepts of Skinner (1974), Bozarth (1993), Pesch (1996) and Schroeder and Pesch (1994), see table 2.

Separation: To measure how the FWF is organisationally and physically separated from the rest of the operations apparatus, a new measure had to be developed. Eight semi-structured interviews with operations managers from companies deploying the FWF concept at their plants were conducted. It was the goal to find out, how the separation was realised. Specifically, operations managers were asked to report about the organisational structure of the respective plants, assignment of responsibilities within the plant, the resource situation, the governance structure etc. and any organisational changes over time. From the results of those interviews, eight different means of separating the FWF were identified (see table 2). Respondents in the survey were asked to express their agreement to the statements regarding the separation on a Likert-scale from 1 (strongly disagree) to 7 (strongly agree), see table 2.

Table 2 - Measures

| Construct         | Item        | Description  |
|-------------------|-------------|--|
| FWF Focus         | FWF_focus_1 | One single competitive priority, which is clearly defined.   |
|                   | FWF_focus_2 | Manufacturing characteristics and capabilities are designed in a way that they specifically fit the market requirements of the respective targeted market. |
|                   | FWF_focus_3 | Manufacturing capabilities are consistent with the overall corporate strategy.   |
|                   | FWF_focus_4 | Manufacturing characteristics are consistent and compatible.   |
|                   | FWF_focus_5 | Production lines' volumes within the PWP are very similar.   |
|                   | FWF_focus_6 | Product requirements of the products produced are not very diverse.  |
|                   | FWF_focus_7 | There are only one or two new or unknown technologies in use.  |
| FWF Separation    | FWF_sep_1   | Dedicated production resources, not shared with other units  |
|                   | FWF_sep_2   | Separate and specifically dedicated workforce  |
|                   | FWF_sep_3   | Own management team  |
|                   | FWF_sep_4   | Own legal entity   |
|                   | FWF_sep_5   | Dedicated support functions workers, no use of shared services   |
|                   | FWF_sep_6   | Own building or otherwise physically fully separated   |
|                   | FWF_sep_7   | Reports to different business units  |
|                   | FWF_sep_8   | Own organizational structure   |
| FWF Performance   | FWF_perf_1  | Relative to the primary competitors, the PWP produces products at lower internal costs.  |
|                   | FWF_perf_2  | Relative to the primary competitors, the PWP reaches higher product quality in market-decisive quality measures.   |
|                   | FWF_perf_3  | Relative to the primary competitors, the PWP reaches higher delivery reliability.  |
|                   | FWF_perf_4  | Relative to the primary competitors, the PWP is more flexible (i.e. changes in product mix, changes in product volumes).                                   |
|                   | FWF_perf_5  | Relative to the primary competitors, the PWP has reached higher sales growths over the past three years.   |
|                   | FWF_perf_6  | Relative to the primary competitors, the PWP reaches higher returns on assets (ROA).   |
| Control Variables | Industry    | Industry of biggest PWP  |
|                   | Age         | Years since plant opened   |
|                   | Plant Size  | Number of FTE in the plant   |

Performance: To avoid a nondisclosure of the requested numbers for privacy and competition-related concerns, it was decided to ask respondents to rate the relative performance of their FWF compared to their primary competitors on a seven point Likert-scale. Following Rosenzweig et al. (2003), the chosen method of perceptual rating offers to be a reliable alternative to objective measures. The measures used were developed on the basis of the works of Cai and Yang (2014) and Rosenzweig et al. (2003), see table 2.

Control variables: It was controlled for industry type (SIC codes from 10 to 33), plant size, and plant age (cf. Ketokivi and Jokinen, 2006), see table 2. Since data was collected in a categorical form, it cannot be included in the following regressions without being transformed first. Therefore, dummy coding was used to be able to include the originally

categorical variables into the regression. For each categorical variable with k groups, k binary dummy variables were created as suggested by Hair et al. (2010).

Table 3 provides more details on the data about the separation of the FWF (wording adapted). Three observations can be drawn from the mean values: First, FWF appear to generally tend to have dedicated work forces and production resources, as well as a somewhat dedicated management team. Second, FWF show a clear tendency to not represent their own legal entity and to rather not report to different business units. Third, the use of shared services and support functions across multiple FWF seems to be common in the plants of the sample.

*Table 3 – Separation items*

| <b>Items</b>   | <b>N</b> | <b>Mean</b> | <b>SD</b> |
|--|----------|-------------|-----------|
| FWF_sep_1 Dedicated production resources, not shared with others | 47       | 4,94        | 1,916     |
| FWF_sep_2 Separate and specifically dedicated workforce          | 47       | 5,38        | 1,649     |
| FWF_sep_3 Own management team                                    | 47       | 5,47        | 1,78      |
| FWF_sep_4 Own legal entity                                       | 47       | 1,7         | 1,317     |
| FWF_sep_5 Dedicated support function workers, no shared services | 47       | 2,96        | 1,841     |
| FWF_sep_6 Own building or otherwise physically fully separated   | 47       | 3,96        | 2,043     |
| FWF_sep_7 Reports to different business units                    | 47       | 2,96        | 2,177     |
| FWF_sep_8 Own organizational structure                           | 47       | 4,62        | 1,973     |

Pearson’s correlation coefficients among the eight separation items in the sample are displayed in table 4. Significant correlations are highlighted and deserve to be commented on here following. First, there is a significant correlation between dedicated and not shared production resources and a specific and dedicated workforce. This follows the intuition that production resources are connected to specific workforces. Second, the existence of a separate management team positively and significantly correlates with dedicated work forces as well as dedicated production resources. This can be interpreted as indication that in the sample, work force, production resources, and management are considered to separate a FWF, with separation tending to take place along these three items as a connected block. Third, a high degree of dedicated support function workers without using shared services tend to is linked to using dedicated production resources and having an own management team. Fourth, the higher degree of an own organizational structure positively and significantly correlates with the existence of an own management team and the reporting to a different business unit. The observed correlations support the notion that organizational separation of the FWF tends to be executed along the items mentioned together, hence supporting the idea of some sort of strategic organizational separation of the FWF, especially in terms of organization and management as well as in separation of production resources.

#### *Factor analysis*

For testing the hypotheses through multiple regression, the six manufacturing performance items are merged by using factor analysis. Since performance items are derived from previous studies, a conceptual foundation is given. Orthogonal factor rotation (Varimax) was conducted in order for the extracted factors to be uncorrelated. There are two factors underlying the performance items. Factor loadings between 0,603 and 0,879 reveal that the items related to operational performance measures load high on factor one and items related to financial performance measures load high on factor two.

Bartlett's test of sphericity was found to be significant on a .000 level and the Kaiser-Meyer-Olkin measure of sampling adequacy resulted to be .665.

*Table 4 - Correlation matrix of separation items*

|           | 1 | 2       | 3       | 4      | 5       | 6      | 7      | 8       |
|-----------|---|---------|---------|--------|---------|--------|--------|---------|
| FWF_sep_1 | 1 | 0,503** | 0,411** | -0,042 | 0,375** | 0,372* | 0,182  | 0,258   |
| FWF_sep_2 |   | 1       | 0,419** | -0,217 | 0,285   | 0,231  | 0,247  | 0,347   |
| FWF_sep_3 |   |         | 1       | 0,033  | 0,384** | 0,269  | 0,314* | 0,442** |
| FWF_sep_4 |   |         |         | 1      | 0,335*  | -0,013 | 0,208  | -0,103  |
| FWF_sep_5 |   |         |         |        | 1       | 0,242  | 0,298* | 0,097   |
| FWF_sep_6 |   |         |         |        |         | 1      | 0,122  | 0,303*  |
| FWF_sep_7 |   |         |         |        |         |        | 1      | 0,396** |
| FWF_sep_8 |   |         |         |        |         |        |        | 1       |

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

#### *Reliability of scales*

To test reliability of the focus scale, Cronbach's Alpha is calculated for each focus item. The initial calculation of Cronbach's Alpha with all focus items lead to a value of .59. The elimination of two items was necessary to eventually reach a Cronbach's Alpha of .7. The items eliminated are FWF\_focus\_7 and FWF\_focus\_6. Consequently, these items are not being considered for testing levels of focus. Reliability of subscales operational performance and financial performance is given with Cronbach's Alphas of .8 and .7.

#### **Results**

First, the relation between the degree of focus and the performance of the FWF was tested. Literature suggests that the higher the degree of focus, the better the performance would be. Adding control variables step-wise, the effects were controlled for industry type, plant age and size. As cases with missing data were excluded, block-wise regression with 40 FWF was conducted. Due to limited sample size the increase of  $R^2$  largely is caused by the relatively high number of independent variables used compared to the rather small sample size. Since the hypothesis is rooted in focus literature, we consider  $R^2$  of .215 as relatively modest. Since no significant results are found, we surprisingly reject H1 for the dependent variable operational performance. Testing the model for financial performance delivers better  $R^2$  of .563 and significant results with an alpha level of  $p=.008$ . Thus, we partially confirm H1 for financial performance only (see table 5).

*Table 5 - ANOVA after block-wise regression models for focus and performance*

|                 | Sum of Squares | df | Mean Square | F     | Sig. |
|-----------------|----------------|----|-------------|-------|------|
| Op. Regression  | 22,981         | 22 | 1,045       | 1,487 | ,204 |
| Perf. Residual  | 11,945         | 17 | ,703        |       |      |
| Total           | 34,925         | 39 |             |       |      |
| Fin. Regression | 31,017         | 22 | 1,410       | 3,288 | ,008 |
| Perf. Residual  | 7,289          | 17 | ,429        |       |      |
| Total           | 38,306         | 39 |             |       |      |

Coefficients of the linear model of predictors of FWF financial performance leads to the item describing the existence of a single and clearly defined competitive priority as the only coefficient among the focus items, which is below the significance alpha level of

p=0.05. With a standardized coefficient value of 0.359 it is also the most relevant coefficient in the model predicting the financial performance of the FWF. The second most relevant focus item, the manufacturing capabilities' consistency with the overall strategy, would also be a considerably relevant influential predictor, does however not reach significance in the test carried out.

For analysing the moderation effect of separation between focus and performance variables were mean centered to increase interpretability of the outcome of the analysis. In total, eight simple moderation models were tested. In each model, the variable representing a single, clearly defined competitive priority was used as predictor, and the PWP financial performance variable was used as predicted outcome variable. All models were controlled for industry type, plant age and plant type. The difference in the models lies in the moderators used, with each model testing one of the eight items. After excluding cases with missing data, the sample size was 42. The existence of an own organizational structure of a FWF is the only case, for which in the sample significant moderation could be found on the relationship between focus and financial performance of the FWF. With higher levels of an own organisational structure, there is an increasingly positive and significant relationship between focus and financial performance (table 6).

*Table 6 - Significance test, hypothesis 2, dependent variable: Op. Perf.*

| <b>FWF_org_8</b> | <b>Effect</b> | <b>SE</b> | <b>t</b> | <b>p</b> |
|------------------|---------------|-----------|----------|----------|
| -1,9609          | 0,0582        | 0,163     | 0,358    | 0,724    |
| 0,000            | 0,3684        | 0,115     | 3,204    | 0,004    |
| 1,9609           | 0,6785        | 0,187     | 0,187    | 0,002    |

## **Discussion**

### *Focus-performance relationship*

The results regarding the relationship between the degree of focus and the operational and financial performance of a FWF were heterogeneous. Against the assumption of the model created, no support of focus positively influencing operational performance was found. However, significant support for focus positively influencing financial performance of a FWF was found for the sample plants. Those results could be put in relation to the findings of Bozarth and Edwards (1997). The two authors found significant influence of focus on manufacturing performance, which in their case was measured in operational means. More so, the most significant relationships between focus and performance are found for focused work cells.

Those differing outcomes can be explained by the dissimilarity of the research settings. Most importantly, Bozarth and Edwards' study analysed the influence of focus on performance on a plant level, whilst the paper at hand studies the influence of focus on performance exclusively for the FWF. Moreover, Bozarth and Edwards studied a sample specific to the automotive industry, whereas the underlying study analysed a sample across different industries, controlling for the industry.

Regarding the relationship between focus and financial performance of the FWF, this study results in similar outcomes as previous studies did for the overall plant level. To mention two of them, Richardson et al. (1985) and Vokurka and Davis (2000) found strong empirical support of the positive relationship between focus and financial performance. Hence, the relationship between focus and financial performance appears to be generally valid, on plant level as well as for the FWF.

Reasons for the divergent results between operational and financial performance measures might lie in the difference of the two aspects measured. Financial performance

follows a rather one-directional goal in practice, meaning that high financial performance is typically a commonly shared goal across companies and industries. However, operational performance underlies a more complicated logic. Depending on strategic choices, some companies might for example aspire to perform well not on all, but only a few operational measures, as only those might result decisive in their strategic view. This, of course, is especially true for the focused factory which essential idea is to focus on one competitive priority only. The rather simple supposed relationship between focus and operational manufacturing performance might therefore have to be reconsidered in favour of a more sophisticated measure of the impact that focus has on manufacturing outputs. Nonetheless, as no previous studies have analysed the relationship between focus and performance specific to the FWF, the results of the sample in this study, representing the first of this kind, present a valid first point of reference in the research on the FWF and provides orientation for future studies.

#### *Moderating role of separation*

It was suspected that higher organizational and physical separation along eight items positively moderates the relation between focus and performance. In a first step, analysing the correlations between the single aspects revealed patterns of FWF design. More so, significant positive correlations between the degrees of separation in production resources, separation in workforces, as well as separation in support functions are found. The correlation was especially strong between dedicated production resources and dedicated workforce. Additionally, the existence of an own management team and the existence of an own organizational structure revealed a comparatively high and positive correlation. Further, means for these two aspects were high in the sample. Therefore, a tendency of a high organisational separation can be assumed.

However, only for one of the eight organizational measures, namely the degree of the existence of an own organisational structure for the FWF, significant moderation has been found. More specifically, with higher separation of the FWF regarding its organisational structure, the conditional effect of the focus item on financial performance is predicted to be higher as well. The results must not be mistaken to indicate the opposite of Skinner's original postulation of physical and organizational separation. To the same degree that physical and organisational separation was for seven of the eight aspects studied not found to enhance the effect of focus on performance, it was also not found to diminish it.

With a larger sample, a factor analysis is suggested to be carried out. Such analysis would point at potential factors underlying some of the correlated eight dimensions we have tested. We suppose that this would lead to a set of items usable for measuring the separation construct. Further statistical analysis requiring larger sample could then be undertaken to investigate the effect of this construct on the focus-performance relation. This analysis, mostly due to the small sample size, can thus be viewed as a starting point only for further research on FWF.

#### **Conclusions**

Despite controlling for effects originating in differences of industry types, plant size and plant age, an unrestricted exclusion of the existence of other unknown effects influencing the analysis cannot be claimed. Additionally and most problematically, the sample size applicable for the regressions conducted must be seen as borderline for the number of independent variables used. The differences in  $R^2$  and adjusted  $R^2$  exemplify that a larger sample size would be preferable and allow a more clear and solid analysis of the hypotheses.

Further, using just one introductory question in the survey in order to assess and classify the respondents' plants might be overly simplistic. Using only one question to evaluate the degree of usage of the PWP principle could lead to mainly two flaws: First, a misunderstanding of one single question directly leads to the incorrect classification of a unit as a FWF and might falsify results obtained. Second, by using only one qualifying question, the researcher to a big part gives up the control of classification as FWF or not.

However, the analysis conducted was – to our knowledge – the first of its kind. None such analysis was previously conducted on the level of the factory-within-a-factory. Therefore, the boundary conditions of a FWF are not yet fully understood and the conceptual model is a first attempt only to modelling construct interdependencies.

## References

- Bozarth, C.C. (1993), "A Conceptual Model of Manufacturing Focus", *International Journal of Operations & Production Management*, Vol. 13 No. 1, pp. 81–92.
- Bozarth, C. and Edwards, S. (1997), "The impact of market requirements focus and manufacturing characteristics focus on plant performance", *Journal of Operations Management*, Vol. 15 No. 3, pp. 161–180.
- Cai, S. and Yang, Z. (2014), "On the relationship between business environment and competitive priorities: The role of performance frontiers", *International Journal of Production Economics*, Vol. 151, pp. 131–145.
- Hair, J.F., Black, W.C., Babin, B.J. and Anderson, R.E. (2010), *Multivariate Data Analysis: A Global Perspective*, 7. ed., global ed., Pearson, Upper Saddle River, NJ.
- Hallgren, M. and Olhager, J. (2006), "Differentiating manufacturing focus", *International Journal of Production Research*, Vol. 44 No. 18/19, pp. 3863–3878.
- Hill, A. (2008), "How to organise operations: Focusing or splitting?", *International Journal of Production Economics*, Vol. 112 No. 2, pp. 646–654.
- Huckman, R.S. (2009), "Are You Having Trouble Keeping Your Operations Focused?", *Harvard Business Review*, Vol. 87 No. 9, pp. 90–95.
- Ketokivi, M. and Jokinen, M. (2006), "Strategy, uncertainty and the focused factory in international process manufacturing", *Journal of Operations Management*, Vol. 24 No. 3, pp. 250–270.
- Miltenburg, J. (2008), "Setting manufacturing strategy for a factory-within-a-factory", *International Journal of Production Economics*, Vol. 113 No. 1, pp. 307–323.
- Pesch, M.J. (1996), "Defining and understanding the focused factory: A Delphi survey", *Production and Inventory Management Journal*, Vol. 37 No. 2, p. 32.
- Richardson, P.R., Taylor, A.J. and Gordon, J.R.M. (1985), "A Strategic Approach to Evaluating Manufacturing Performance", *Interfaces*, Vol. 15 No. 6, pp. 15–27.
- Rosenzweig, E.D., Roth, A.V. and Dean Jr., J.W. (2003), "The influence of an integration strategy on competitive capabilities and business performance: An exploratory study of consumer products manufacturers", *Journal of Operations Management*, Vol. 21 No. 4, pp. 437–456.
- Ruwe, D.M. and Skinner, W. (1987), "Reviving a Rust Belt factory", *Harvard Business Review*, Vol. 65 No. 3, pp. 70–70.
- Schroeder, R.G. and Pesch, M.J. (1994), "Focusing the factory: Eight lessons", *Business Horizons*, Vol. 37 No. 5, p. 76.
- Shafer, S.M. and Oswald, S.L. (1996), "Product-focused manufacturing for strategic advantage", *Business Horizons*, Vol. 39 No. 6, p. 24.
- Sheu, C. and Krajewski, L. j. (1996), "A heuristic for formulating within-plant manufacturing focus", *International Journal of Production Research*, Vol. 34 No. 11, p. 3165.
- Sheu, C., Krajewski, L.J. and Cai, G. (2012), "A heuristic for designing manufacturing focus units with resource considerations", *International Journal of Production Research*, Vol. 50 No. 6, pp. 1608–1623.
- Skinner, W. (1974), "The focused factory", *Harvard Business Review*, Vol. 52 No. 3, pp. 113–121.
- Vokurka, R.J. and Davis, R.A. (2000), "Focused factories: Empirical study of structural and performance differences", *Production and Inventory Management Journal*, Vol. 41 No. 1, pp. 44–55.