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Impact of Modular Design and Interchangeable Systems on  
Business Profit

**Abdul Salam Khan\***

National University of Sciences and Information Technology,  
Pakistan

\*Corrospounding author's Email: [abdulsalam\\_mechanical@yahoo.com](mailto:abdulsalam_mechanical@yahoo.com)

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[info@readersinsight.net](mailto:info@readersinsight.net)

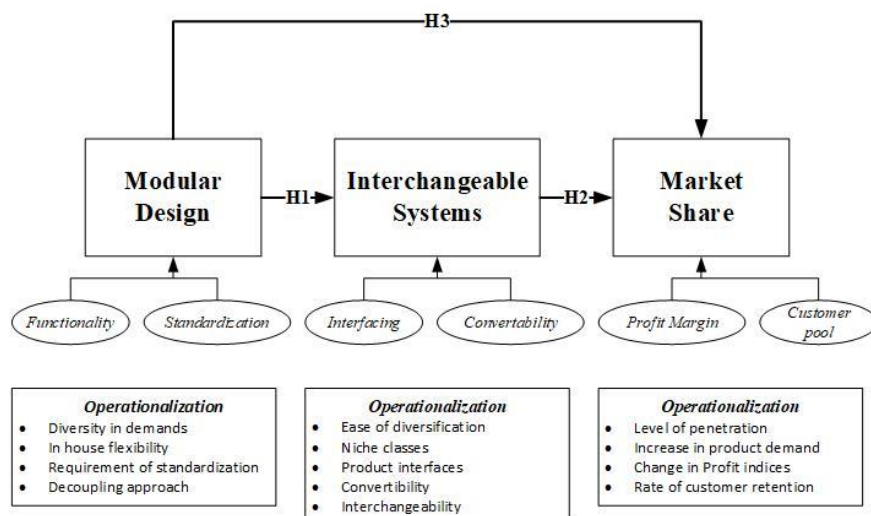
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## Research Highlights

In resource constraint environment, business operates by “doing it right the first time” for timely production and effective delivery. Modular design, Interchangeable systems and “Leagile” manufacturing are essential tools for coping with variable demands. We discuss manufacturing system design & its importance for firm’s competitiveness by operationalizing competitiveness in terms of profit share and understanding mediation of interchangeability between modular design and market share. Our findings suggest that modular design provides an enterprise to explore new customer base, focus on niche market and start on a new learning curve.

## Graphical Abstract



## Research Objectives

We examined key antecedents of Modular design and its impact on market share & profitability by testing following hypotheses.

H<sub>01</sub>: Modular Design does not have a positive impact on Interchangeable Systems

H<sub>1</sub>: Modular Design has a positive impact on Interchangeable Systems

H<sub>02</sub>: Interchangeable Systems does not have a positive impact on Market Share



H<sub>2</sub>: Interchangeable Systems has a positive impact on Market Share

H<sub>03</sub>: Modular Design does not have a positive impact on Market Share

H<sub>3</sub>: Modular Design has a positive impact on Market Share

## Methodology

We drew upon sample of firms using convenient sampling from manufacturing sector, automotive and chemical processing industry. Sample size of firms was 30 out of which 16 belonged to manufacturing, 4 were automotive based and chemical processing was represented by 10 industries. *LISREL* based equation modeling was used to analyze the relationship between observed and latent constructs. Seven points Likert scale based questionnaire was used for collection of data. Variables and constructs were run through confirmatory factor analysis and internal consistency tests indices including chronbach alpha, composite reliability, average variance extracted and standard factor loading (Tarhini et al., 2016).

Uni-dimensional factor loading of items was carried out and all items had a factor loading above bottom-line of 0.5 (Kamariotou et al., 2018). Chronbach alpha is the measure of reliability with threshold of alpha equal 0.6 which was qualified by all measures (Tsai et al., 2017). Though reliability is a necessary condition for goodness of fit, it is complemented by validity analysis through composite reliability and average variance extracted. AVE and composite reliability of all constructs were above the limit of 0.5 (Hair et al., 1998).

## Results

Goodness assessment of the study model was performed. According to the result indices, framework requirements were met and a parsimonious fit was accomplished. Limit for chi-square ratio is  $\leq 5.0$  (Hu et al., 1999) which was fulfilled by both initial analysis model as well as final model. RMSEA is another goodness of fit index with the recommended value below 0.7 (Steiger, 2007). Limits for CFI and TLI 0.9 (Fanet al., 1999). The entire model fit indices exhibited good fit. Discriminant validity was approved provided that average variance extracted (AVE) value for each construct was greater than squared correlation index of each variable. This study was performed to analyze and test three hypotheses. Hypotheses 1 posited a positive relationship between Modular Design and Interchangeable Systems. Statistical regression analysis warranted significant relationship coefficient of 0.674 (Beta-value) significant at p-value  $< 0.01$ . According to hypotheses two, Interchangeable Systems





impacts the market share with a relationship co-efficient 1.024 significant at  $p\text{-value} < 0.05$ . Lastly, relationship coefficient between Modular Design and Market Share is 1.146, significant at  $p\text{-value} < 0.05$ . Modular Design has a direct-effect of 1.146 on Market Share while its in-direct effect is  $0.674 * 1.024$  (0.690) with a total effect of 1.836 on Market share.

## Findings

In current production systems, diversity in demands requires in house flexibility & modular design. This study encourages the implementation of modular design and interchangeable systems. Interchangeable systems can help in addressing the niche/targetted customer needs, changes between classes and provides ease of diversification. Results suggest that both modular design and system level changes can guarantee market share both in terms of profit margins and increase in customer pool. Enterprises can gain penetration into the market & an increased demand of their product as a result of implementing the study findings.

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