The Value of Component Commonality

Junmin Shi
Yao Zhao
Rutgers University
Rutgers Business School – Newark and New Brunswick
Department of Supply Chain Management and Marketing Science
180 University Ave.
Newark, NJ 07032
jshi@andromeda.rutgers.edu, yaozhao@andromeda.rutgers.edu

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Abstract

Component commonality has been widely recognized as a key factor in achieving product variety at low cost. We consider a continuous-time assemble-to-order (ATO) system with base-stock inventory control policy, positive lead times and non-holdback (NHB) allocation rules. Under an NHB allocation rule, a product demand is backordered if and only if at least one of its required components is out of stock. Our objective is to study the value of component commonality by comparing the total backorders, total on-hand inventory and average costs between systems with component commonality and those without, and for systems with different degrees of commonality.

We first study a two-product system and find that for any given base-stock levels and any NHB allocation rule, the total backorder and total on-hand inventory can be reduced with probability one as the degree of commonality increases. We then extend the result to more general systems with multiple products. Next, we derive closed-form expressions for the long-run average costs for systems under certain symmetric conditions, as well as an approximation for the average backorder of each individual product systems without the symmetric conditions under the MFIFO rule (a special case of NHB rule). Based on these results, we conduct a numerical study to quantify the value of component commonality in terms of expected backorders and system-wide average cost.

Keywords and Phrases: Assemble-to-Order systems, non-holdback allocation rules, component commonality.