APEM journal

Advances in Production Engineering & Management
Volume 16 | Number 4 | December 2021 | pp 473–484
https://doi.org/10.14743/apem2021.4.414

ISSN 1854-6250
Journal home: apem-journal.org
Original scientific paper

A comparative study of different pull control strategies in multi-product manufacturing systems using discrete event simulation

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ABSTRACT

Pull production control strategies coordinate manufacturing operations based on actual demand. Up to now, relevant publications mostly examine manufacturing systems that produce a single type of a product. In this research, we examine the CONWIP, Base Stock, and CONWIP/Kanban Hybrid pull strategies in multi-product manufacturing systems. In a multi-product manufacturing system, several types of products are manufactured by utilizing the same resources. We develop queueing network models of multi-stage, multi-product manufacturing systems operating under the three aforementioned pull control strategies. Simulation models of the alternative production systems are implemented using an open-source software. A comparative evaluation of CONWIP, Base Stock and CONWIP/Kanban Hybrid in multi-product manufacturing is carried out in a series of simulation experiments with varying demand arrival rates, setup times and control parameters. The control strategies are compared based on average wait time of backordered demand, average finished products inventories, and average length of backorders queues. The Base Stock strategy excels when the manufacturing system is subjected to high demand arrival rates. The CONWIP strategy produced consistently the highest level of finished goods inventories. The CONWIP/Kanban Hybrid strategy is significantly affected by the workload that is imposed on the system.

ARTICLE INFO

Keywords:
Discrete event simulation (DES);
Open-source software;
JaamSim DES software;
Multi-product manufacturing;
Multi-stage production systems;
Pull-type production control strategies

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Article history:
Received 17 September 2021
Revised 30 November 2021
Accepted 3 December 2021

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APEM journal

Advances in Production Engineering & Management
Letnik 16 | Številka 4 | December 2021 | Strani 473–484
https://doi.org/10.14743/apem2021.4.414

ISSN 1854-6250
Spletna stran: apem-journal.org
Izvirni znanstveni članek

Primerjalna študija različnih vlečnih strategij nadzora pri sistemih za proizvodnjo več vrst izdelkov z uporabo simulacije diskretnih dogodkov

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POVZETEK

Vlečna strategija nadzora proizvodnje usklajuje proizvodne operacije na podlagi dejanskega povpraševanja. Doslej so relevantne publikacije večinoma preučevale proizvodne sisteme, ki proizvajajo eno vrsto izdelka. V tej raziskavi proučujemo vlečne strategije CONWIP, Base Stock in hibridno CONWIP / Kanban v proizvodnih sistemih z več izdelki. V proizvodnem sistemu z več izdelki se z uporabo istih virov proizvaja več vrst izdelkov. Razvijamo omrežne modele čakalnih vrst večstopenjskih proizvodnih sistemov z več izdelki, ki delujejo v skladu s tremi zgoraj omenjenimi strategijami vlečnega nadzora. Simulacijski modeli alternativnih proizvodnih sistemov so zgrajeni z uporabo odprtokodne programske opreme. Primerjalno vrednotenje strategij CONWIP, Base Stock in hibridna CONWIP/Kanban v proizvodnji več izdelkov je izvedeno v seriji simulacijskih eksperimentov z različnimi stopnjami prejema povpraševanja, časi nastavitve in nadzornimi parametri. Strategije nadzora se primerjajo na podlagi povprečnega čakalnega časa za ponovna naročila, povprečnih zalog končnih izdelkov in povprečne dolžine čakalnih vrst za ponovna naročila. Strategija Base Stock je odlična, ko je proizvodni sistem izpostavljen visokim stopnjam prejema povpraševanj. Strategija CONWIP je dosledno zagotavljala najvišjo raven zalog končnega blaga. Na strategijo hibridna CONWIP/Kanban močno vpliva delovna obremenitev sistema.

PODATKI O ČLANKU

Ključne besede:
Simulacija diskretnih dogodkov (DES);
Odprtokodna programska oprema;
Programska oprema JaamSim DES;
Proizvodnja več izdelkov;
Večstopenjski proizvodni sistemi;
Strategije vlečnega nadzora proizvodnje

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Zgodovina članka:
Prejet 17. septembra 2021
Popravljen 30. novembra 2021
Sprejet 3. decembra 2021