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Study of Kanban and Conwip Analysis on Inventory and Production Control System in an Industry

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Abstract— The Kanban system is more flexible for the assembly system under concern with respect to a given objective than CONWIP system we examine single-product assembly systems with unlimited demand at the end of the assembly line In some cases, if the number of kanbans at each manufacturing/assembling station is optimally set, the Kanban system outperforms CONWIP system with a lower average WIP and the same level of throughput.

***Index Terms*—Kanban, conwip, wip, production.**

I. INTRODUCTION

There are many studies on control policies for manufacturing systems. However, only policies that compare Kanban and CONWIP operations and applications of different CONWIP production control systems.[1] Detailed comparisons for some of the systems. The CONWIP concept could be applied to an assembly system fed by two fabrication lines.[2] The fabrication assembly systems using statistical throughput control (STC) method.[3] An integer nonlinear mathematical programming model to determine an optimal production sequence and lot sizes in a CONWIP single production line.[4] A nonlinear mixed integer programming model for a CONWIP based production system where an assembly station is fed by two parallel fabrication lines.[5] Optimal part assignment, production sequence and lot sizes are simultaneously determined by solving the model, the application of CONWIP control to assembly operations. The analyses used in each of these references rely on queuing network approximations in computing the throughput, a flow-shop (sequence of tandem queues) under CONWIP control. They assumed that processing times are deterministic but service can be interrupted by machine failures that are exponentially distributed in duration, approximated the throughput of an assembly system, consisting of multiple station tandem production lines, feeding an assembly operation under the CONWIP control. [6-10] The approximation to a cyclic assembly system with general processing time distributions.[9] The closed tree structured assembly systems with exponential machine processing times and developed an aggregation/disaggregation algorithm to approximate the system throughput and mean queue lengths at the workstations. [7, 10]
There are also some studies about comparing of Kanban and CONWIP systems. Several authors have shown through both simulation and analytical models that CONWIP outperforms Kanban when processing times are variable. In a flow line that produces a single part type, that CONWIP produces a higher mean throughput than Kanban.[11-13] An assembly station fed by two fabrication lines determine the number of cards. Stochastic Throughput Control (STC).[5] An assembly station fed by two fabrication lines determining optimal part assignment, production sequence, lot sizes Non-linear programming.[4] Single production lines Determining optimal production sequence, lot sizes Non-linear Programming conwip flow-shop subject to failures determining system through put Queuing network. [8-10] An assembly operation fed by multiple stations determining system throughput Queuing network. Closed tree structured assembly system Determining system throughput and mean queue length at the stations Queuing network (aggregation/disaggregation algorithm that CONWIP produces a less variable throughput and a lower maximal inventory than Kanban.[14] CONWIP and synchronized CONWIP to supply chains to determine the superior system. Their considered supply chains contain assembly stages with different lead times. Most researches have pointed out that CONWIP would result in lower WIP levels than Kanban system with the same throughput in most cases. However, Kanban achieves a given throughput level with less WIP than CONWIP. They showed that by choosing appropriate number of cards at each station, Kanban can outperform CONWIP system. They considered a linear production line with exponential service time distributions and unlimited demand at the final buffer. [15]

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II. RESULT AND DISCUSSION

In a single production line, a CONWIP system with circulating card has better performance than a Kanban system with cards. In this section we examine whether this result is hold for an assembly system as well or not. That is, we compare Kanban and CONWIP system applied in an assembly system given the same number of circulating cards within the system. Consider an assembly system fed by fabrication lines with three stations for each fabrication lines as well as the assembly line gives the results consist of systems throughput and average WIP of both Kanban and CONWIP systems, when the total number of circulating cards within the both systems is identical and equal to 13 .

In Table 1, Kij denotes the number of kanbans at i-th station of j-th fabrication line in the Kanban system. That is k_{11},k_{12} and k_{13} denote the number of kanbans at station 1, 2and3of the first fabrication line, respectively, Similarly k_{21}, k_{22} and k_{23} denote the number of kanbans at station 1,2 and 3 of fabrication line 2, respectively. k_1 and k_2 also denote the number of kanbant station 1 and 2of the assembly line, respectively. From the table 2 and 3 two systems has the same rate of throughput (equal 3.75 parts per hour) and, average WIP equal 1.09 and 1.45 parts obtained by Kanban and CONWIP system, respectively. As a result, when the total number of cards in both Kanban and CONWIP systems is equivalent, average WIP can be less in Kanban system than in CONWIP given the same level of throughput. Since final demand is unlimited the number of kanbans at the last station of the assembly line is not relevant in Kanban system. Comparison between Kanban and CONWIP systems in showed that Kanban system provides a less WIP level in average than CONWIP system given the same level of throughput. In most cases, optimized Kanban system (a system with adapted card distribution) outperforms CONWIP system with a lower WIP and the same level of throughput. However, only in rarely cases, CONWIP provides a less WIP level, whereas the difference is too slight and insignificant. In fact, investigating of this observation is a part of our future research. This result is also true for the case that the same number of circulating cards is provided for the both systems. The result showed that when the total number of cards in both systems is equivalent, average WIP can be less in Kanban system than in CONWIP given the same level of throughput. This implies that the result of cannot be valid for all kinds of assembly systems. In addition, in a Kanban system, distribution of kanbans among the stations, and in a CONWIP system the number of circulating cards can affect the system performance such that, WIP might rise by increasing the number of cards. For CONWIP system, the total number of circulating cards equal to the total number of stations may obtain the best performance (the minimum WIP). However, for Kanban system, in most cases by assigning only one card at each station, the minimum WIP can be achieved, while for some cases an adaptation of card distribution is necessary in order to get the optimal solution. In other words, choosing an appropriate distribution of Kanban may give the expected results. Finding the optimal card distribution is also a part of our future research. Furthermore, another part of our future research is comparing our results, which developing a unified model would be necessary to have a significant comparison.

Table 1 Average WIP and throughput in the both systems given the same number of cards

Control system	TH	A_WIP	
Kanban	3.75	1.09	(Kanbans distributions) k_{11}, k_{12}, k_{13}, k_{21}, k_{22}, k_{23}, k_1, k_2 1 3 2 1 1 1 2 1
CONWIP	3.75	1.45	(Total number of circulating cards) 13

Table .2 Data collection and analysis

Work in Progress

Product **GEAR 41T ON C/SHAFT**

Post No **1293/2**

Date	Turn	T/C	SHV	H/T	Grad	Final	L/V	O/S	BMC	Total	RNT

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ISO 9001:2008 Certified
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Volume 2, Issue 4, July 2013

1/3/08	76	176	430	158	163	20	102	8	64	47	120
2/3/08	8	186	478	176	156	120	47	16	110	39	126
3/3/08	16	202	525	186	150	126	39	255	155	377	133
4/3/08	24	214	572	19	144	133	31	262	175	379	139
5/3/08	182	229	619	64	138	139	19	268	107	94	146
6/3/08	210	243	667	110	188	146	68	98	104	260	153
7/3/08	237	257	714	155	206	153	120	96	101	279	368
8/3/08	265	271	761	134	22	159	173	83	98	299	386
9/3/08	114	285	808	89	79	166	225	73	69	318	404
10/3/08	129	299	856	56	163	172	163	62	324	79	422
11/3/08	144	314	903	84	108	3	156	52	123	163	440
12/3/08	158	328	950	93	56	8	234	42	324	108	458
13/3/08	173	342	997	123	26	76	293	31	45	235	16
14/3/08	188	711	246	445	369	8	350	21	93	241	8
15/3/08	202	98	282	56	463	16	368	406	20	248	333
16/3/08	217	8	333	189	158	163	386	420	134	255	324
17/3/08	232	82	324	199	176	156	404	434	156	155	123
18/3/08	228	47	123	209	47	150	422	448	234	134	324
19/3/08	235	39	445	219	39	26	440	462	293	180	45
20/3/08	241	31	56	378	377	20	458	476	350	205	93
21/3/08	248	24	26	392	379	26	13	18	368	185	20
22/3/08	255	16	369	406	94	369	3	3	386	369	134
23/3/08	262	143	186	420	260	186	221	11	404	371	175
24/3/08	268	183	174	434	352	174	176	26	473	373	107
25/3/08	275	98	162	448	254	123	262	375	185	39	163
26/3/08	282	74	150	462	79	324	268	368	369	31	156
27/3/08	289	98	139	476	163	123	275	386	371	19	150
28/3/08	295	137	155	434	108	445	282	422	373	64	26
29/3/08	302	149	118	448	235	56	289	440	11	110	20
30/3/08	309	161	103	462	241	216	295	458	26	126	26
31/3/08	95	45	41	217	560	52	262	84	24	26	100

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Table-3. General wip report

Product **Input Shift**

Post No **1185/1**

Date	Turn	T/C	SHV	H/T	Total
1/3/08	645	143	34	27	849
2/3/08	93	167	98	39	397
3/3/08	345	187	67	163	762
4/3/08	28	98	46	19	191
5/3/08	94	22	23	163	302
6/3/08	67	34	60	14	175
7/3/08	178	156	58	22	414
8/3/08	234	26	57	154	471
9/3/08	465	586	56	119	1226
10/3/08	45	223	55	145	468
11/3/08	85	12	54	139	290
12/3/08	218	22	53	93	386
13/3/08	315	176	65	117	673
14/3/08	161	117	87	93	583
15/3/08	153	157	75	85	470
16/3/08	145	135	234	84	598
17/3/08	137	97	14	73	321
18/3/08	130	93	87	83	393
19/3/08	122	84	73	85	364
20/3/08	114	76	72	70	332
21/3/08	106	56	13	76	281
22/3/08	98	53	92	83	326
23/3/08	90	26	187	67	370
24/3/08	82	12	163	67	324
25/3/08	74	9	129	59	278
26/3/08	66	1	217	39	323
27/3/08	59	3	169	45	276
28/3/08	51	8	179	34	272
29/3/08	43	287	278	24	632
30/3/08	35	23	246	35	339
31/3/08	27	18	265	22	332

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Table-4 -Kanban wip report

Product **Input Shift**

Post No **1185/1**

Date	Turn	T/C	SHV	H/T	Total
1/3/08	704	289	94	32	1119
2/3/08	122	292	87	45	546
3/3/08	423	233	67	173	846
4/3/08	33	123	53	23	232
5/3/08	134	23	39	173	369
6/3/08	74	45	23	23	165
7/3/08	206	234	17	27	484
8/3/08	324	34	9	189	556
9/3/08	554	624	10	124	1312
10/3/08	56	173	28	167	424
11/3/08	81	23	32	142	278
12/3/08	234	27	45	127	433
13/3/08	423	189	66	126	804
14/3/08	311	124	87	121	643
15/3/08	349	167	75	116	707
16/3/08	233	142	347	111	833
17/3/08	52	127	23	106	308
18/3/08	87	115	98	101	401
19/3/08	234	97	83	96	510
20/3/08	263	84	87	91	525
21/3/08	298	63	23	86	470
22/3/08	219	62	156	81	518
23/3/08	222	34	219	76	551
24/3/08	231	24	212	71	538
25/3/08	256	10	137	66	469
26/3/08	278	2	231	61	572
27/3/08	276	5	175	56	512
28/3/08	245	14	184	51	494
29/3/08	201	321	283	46	851
30/3/08	294	45	285	41	665
31/3/08	482	28	274	35	819

III. CONCLUSION

Kanban system provides a less WIP level in average than CONWIP system given the same level of throughput. Whereas the difference is too slight and insignificant. This result is also true for the case that the same number of

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circulating cards is provided for the both systems. The result showed that when the total number of cards in both systems is equivalent, average WIP can be less in Kanban system than in CONWIP given the same level of throughput. In addition, in a Kanban system, distribution of Kanban among the stations, and in a CONWIP system the number of circulating cards can affect the system performance such that, WIP might rise by increasing the number of cards. For CONWIP system, 40 setting the total number of circulating cards equal to the total number of stations may obtain the best performance (the minimum WIP). However, for Kanban system, in most cases by assigning only one card at each station, the minimum WIP can be achieved, while for some cases an adaptation of card distribution is necessary in order to get the optimal solution. In other words, choosing an appropriate distribution of Kanban may give the expected results. Now with reference to our data collection and analysis we can say that the Kanban system provide a less WIP.

REFERENCES

[1] Framinan, J.M., Gonzalez, P.L., Ruiz-Usano, R., The CONWIP production control system: Review and research issues. Production planning & control, 14.255-256, 2003.

[2] Speaeman, M.L., Woodruff, D.L., Hop, W.J., CONWIP: A pull alternative to kanban international journal of product, ion Research, 23,879-894, 1990.

[3] Hopp, W.J., Roof M.L., Setting WIP levels with statistical thought control (STC) in CONWIP production lines International Journal of production Research. 36. 867-887., 1998.

[4] Zhang, W., and Chen, M.A. Mathematical programming model for production planning using CONWIP. International Journal of Production Research, 39, 12. 2723-2734, 2001.

[5] Cao, D., and chen, M., A mixed integer programming model for a two line CONWIP based production and assembly system. International journal of production Economics, 95, 317-326, 2005.

[6] Hopp, W.J., Speraman, M.L. Thought put of a Constant work in process manufacturing line subject to failures. International journal of production research. 29, 635-655, 1991.

[7] Duenyas. I Hop, W.J. CONWIP assembly with deterministic processing and random outages. IIE transactions. 24, 97-109, 1992.

[8] Duenyas I., Hoop, W.J., Estimating the throughput of an exponential CONWIP assembly system. Queuing Systems, 14, 135-157, 1993.

[9] Duenyas, I .,Estimating the throught put of acyclic assembly system . International Journal of Production Research 32, 1403-1419, 1994.

[10] Hajra J., Seidmann, A., performance evaluation of closed tree-structured assembly systems. IIE Transactions, 28, 591-599, 1996.

[11] Hoop, W.J., Spearman, M.L., Factory physics: The foundation of manufacturing management. McGraw-Hill. New York 2001.

[12] Muckstadt, J.A., Tayur, S.R.,A compsults.of alternative kanban control mechanisms:II,experimental results .IIE Transactions, 27(1), 140-150, 1995.

[13] Muckstadt, J.A., Tayur, S.R.,A compsults of alternative kanban control mechanisms:II,experimental results.IIE Transactions, 27(1),151-161,1995.

[14] Takahashi, K., myreshka and Hirotani, D., comparing CONWIP, synchronized CONWIP, and Kanban in complex chain s International Journal of production Economics, 93-94, 25-40, 2005.

[15] Gstettner , S., and Kuhn , H., Analysis of production control systems kanban and CONWIP. International journal of production Research. 34(11), 3253-3274, 1996.

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