Generalized Data Based Model to Improve the Productivity of Smart World Flexible Manufacturing System: 2020

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Abstract: *Today need for automation technology to enhance the production rate. This research paper writing for the improvement system in Flexible Manufacturing System area. There are lots of failures are available in FMS section. The model is developed for the empirical job production purposes some critical program needed. It's not a routine turning or milling job producing on set - up. The theme is to create for formulating new sort of program, which is universal monogram will detect. The sometimes it is not possible to empirical monogram evaluated by foundry process. In a very urgent time operate the Computer Numerical Control Machine for such program. Some of the parameters will decide to machine the object. A proper understanding of factors affecting material loss and tool losses in the creation of the job. Mathematical modeling is complex, and several data should be assumed. An Automated Program tool approach has been used with this data to estimate losses using a linear model. Other climatic and operating factors did not have a significant effect on the losses developed in this study. The model can be a useful tool to determine the new product development timing as a function of environmental and operational conditions (e.g. machine code using [fanuc] type working, material quantitative quality, maintenance schedule, etc.) in order to minimize critique job production and pulse losses.*

Keyword: *CNC Turning, CNC Milling Machine, Aristo Robot, APT Program, Samples.*

1. Introduction: Into day's product development global market, manufacturers have to invent their operations to ensure a better and speedy response to the needs of customers. The earlier goal of any manufacturing industry is to achieve a high level of productivity and flexibility which can only be done in a computer-assisted manufacturing root. The amount of punctuality that allows the system to react in the case of changes, whether predicted or unpredicted. FMS consists of three main systems. An AIP is modeled as a collection of workstations and automated guided vehicles (AGV).

2. Literature Survey: Han et al. [1] & Dhande et al. 2019[a] present the setup and scheduling problem in a special type of flexible manufacturing system, where all the machines are of the same type, and tools are 'borrowed' between machines and from the tool crib as needed. In their model, there were limited tools. This is a nonlinear integer programming problem and is computationally expensive. To solve the problem efficiently, the authors propose to decompose the problem. Phrased in this way, both problems become linear. The first problem is a capacitated transportation problem, and the second is a generalized assignment problem. All machine tools are assumed identical. Kimemia and Gershwin [2] report on an optimization problem that optimizes the routing of the parts in a flexible manufacturing system with the objective. The operation has different processing time for different machines in a cell. A network of queues approach is used. The technique showed good results in simulation. Chen and Chung [3]& Dhande, Himte, Nanoti, Modak, et al. 2017 (a)(b) evaluate loading formulations and routing policies in a simulated environment. Events and Van Wassenhove [4] present a unique procedure to select the part mix and the routing of parts in an FMS. An LP model is used to select the part mix using cost differential from producing the part outside the FMS. The selected loading is then checked by a queuing model for utilization in an iterative fashion. The FMS system following tools are used, such as

1. CNC Turning Machine
2. CNC Milling Machine
3.Industrial Robots

3. Object: 1] To analyze, formulate & investigate the system.
2] To evaluate the value addition Process.
3] To design, assemble, construct & conjecture the idea

3.1 Formulation: Small manufacturing system modeled in this paper is taken from [6]. Which consists of five work stations and five machines and there are four parts produced by these machines. Every work station consists of one machine. Here we have used four factors which affect the objective of FMS: these factors and their levels are as follows:

1. Distance preference (Y 1):- distance preference means what distance between two stations. It can be the smallest distance between two stations or the largest distance between two stations or the distance in cyclic order. So the level of distance preferences is the smallest distance(S), largest distance (L), cyclic distance (C).
2. Arrival (demand) time (min.) (Y 2): -It's the time of arriving demand of parts. Smallest Distance Machine Flexible Manufacturing system Machine
3. No. of carts(Y 3):- No. of carts used in the simulation.
4. Speed of carts (feet/min.) (Y 4):-it's the speed of carts or AGVs, which also affect the FMS objectives. Here in this thesis, three levels of speeds were assumed 60, 65 and 70.

3.1.1 FMS Modelling: Dhande et al. 2019[a [b] For finding the output of Flexible Manufacturing System is

$Y = K [A^a \times Bb \times Cc \times Dd \times E e \times Ff \times Gg \times Hh \times I i \times J j]$----------[equ.1]

K= Propornationality Constant
A, B, C, D, E, F, G, H, I, J = Are the FMS system.
a,b,c,d,e,f,g,h,i,j are respective indices of FMS system need.

The parameter are given shows in table: 1

Flexible Manufacturing System Model					
S. N.	Constant Variables	Movable Variables		Classification of Movable Variables	
Variables:1	Job Quality[A]	Human skill	A_1	Technical	Non- Technical
		Age	A_2	20-30	30-58
		Place	A_3	Native	Transferable
		Leaving standard	A_4	High class	Medium class
		Experience	A_5	Higher	Lower
		Maintality	A_6	Sound	Normal
		Family Background	A_7	Industrial Oriented	Non- industrial
		Water Capability	A_8	High	Low
		Add-on Program attd.	A_9	High Number	Low Number
		Software awareness	A_{10}	Modern software	Normal software
		Vehical using	A_{11}	Own	Industrial vehical
		Higher study deserving people	A_{12}	Part time	Full time
		Categories of operator	A_{13}	Permanant	Contract
		Working Capability	A_{14}	Hardcore	Software
		Operator Availability	A_{15}	Mass Quantity	Limited
Variables:2	Location [B]	Hill area	B_1	High hill	Lower hill

		Distance from city	B_2	Nearby	Not possible to operator up-down
		Quality of Land	B_3	Dry	Stone oriented
		Facility	B_4	Gardening	Robust area
		Water facility	B_5	Amples	Only working
		Land ownership	B_6	lease	owen purchased
		Trolly facility	C_1	Road	Rail
Variables:3	Transport [C]	By Monthly convence	C_2	Logistic	Daily/ Weekly/ Monthaly
		Ergonomics	D_1	Light system	Colour light system
Variables:4	Working Environment [D]	Seating arrangement	D_2	Suitable m/c operating oriented chair	Abedent
		Air system	D_3	Air conditioning	Naormal
		Suitable to body	D_4	Healthy	Tidious
Variable:5	Electrification [E]	Power Consumption	E_1	Heavy	Normal
		Current Flowing Capability	E_2	A/C	D/C
Variable:6	Finance [F]	Money Mode	F_1	Bank	Own Finance
		From Market Collection	F_2	Share	Bond
Variable: 7	Laboratory[G]	Quality testing M/c	G_1	Automatic	Semi- automatic
		M/C Orientation	G_2	Traditional	Unconventional
		Place of invention	H_1	Laboratory Invention	Industrial Invention
		Invention	H_2	Industry Incubation	Business Incubation
		Idea	H_3	New idea	Research Idea
Variable:8	Innovation[H]	Enhancement Level	H_4	Corporation level	Institute level
		Opinion invention	H_5	Interactive invention	Experimental invention
		Categories of invention	H_6	Number of idea	Complete Invention
			I_1	Order base	Door to Door
Variable:9	Marketing [I]	Spread in Market	I_2	Mass Quantity	Retailor
			I_3	Digital	Communication
			J_1	Individual	Group
Variable:10	Feedback [J]	Inventional Product	J_2	High Soceity	Medium Soceity
			J_3	Limited Demand	Heavy Demand

Table : 1: Flexible Manufacturing System Parameter's for constant & movable variables (Dhande et al. 2019 a)

Following equ. put in equ. [i] to [x] put in equ.[1]

$A=A_1^a, A_2^a, A_3^a, A_4^a, A_5^a, A_6^a, A_7^a, A_8^a, A_9^a, A_{10}^a, A_{11}^a, A_{12}^a, A_{13}^a, A_{14}^a, A_{15}^a$ ----------equ.[i]

$B=B_1^b, B_2, {}^bB_3^b, B_4^b, B_5^b, B_6^b$ ----------equ.[ii]

$C=C_1^c, C_2^c$----------equ.[iii]
$D=D_1^d, D_2^d, D_3^d, D_4^d$----------equ.[iv]
$E=E_1^e, E_2^e$----------equ.[v]
$F=F_1^f, F_2^f$----------equ.[vi]
$G=G_1^g, G_2^g$----------equ.[vii]
$H=H_1^h, H_2^h, H_3^h, H_4^h, H_5^h, H_6^h$----------equ.[viii]
$I=I_1^i, I_2^i, I_3^i$----------equ.[ix]
$J=J_1^j, J_2^j, J_3^j$----------equ.[x]
$Y= K [(A_1^a, A_2^a, A_3^a, A_4^a, A_5^a, A_6^a, A_7^a, A_8^a, A_9^a, A_{10}^a, A_{11}^a, A_{12}^a, A_{13}^a, A_{14}^a, A_{15}^a) X (B_1^b, B_2, {}^bB_3^b, B_4^b, B_5^b, B_6^b) X (C_1^c, C_2^c) X (D_1^d, D_2^d, D_3^d, D_4^d) X (E_1^e, E_2^e) X (F_1^f, F_2^f) X (G_1^g, G_2^g) X (H_1^h, H_2^h, H_3^h, H_4^h, H_5^h, H_6^h) X (I_1^i, I_2^i, I_3^i) X (J_1^j, J_2^j, J_3^j)] = 1$ ----------equ.[3]

4.1 Experimentation: Below table 3 indicates CNC Machine Parametric data. Such as CNC Turning Machine, CNC Milling Machine & Aristo Robot.

Table:2 CNC Turning/ Milling & Aristo Robot Operations [Dhande actual performing operation which noted here]

S.N.	Name of Machine	Specification	Tool	Operation
1	CNC Turning machine (two axis X-axis & Z-axis) with Industrial Controller [On -line software]	230 volt stabilizer with 2KVA supply.	SPCT	Facing
2			SPCT	Turning
3			SPCT	Step Turning
4			MPCT	Drilling
5			MPCT	Boaring
6			SPCT	Threading
7			MPCT	Nurling
8			SPCT	Chamfering
1	CNC Milling Machine (Three axis X-axis, Y-axis & Z-axis) with Industrial Controller[On-line software]	230 volt stabilizer with 3KVA supply, 7 bar compressor pressure. for ATC.	MPCT	Drilling
2			SPCT	Linear path
3			SPCT	Circular path
1	Six Axis Aristo Robot (Industrial Robot) [On-line software]	230 volt stabilizer with 2KVA supply, 7 bar compressor pressure. for jaw.	330 degree rotaion	Pick & Place
1	CNC Turning machine (two axis X-axis & Z-axis) with Industrial Controller [offline software]	With the help of hardware lock, change the material or dimensional numericals		
1	CNC Milling Machine (Three axis X-axis, Y-axis & Z-axis) with Industrial Controller[offline software]	With the help of hardware lock, change the material or dimensional numericals		
1	Six Axis Aristo Robot (Industrial Robot)[offline software]	licence reg. key used.		

4.2 Analysis: The aluminium or acrelic material used over the CNC Machine for the production of smooth job. This work done on table top CNC Machine. This is no production machine. But for the mild steel or any other hard material need of high specification machine. Depending upon type of production the different parameters will change.

4.3 Evaluation: Table 4 indicates machine body dimension of CNC Turninig, Milling Machine

Table:3 CNC Turning/ Milling & Aristo Robot Specification

CNC Turning		CNC Milling		Aristo Robot	
Capacity		Table Size	360mm*132mm	Number of Axes/ Hright	6/522mm
Swing over bed	dia.150mm	Travel X-axis	225mm	Joint Actuators	Servo Motor(With encoders)
Swing over crosslide	dia.50mm	Travel Y-axis	150mm	Transmission	Belt drives, Ball screws,Elbow&Gear drive
Distance between centers	210mm	Travel Z-axis	+115mm -115mm	Joints	Ball Bearing
Maximum Turning Diameter	dia.32mm	Spindle to table Distance	70mm to 185mm	Gripper	Angular JawsTypes (Detachable)
Maximum Turning lenght	120mm	Spindle column	110mm	Gripper Actuator	Pneumatic
Main Spindle		Spindle Nose Taper	ISO30	Motor(Waist, Shoulder,Elbow, Wrist,Pitch,Roll)(J1,J2,J3,J4,J5,J6)	340,45,45(Dependent on shoulder),340,180,340degrees
Spindle Power	1hp	ATC	6 Station	Control Software	Specially Developed Robot Programming Language
Spindle speed range	100-3000rpm	ATC- Maximum tool diameter	16mm	Path Type	Point to Point, Continuous Path, Linear and Circular
Spindle taper	MT3	ATC- Maximum tool height	40mm	Communication	Ethernet
Bore Through spindle	dia.20mm	ATC- Direction	Bi direction	Power Supply	230V/110AC,50/60Hz and 5A
Chuck size	dia.100mm	Programmable Spindle Speed	100-4000rpm	Pay Load(Including Gripper)	3Kg
Slides		**Programmable Feed Rate**		Repeatability	0.3mm
Z Stroke(Longitudinal travel)	140mm	X & Y axis	0-500mm/min	Horizontal Reach	654mm
X Stroke(Cross travel)	75mm	Z axis	0-500mm/min	Tip Speed	0.2m/sec
Rapid traverse rate -Z axis	1.2m/min	Repeatability	0.01mm	Position Feedback	Optical encoder(hp 2 phase 500rpm)
Rapid traverse rate -X axis	1.2m/min	Rapid Rate(X, Y& Z axis	1.2m/min	Operating Temprature	18 to 40 degree
Tail Stock		Axis Motor (Stepper Motor)	200Steps/rev.	Mounting Method	Floor
Quill diameter	dia.26mm	Machine Weight	170Kg	Controller	PC Based Ethernet Port
Quill stroke	40mm	Machine Dimension(L*W*H)MM.	1000*575*650	Application	Pick & Place Application Palletizing KIt, Stacking, Assembly,Testing with Banks
Quill taper	MT2			Weight (Body& Contro Box)	(35Kg & 35Kg)

Tailstock Base stroke	150mm				
Turret					
No. of stations	8				
Maximum boring bar dia.	dia.16mm				
Toll cross section	12*12mm				
Dimension					
Lenght	880mm				
Width	575mm				
Height	615mm				

5.1 FMS System Design:

5.1.1 Methodology: In this research work five major system are used here.
1] CNC Turning machine,
2] CNC Milling Machine,
3] Six Axis Aristo Robot (Pick & Place),
4] CNC online & off line software,
5] Robot online & off line software.

5.1.2 Parametric Model:
Capability parameter: Time management, Tool speed, Type of tool. Table 5 shows machine indications, Material, coolant, Power supply, oil.

Table:4 Capability parameter

S.N.	Parameters	Key's	Capacity	Unit
1	Capability Parameters	Time management	Depending upon shape	Min
2		Tool speed	100 TO3000	RPM
3		Type of tool,	SPCT,MPCT	
4		Material	Aluminium	100*100mm
5		coolant	milky type	
6		Power supply	230 volt	single phase.
7		Oil	30grade	
8		Compressor	7	bar

5.1.3 Tool Path: Continuous tool path used.

6. Sample Program: There are attending some program, which given bellow, with geometrical statements.

6.1 Threading Program:

```
M06 T0303
M03 S400
G00 X25 Z5
G76 P0300B0Q0.05R0.01
G76X23.14Z15Q0.05P0.919F1.5
```

6.1.1 Drilling Program:

M06T0404
M03S800
G00X0Z5
G74R1
G74X0Z-30Q0.3R0.5

6.1.2 Boring Program:

M06T0606
M03S1500
G00X012Z5
G71U0.25R1
G71P1Q2U01W01F100

6.1.3 Internal Threading:

M06T0808
M03S450
G00X29Z5
G76F0300b0Q0.05R0.01
G76X30.226Z-12Q0.05
G00X29Z5

7. Results & Conclusion:

Table 6 shows the practical jobs perform on CNC Turning Machine. Thereare four jobs are performing operation. **[**Dhande collect the Real result from lab as shown in below table 6, 7 & 8.]

Table: 5 CNC Turning Sample Result

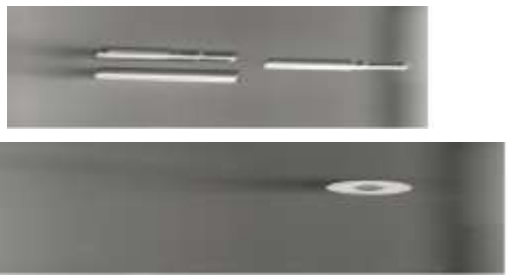
S. N.	Process	Sample
1	CNC Turning	
2		
3		
4		

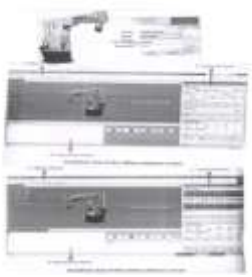
Table 7: shows the practical jobs perform on CNC Milling Machine. Thereare three jobs are performing operation .

Table:6 CNC Milling Sample Result

S. N.	Process	Sample
1	CNC Milling	
2		
3		

Table 8 shows the practical jobs per. form on aris to 6 axis robot pick & place operation. There are one jobs are performing operation .

Table:7 Pick & Place Robot Sample Result

S. N.	Process	Sample
1 2	Pick & Place Robot	
3		

It is observed that over the CNC Turning, Milling machine and Robotic system, the capacity of FMS module very high as comparing the non traditional processes. For the automobile sector there are thousands of nut bolts & other ancillary parts required for the assembling of system. Obiously automation needed. To justify the society urgency purposes such automation station essential for producing large quantitative quality jobs.

8. PIET Name Plate Program [Automated Programming Tool: The practically over the aluminium raw material, Milling Machine perform the operation. The program as given below.

```
G21 G94
G28 G91 Z0
G28 X0 Y0
M06 T1
M03 S1500

G00 G90 G54 X0Y0-----[G54- Work co-ordinate]
G00 G43 H1 Z5--[G43- Height of offset ]
G00 X0 Z0 Y-10
G01 Z-0.5 F50
G01 Y10

G02 X-24 Y5 R15
G02 X-35 Y0 R15
G00 Z5
G00 X-18 Y00
G01 Z0.5 F50
G01 X-2
G01 X-10.5
G01 Y-10
G01 X-18
G01 X-3
G00 Z5
G00 X10 Y10
G01 Z-0.5 F50
G01 X3
G01 Y-10
G01 X10
```

```
G00 Z5
G00 X3 Y10
G01 Z-0.5 F50
G01 X15

G00 Z5
G00 X24 Y10
G01 Z0.5 F50
G01 X35
G01 Y-10

G00 G90 Z15

G28 G91 Z0
G28 X0Y0
M05
M30
```

9. Future Scope: Is in future CNC Under Water Welding machine can effectively be used to make speedy welding. Skilled manpower can be used. Further, the scope is in non-traditional machining processes. There is the number of machines is the available need to used their CNC programming module.

Abbreviation:
CNC= Computer Numerical Control
FMS= Flexible Manufacturing System
AGV= Automated Guided Vehicle

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Author Contribution:
I have teaching, Research, & field-based work experience.

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