Turkish Online Journal of Qualitative Inquiry (TOJQI)
Volume 6, July 2021: 6244- 6255

Research Article

Prioritising the factors influencing productivity in an Aerospace manufacturing sector: An application of Analytical Hierarchical Process

Arabinda Swamy[a], Susanta Kumar Mishra[b]

[a]Research Scholar, Centurion University of Technology and Management, Odisha, India
[b]Professor, Centurion University of Technology and Management, Odisha, India

[b*]**Corresponding author:** susanta.mishra@cutm.ac.in

Abstract

Increase in Productivity is an important factor for any business as it leads to the betterment in the quality goods and services, which results in greater customer satisfaction and thus resulting in higher profitability for the firm. With the increase in productivity, organisation turn their resources into revenues, which increases the earnings of the shareholders and increases the cash flows, which fuels the future growth and expansion. Continuous improvement in productivity is a desirable function for every organisation and also a prime objective of any organisation. The aim of the paper is to identify the factors affecting the performance of the Indian aerospace manufacturing sector and to suggest suitable improvement techniques for increasing the productivity. At first various factors that affect the productivity are identified by the review of available literature in this field and from the opinions of experts from the Indian aerospace manufacturing sector. By utilizing the expert opinion, questionnaire was formed and same was used as input for AHP model. Considering the results of AHP technique, weights of different factors, the most important factors are identified by prioritizing and using ranking method. The most important factor was identified as Process (41.3%) followed by Human Resource factors (23.1%). The lean philosophy is best suited to control these factors and improve productivity. Accordingly, suitable method was identified for implementation so that to assure success in future.

Keywords: Productivity, critical success factors, AHP

1. Introduction

India become a key destination for aerospace major for its low production cost and govt's strong interest for building manufacturing sector under Make in India initiative.Govt. is slowly creating ecosystem of policies and regulations to help the defense industry. In last few years, it has created much significant interest for domestic and foreign players. Considering complex industry structure, procurement process, uncertainty in order booking timeline, industries need to infuse large capital. Defense majors like Europe's Airbus, Americas' Lockheed Martin, Germany's ThyssenKrupp Marine Systems have made offer to India. Similarly, local players like HAL, BEl, Tata Aerospace, Mahindra Aerospace, Taneja Aerospace, Adani Defense Aerospace, and Bharat Forge have tied up with many OEM's but the deals are to be finalised. The govt also created single window facility through industrial guidance bureau to clear all defense related manufacturing projects.

India's defense manufacturing sector foresee ample opportunities for export to South East Asian and Gulf Countries where slow economic growth put pressure on their defense budgets. Boeing has set up a production facility for their F/18 Super Hornet fighters as Indo-America defense ties is in upswing. Rayla group has gone with joint venture with Chennai based Rialto Enterprise to produce aerospace components. Indian software companies are in the level of global competencies. It is now to leverage and integrate. Defence Aerospace is 500BN USD industries and presently India has business of 10-12BN USD.

Due to geographical location, cheap labour rate, high competencies in software skills and friendly relation with developed nations, India is turning towards a major Aerospace hub. It follows ToT (Transfer of Technology) defense production ecosystem. India believes that ToT model can take us far and need more control on technology, production process, delivery timeline.

In spite of many favourable condition, Indian defense manufacturing sector is still lagging behind in the export market. The objective of this paper is to find out the factor that influence the productivity using AHP and suggest corrective action to overcome these difficulties.

2. Literature review:

Productivity is the measure of the efficiency in the production process. At national level, it captures the economic ability to harness its physical and human resource to generate output and income. The main theoretical approach to studying productivity is, where **Output = F^n (Inputs)** and growth in the efficiency with which inputs are transformed into outputs.

The following are some of the factors that affect industrial productivity

a. Technological Development in the Industry

b. Quality of Human resources Engaged

c. Availability of Finance for the project

d. Managerial talent required

e. Government policy for the Sector of business

f. Natural factors affecting the industry

Technological factors include degree of mechanisation, technical knowledge product design etc. and have influenced productivity in a great extent. In the age of rising industrial productivity, quality of man power plays an important role in enhancing productivity. Finance is always heart of any business. More the degree of mechanisation and complexity of product, finance requirement is more. Role of managerial talent has increased with complexity of product, supply chain and technology intensive. Government policy always have a great impact on the business and polices and taxation are directly linked productivity. Natural factors such as physical, climatically geographical always have impact on business and have considerable impact on productivity.

2.1 According to the views of Choudhury productivity improvement is required not only from the growth point of view but also for improving efficiency and it needs the right mix of labour, capital and industry associations.

Jain et al. says that for a business to attain competitive advantage in the market place manufacturing flexibility is a critical component. Various issues related with flexibility in manufacturing, dimensional requirement, measurement, relationship among various dimensions, implementation etc. contribute to the conceptual systemisation of the material.

Kottawata in his publication studied the attitudinal factors affecting a job performance, which includes absenteeism, Job satisfaction and organisational commitment. He opined that these factors affect productivity.

Liu & Li in their study focused on the growth factors contributing to the China's manufacturing industries and opined that the industrial strength in China is based mainly on two factors. These factors include input growth, and the improvement in technical progress

Murugesh in his study focused on the recent developments in managerial philosophies .He pointed that the modern Innovative techniques like Total Quality Management (TQM), Business Process Reengineering (BPR), Flexible manufacturing process (FMS), Computer integrated manufacturing (CIM) artificial intelligence (AI) enabled services have replaced the traditional productivity improvement techniques .

Aerospace manufacturer throughout the world facing an increasing demand from their respective customer at lowest possible price without compromising quality and safety. Due to economic slowdown in last ten-year, average age of skilled technicians are high and need skill manpower to bridge the gap generated by the demand created by the industry. The industry needs extensive digitisation, automation and knowledge on complex technological skill to gain competitive advantage.

Parthasarathi on his paper mentioned that Lean manufacturing provides a new management approach for many small and medium size manufacturers. Masimuddin Mohd Khaled in his publication in International of mechanical and Mechatronics Engineering mentioned that by focussing on the implementation of Six Sigma throughout the company, positive effect to the company can be made.

Paul J Mayor in his publication in International Journal of Advanced Manufacturing Technology mentioned that Productivity is never an accident. Rather Productivity is the final result of a production excellence, intelligent planning, and focused approach.

Identification of factors influencing productivity by experts from the Aerospace Manufacturing Domain:

The table below shows the various factors influencing productivity by five experts of aeronautic manufacturing domain out of which two are academician and three are from industry prom Nationalised PSUs and Private sectors. There are about 39 factors classified into five major groups which were listed below:

Table 1 Factors identified by experts.

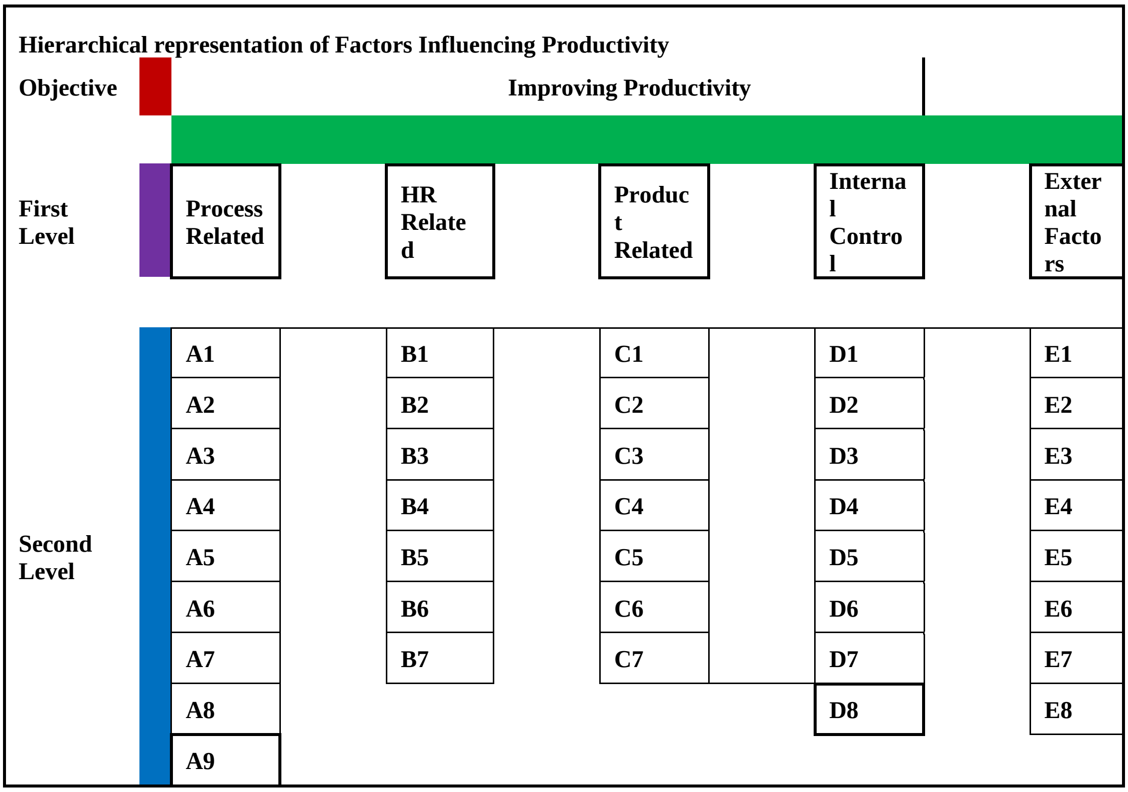
Factors Identified by Expert Domains

	Factor	Meaning	Sub Factor	
1	**Process Factor**	It comprises all process which affect the productionisation the product	**A1**	Cost of the Raw material
			A2	Availability Raw Material
			A3	Technology Support
			A4	Management Support
			A5	Quality Standard
			A6	Reliability
			A7	Lead time
			A8	Complex supply Chain
			A9	Maintenance Support
2	**Human Resource Factor**	It comprises all factors relating to attitude, managerial capability, professional practices of workers, supervisors and managers	**B1**	Training
			B2	Motivation
			B3	Labour Turnover
			B4	Labour Relation
			B5	Absenteeism & Lateness
			B6	Bonus
			B7	Wages
3	**Product Factor**	It comprises all factors that affect final product delivery.	**C1**	Cost
			C2	Flexibility
			C3	Quality of Product
			C4	Volume of Production
			C5	Regulatory Certification
			C6	Delivery Period
			C7	Customer Requirement
4	**Internal Control Factor**	It comprises all factor that can be controlled at plant level	**D1**	Infrastructure
			D2	Inventory
			D3	Rejection
			D4	Repair
			D5	Product Obsolence
			D6	Logistic Function
			D7	Re Sourcing of work
			D8	Flexible Operation
5	**External Factor**	It comprises all factors that is beyond control of the entrepreneur	**E1**	Supplier Location
			E2	Market demand
			E3	Govt procurement policy
			E4	Geo-Political relation
			E5	Long lead-time
			E6	Dependency on OEMs
			E7	Design Changes
			E8	Limited Suppliers Worldwide

4. Analytical hierarchical programming

4.1 Introduction: The **analytical hierarchy process** (**AHP**) is a multi-criteria decision making (MCDM) technique used for analysing complex decisions based on mathematics and psychology developed by T. Satty. AHP has been extensively used due to its practicality. AHP uses a multi-level hierarchical structure consisting of criteria, sub-criteria, and alternatives. paired comparisons technique is used to arrive at the desired solution. The paired comparisons are useful for assigning the weights to the important decision criteria. In cases where the comparisons are not consistent, in such cases AHP provides a method to improve the level of Consistency.

Fig.1.1. Hierarchical Representation of Factors influencing Productivity.



4.2. Methodology for Calculating the AHP

Step 1: At first the problem statement is segregated into goals, objectives, criteria, sub-criteria and other alternatives**.**

Step 2: At this stage Data is obtained based on the expert's opinion in the relative field following a method of paired comparison of alternatives in a quantitative scale. Experts are given the option to rate the comparisons as equal, marginally strong, strong, very strong, and extremely strong in a scale from 1 to 9. The final value of relative importance can be derived by taking geometrical mean of values obtained from each expert.

Step 3: The pair-wise comparison made by above step are put into a squared matrix form.

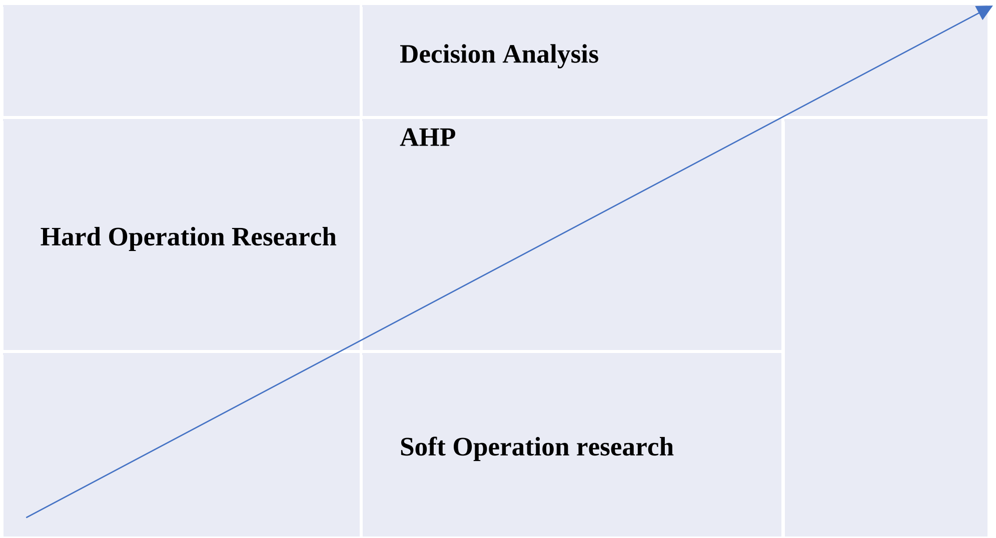
Step 4: The relative importance of the criteria's being compared can be arrived at by the use of Principal Eigen value and the corresponding normalised Eigen Vector of the comparison matrix.

Step 5: The formulae of CR=CI/RI is used to find out the consistency ratio (CR), where CI=Consistent Index and RI=Random Index

Step 6: Ratings thus obtained from each alternative decision is multiplied by the corresponding weights of the sub-criteria and aggregated to get local ratings with respect to each criterion.

For the purpose of evaluation AHP calculator by AHP-OS BPMSG is used.

Position of AHP in Scientific debate



Scales used: The table will show all criteria with calculated weights and ranks

Table-2 The Fundamental Scale for Pairwise Comparisons

Intensity of Importance	Definition	Explanation
1	Equal importance	Both the elements. ***a*** and ***b*** contribute equally to the objective
3	Moderate or weak importance of one over another	Experience and judgment slightly favour element ***a*** over ***b***
5	Essential or strong importance	Experience and judgment strongly favour element ***a*** over ***b***
7	Demonstrated importance	Element ***a*** is favoured very strongly over ***b***; its dominance is demonstrated in practice
9	Absolute importance	The evidence favouring element over ***a*** over ***b*** is of the highest possible order of affirmation
2, 4, 6, 8	Intermediate values between the two adjacent judgments	When compromise is needed. For example, 4 can be used for the intermediate value between 3 and 5
Reciprocals of above nonzero	If ***a*** has one of the above numbers assigned to it when compared with ***b***. Then ***b*** has the reciprocal value when compared with ***a***.	
rationales	Ratios arising from the scale	If consistency were to be forced by obtaining n numerical values to span the matrix.

Consistency:

CR (Consistent Ratio) is calculated for all inputs.

The consistency ratio is calculated **as CR=CI/RI**

The value of RI taken from random consistency table as below

N=1	2	3	4	5	6	7	8	9	10
RI=0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.40

In order to give positive result, the consistency ratio (CR) should be less than 10% in the pair-wise comparisons in a judgment matrix. However, if the CR value is greater than 10%, then the problem should be studied further and the paired comparisons should be revaluated.

5. Case Study on Quantification of factors affecting productivity in Aerospace Manufacturing industry

5.1 Designing of the Questionnaire: While designing the Questionnaire for AHP input, the important factors identified by the experts are included.

Part A: Compare the relative preference with respect to: main criteria < goal using the following **Saaty scale 1 to 9 where (1= equally important, 2= equally to moderately, 3= moderately preferred, 4= moderately to strongly, 5= strongly preferred, 6= strongly to very strongly, 7= very strongly preferred, 8= very strongly to extremely, 9= extremely preferred)**

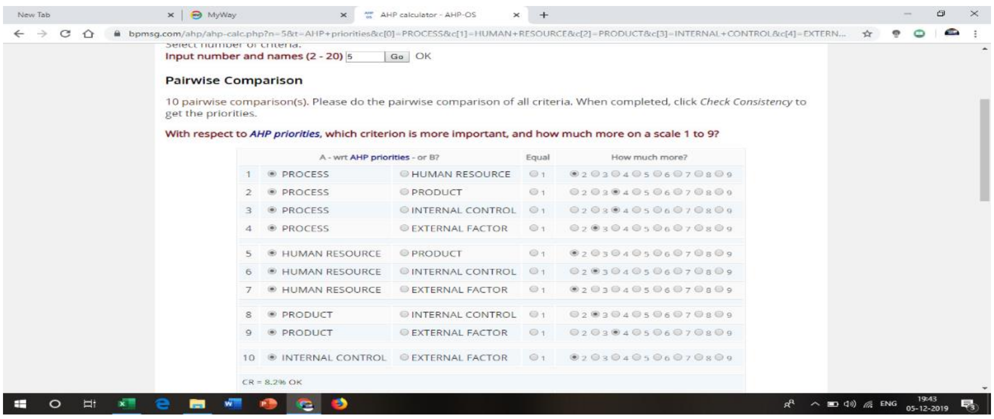
Part-B - AHP Questionnaire:

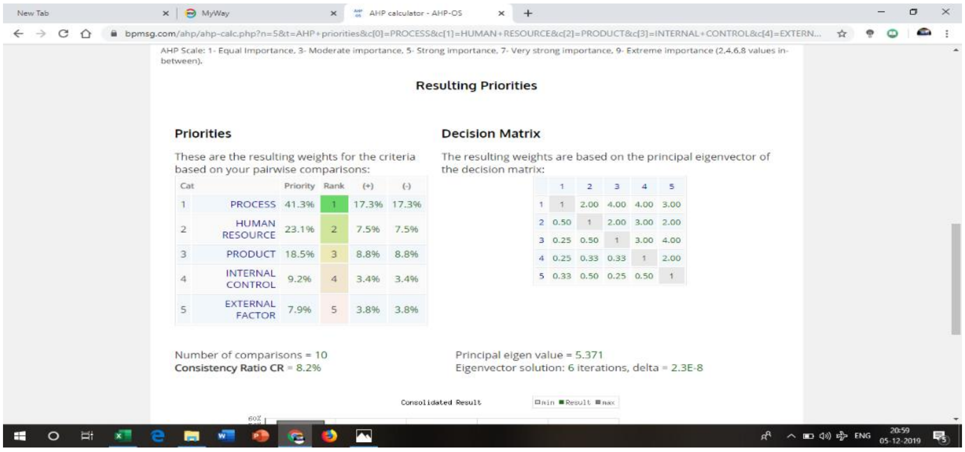
The consolidated result for each factor of the questionnaire is displayed in the following matrices by the use of weights and ranking by taking geometric mean of individual preference comparison. Suppose the values of preference by comparing of Criteria "Process "with "HR" the values given by experts are (Process is more important than HR): 2,3,4,5,2. Then value obtained for preference is i.e**.**

$(\mathbf{r_1 . r_2 . r_3 . r_4 . r_5})^{1/5}$ = $(2x3x4x5x2)^{1/5}$ i.e. $(.240)^{1/5}$ = 3 (nearly). So, in relative performance measurement Process will be 2 more than HR. Similarly, the pair-wise comparisons among other criteria's will be calculated basing on the opinions of experts and calculation thereafter.

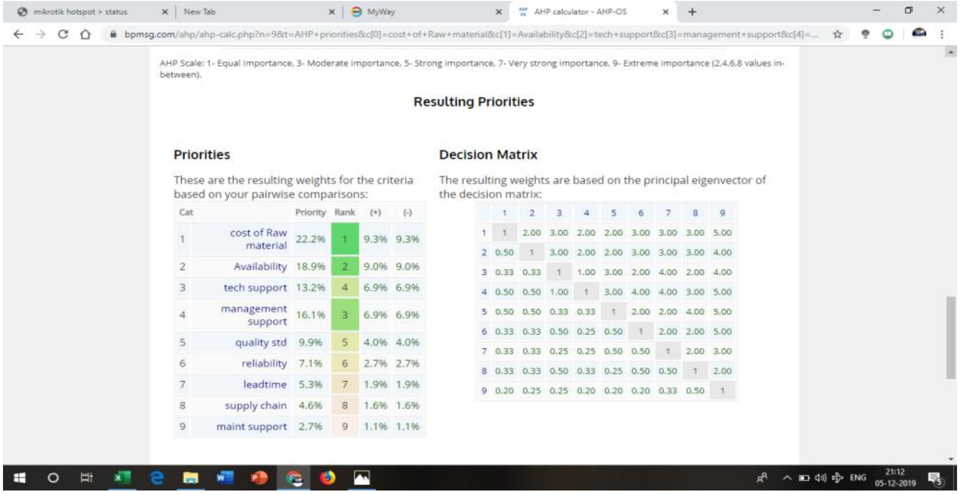
5.2 Result:

5.2.1 Part A: For Goal (Main factors are considered)





5.2.2 Part B: Sub-factors in the Process factor (Priority Matrix for Process)



AHP Scale: 1- Equal Importance, 3- Moderate importance, 5- Strong importance, 7- Very strong importance, 9- Extreme importance (2,4,6,8 values in-between).

Resulting Priorities

Priorities

These are the resulting weights for the criteria based on your pairwise comparisons:

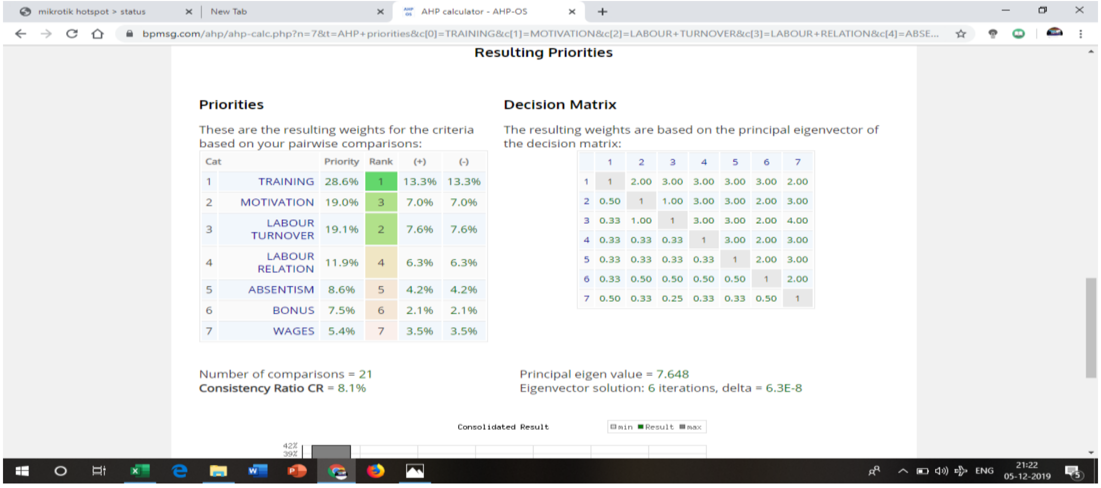
Cat		Priority	Rank	(+)	(-)
1	cost of Raw material	22.2%	1	9.3%	9.3%
2	Availability	18.9%	2	9.0%	9.0%
3	tech support	13.2%	4	6.9%	6.9%
4	management support	16.1%	3	6.9%	6.9%
5	quality std	9.9%	5	4.0%	4.0%
6	reliability	7.1%	6	2.7%	2.7%
7	leadtime	5.3%	7	1.9%	1.9%
8	supply chain	4.6%	8	1.6%	1.6%
9	maint support	2.7%	9	1.1%	1.1%

Decision Matrix

The resulting weights are based on the principal eigenvector of the decision matrix:

	1	2	3	4	5	6	7	8	9
1	1	2.00	3.00	2.00	2.00	3.00	3.00	3.00	5.00
2	0.50	1	3.00	2.00	2.00	3.00	3.00	3.00	4.00
3	0.33	0.33	1	1.00	3.00	2.00	4.00	2.00	4.00
4	0.50	0.50	1.00	1	3.00	4.00	4.00	3.00	5.00
5	0.50	0.50	0.33	0.33	1	2.00	2.00	4.00	5.00
6	0.33	0.33	0.50	0.25	0.50	1	2.00	2.00	5.00
7	0.33	0.33	0.25	0.25	0.50	0.50	1	2.00	3.00
8	0.33	0.33	0.50	0.33	0.25	0.50	0.50	1	2.00
9	0.20	0.25	0.25	0.20	0.20	0.20	0.33	0.50	1

5.2.3 Part C: Sub-factors OF Human Resource Factor (Priority Matrix for Human Resource)



Resulting Priorities

Priorities

These are the resulting weights for the criteria based on your pairwise comparisons:

Cat		Priority	Rank	(+)	(-)
1	TRAINING	28.6%	1	13.3%	13.3%
2	MOTIVATION	19.0%	3	7.0%	7.0%
3	LABOUR TURNOVER	19.1%	2	7.6%	7.6%
4	LABOUR RELATION	11.9%	4	6.3%	6.3%
5	ABSENTISM	8.6%	5	4.2%	4.2%
6	BONUS	7.5%	6	2.1%	2.1%
7	WAGES	5.4%	7	3.5%	3.5%

Decision Matrix

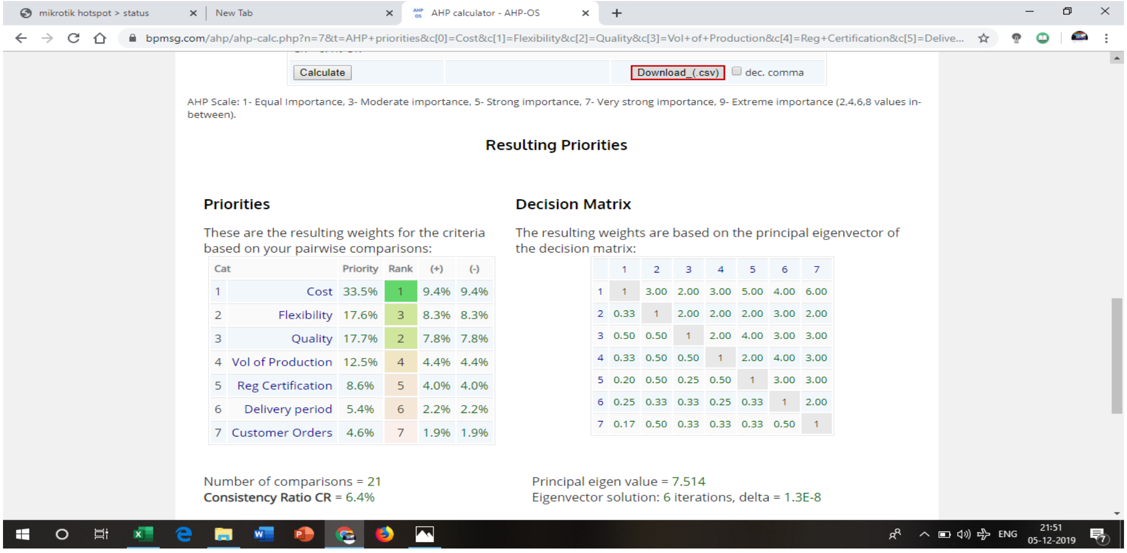
The resulting weights are based on the principal eigenvector of the decision matrix:

	1	2	3	4	5	6	7
1	1	2.00	3.00	3.00	3.00	3.00	2.00
2	0.50	1	1.00	3.00	3.00	2.00	3.00
3	0.33	1.00	1	3.00	3.00	2.00	4.00
4	0.33	0.33	0.33	1	3.00	2.00	3.00
5	0.33	0.33	0.33	0.33	1	2.00	3.00
6	0.33	0.50	0.50	0.50	0.50	1	2.00
7	0.50	0.33	0.25	0.33	0.33	0.50	1

Number of comparisons = 21
Consistency Ratio CR = 8.1%

Principal eigen value = 7.648
Eigenvector solution: 6 iterations, delta = 6.3E-8

5.2.4 Part D: Sub-Factors OF Product factor (Priority Matrix for Products)



AHP Scale: 1- Equal Importance, 3- Moderate importance, 5- Strong importance, 7- Very strong importance, 9- Extreme importance (2,4,6,8 values in-between).

Resulting Priorities

Priorities

These are the resulting weights for the criteria based on your pairwise comparisons:

Cat		Priority	Rank	(+)	(-)
1	Cost	33.5%	1	9.4%	9.4%
2	Flexibility	17.6%	3	8.3%	8.3%
3	Quality	17.7%	2	7.8%	7.8%
4	Vol of Production	12.5%	4	4.4%	4.4%
5	Reg Certification	8.6%	5	4.0%	4.0%
6	Delivery period	5.4%	6	2.2%	2.2%
7	Customer Orders	4.6%	7	1.9%	1.9%

Decision Matrix

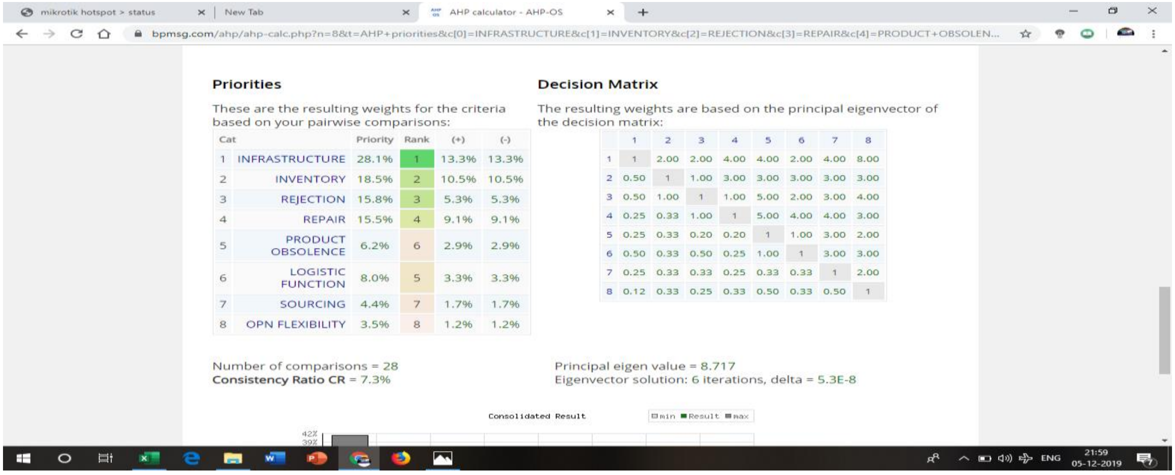
The resulting weights are based on the principal eigenvector of the decision matrix:

	1	2	3	4	5	6	7
1	1	3.00	2.00	3.00	5.00	4.00	6.00
2	0.33	1	2.00	2.00	2.00	3.00	2.00
3	0.50	0.50	1	2.00	4.00	3.00	3.00
4	0.33	0.50	0.50	1	2.00	4.00	3.00
5	0.20	0.50	0.25	0.50	1	3.00	3.00
6	0.25	0.33	0.33	0.25	0.33	1	2.00
7	0.17	0.50	0.33	0.33	0.33	0.50	1

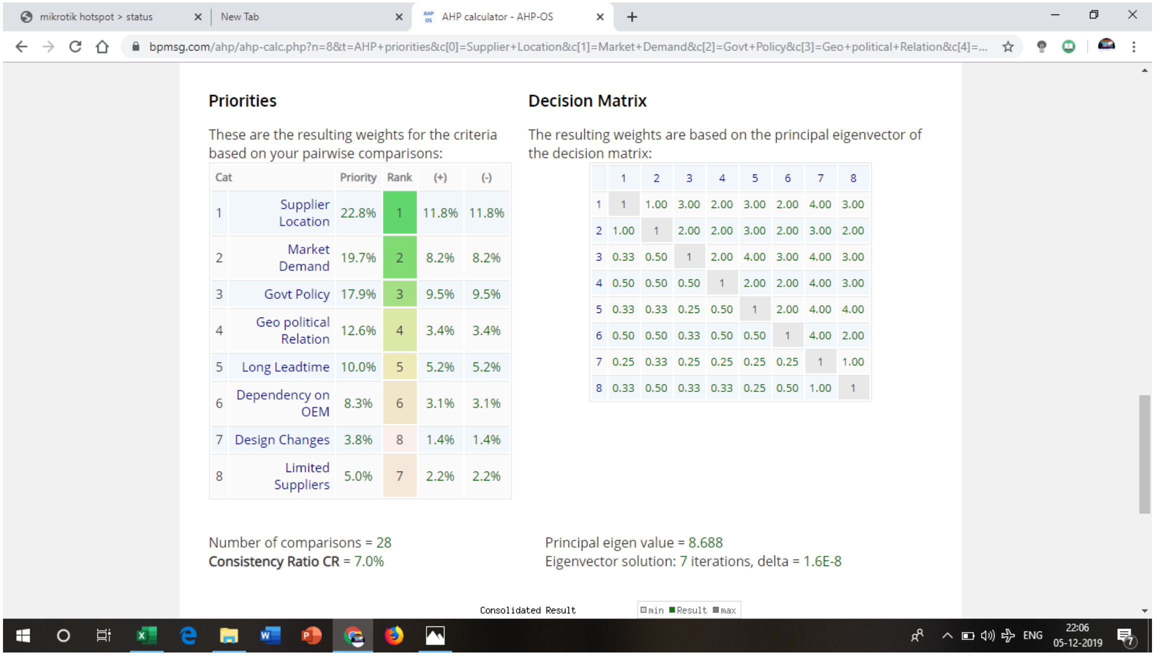
Number of comparisons = 21
Consistency Ratio CR = 6.4%

Principal eigen value = 7.514
Eigenvector solution: 6 iterations, delta = 1.3E-8

5.2.5 Part E: Sub-Factors in Control factor (Priority Matrix for Internal Controls)



5.2.6 Part F: Sub-factors within the External Factor (Priority Matrix for External Factors)

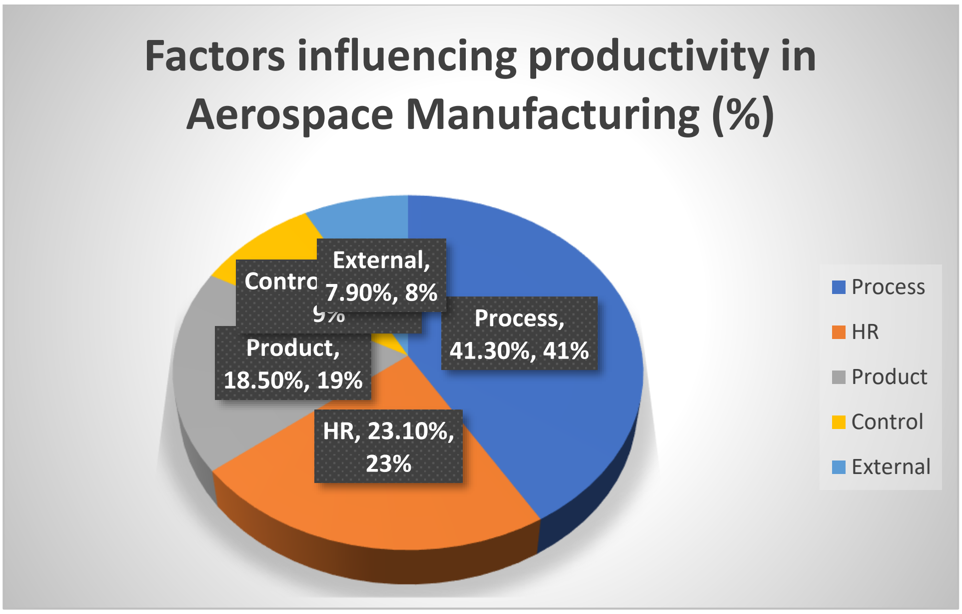


5.3 Quantification of the factors: Weights (global and local) of different factors

Sl No	Name of the Factor/Sub Factor		Local Weight	Global Weight
A	**PROCESS**		0.413	**0.413**
	A1	Cost of the Raw material	0.222	0.091686
	A2	Availability Raw Material	0.189	0.078057
	A3	Technology Support	0.132	0.054516
	A4	Management Support	0.161	0.066493
	A5	Quality Standard	0.099	0.040887
	A6	Reliability	0.0071	0.0029323
	A7	Lead time	0.0053	0.0021889
	A8	Complex supply Chain	0.0046	0.0018998
	A9	Maintenance Support	0.0027	0.0011151
B	**HUMAN RESOURCE**		0.231	**0.231**
	B1	Training	0.286	0.066066
	B2	Motivation	0.19	0.04389

	B3	Labour Turnover	0.191	0.044121
	B4	Labour Relation	0.119	0.027489
	B5	Absenteeism & Lateness	0.086	0.019866
	B6	Bonus	0.075	0.017325
	B7	Wages	0.054	0.012474
C	**PRODUCT FACTOR**		0.185	**0.185**
	C1	Cost	0.335	0.061975
	C2	Flexibility	0.176	0.03256
	C3	Quality of Product	0.177	0.032745
	C4	Volume of Production	0.125	0.023125
	C5	Regulatory Certification	0.086	0.01591
	C6	Delivery Period	0.054	0.00999
	C7	Customer Requirement	0.046	0.00851
D	**INTERNAL CONTROL**		0.092	**0.092**
	D1	Infrastructure	0.281	0.008464
	D2	Inventory	0.185	0.025852
	D3	Rejection	0.158	0.01702
	D4	Repair	0.155	0.014536
	D5	Product Obsolesce	0.062	0.01426
	D6	Logistic Function	0.08	0.005704
	D7	Re Sourcing of work	0.044	0.00736
	D8	Flexible Operation	0.034	0.004048
E	**EXTERNAL FACTOR**		0.079	**0.079**
	E1	Supplier Location	0.228	0.018012
	E2	Market demand	0.197	0.015563
	E3	Govt procurement policy	0.179	0.014141
	E4	Geo-Political relation	0.126	0.009954
	E5	Long lead-time	0.1	0.0079
	E6	Dependency on OEMs	0.083	0.006557
	E7	Design Changes	0.038	0.003002
	E8	Limited Suppliers Worldwide	0.05	0.00395

Table 5: Percentage of factors affecting Productivity



6. Improvement of Productivity in Aerospace Manufacturing through LEAN practice:

In the aerospace manufacturing industry, the suppliers manufacture the hardware, which include aircraft, component, spare and service support software in the areas of design, logistics, service etc. to their customers spread across the globe. Here customer satisfaction is of prime importance to maintain long-tern relationship. These activities can be categorised as follows:

1) Product Delivery: It includes controlling the production programme through proper design, tooling, engineering of detail parts to assembly stage. Planning the detail production schedule and to deliver the products as per the schedule.
2) Product Quality: As quality of the product plays very important role in this sector, hence no compromise in the quality of parts, components or assemblies produced is accepted. A proper production system ensuring consistent high quality is required to manufacture the products within the required specification of customers.
3) Product Cost: Here the objective is to build the products in a competitive cost environment and to ensure a competitive profit for enterprise.
4) Product Flexibility: As there is constant fluctuation in the market due to change in technology and production lines are dynamic, hence a flexibility in design as well as in manufacturing is highly desired.

5) Concept of Lean application in production process of Aerospace industry especially for aerospace manufacturing suppliers, plays a significant role in reducing cost and to increase competitiveness. Lean production aims at continuous improvement. It is a long-range planning which combine the link of PDCA(Plan-Do-Check-Action) cycle.

(P) A. Plan Aspect :(Process Improvement for Productivity in Lean)

1. Top management mind-set plays a significant role in implementation of Lean practices in any industry.
2. Leader- Lead -Lean (3L) is the recent concepts used in lean improvement. Since various levels of management is involved in resources allocation, authorization, information sharing, and judgment, practicing lean in the industry can be quicker and more result oriented.
3.Seven types of wastes include overproduction, defects, transportation, waiting, inventory, motion, and processing.

(D) Do Aspects:

1. The machining of parts and fabrication line should follow the process sequence to construct the stream flow line Operation as per the customer requirement.
2. Standardization: The suppliers in the aerospace manufacturing industry must consider and use the new ideas to apply standardisation and to take the advantage of the improved results. The key issues to be considered for standardization in the of operation are: (a) Use of the proper combination of 4M, which include man, machine, material, and method in order to bring quality in the products and processes (b)

Process capacity (c) Standard work combination table (d) Visual aid and work instruction to bring efficiency and ease for the operator manufacturing complicated parts.

(C) Check Aspects:

Aligning the IT system: By aligning the IT system, the key issues like: production control information, Key Performance Indicators (KPI), Scheduling parameters updation, shop floor control information and visibility can be improved.

(A) Action Aspects:

System Transformation: For this purpose, the organizational and functional group integration is required to reduce the interface and barrier.

Human Resource Improvement in Lean: Human resource is an important resource in any industry and play a major role in improving productivity. For lean implementation, two main activities in any organisation are 5S throughout the organisational process and personnel training for further improvement.

5S Implementation: The main objective of 5S implementation is to strengthen the employee discipline and to bring improvement in the enterprise culture through organizational awareness and involvement in improvement process. The goal of 5 S is to create a work environment that is clean and well organized. The elements are (i) Sort, i.e., to eliminate anything that is not required (ii) Set, i.e., to Set the items in Order (iii) Shine, i.e., to Inspect & clean work area (iv) Standardize, i.e., to create standards, and (v) Sustain, i.e., to maintain continuously.

Personnel Training: The objective of Personnel training is to improve productivity and accountability among the employees like multi-Skilled operator, Self-Inspection, On the Job Training and Self Maintenance.

Total Productive Maintenance (TPM): In this process the operator gets involved in maintaining his own machine/equipment and takes preventive measures leading to fewer breakdown, defects or stops. It cares a shared responsibility for the equipment that creates greater involvement at floor level workers.

Methods: Various methods and techniques are used in lean implementation. Some of these are (i)Elimination of wastes (ii) Kaizen (iii) Respect for Human elements (iv) Just in Time(vi) One Piece Flow (vii) Mistake proofing, and (ix) Detecting defects through automation.

Process Mapping: This tool identifies the area within the organisation where improvement is needed. Further it creates the sequence to be followed in the process thus making it easier to get an overview of the process to be studied.

7. Conclusion:

From the above analysis, it is clear that the factor manufacturing process of aerospace sector contributes 41.3% in improving the productivity followed by Human resource 23.1% and type of product 18.5% and internal control 9.2% respectively. These factors are presented in Pie chart for better understanding. Skilled and trained manpower also play a significant role in aero sector for improving productivity. All these factors are from different departments of the industry and needs to be controlled to improve productivity.

The lean concept emphasized here can apply to improve productivity in various process of aerospace industry and also in the total business processes. In order to maintain competitiveness, the aerospace manufacturing firms, need to keep a check on the production cost. Lean application in the production process should be a continuous one and not a one-time solution. The goal of Lean applications is to strengthen the management performance of an enterprise, which needs the commitment and involvement from the top management, in order to make sure that the internal resources are aligned and focused.

References

[1] “Productivity and capital investments: An empirical study of three manufacturing Industries in India” IIMB Management Review Volume 22, Issue 3, September 2010, Pages 62: Chaudhary et al. (2010)

[2] “The influence of Flexible Manufacturing Technology adoption on productivity of Malaysian manufacturing industry” Economic Modelling Volume 27, Issue 1, January 2010, Pages 395–403: Dolage et al. (2010)

[3] “A review on manufacturing flexibility” International Journal of Production Research Volume 51, Issue 19, 2013 pages 5946-5970 :Jain et al. (2013

[4] "Impact of Attitudinal factors on job performance of executive and non-executive employees in Apparel industry in Sri-lanka" Sri-Lankan journal of human resource management Vol 1, No 1: Kottawata (2007)

[5] "Analysing China's productivity growth: Evidence from manufacturing industries" Economic Systems Volume 36, Issue 4, December 2012, Pages 531–551: Liu and Li (2012)

[6] "Review and preview of productivity research and applications" Production Planning & Control: The Management of Operations Volume 8, Issue 4, 1997 pages 310-320: Murugesh et al. (2010)

[7] AHP calculator –AHP-BPMSG