

KUMADUHAL's Hierarchy of Productivity Factors' Perspectives

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Evaluation of factors important to enhance productivity

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Evaluation of factors important to enhance productivity

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Abstract: Productivity as a measure for output is important to industry and academia. In this research, factors to enhance productivity have been identified from the literature by reviewing various international and national sources to explore this evergreen field of research that is “productivity,” which has always been an increasingly interesting area of research for researchers over decades or perhaps over centuries. In total, 15 number of factors have been identified to enhance productivity. Analytic hierarchy process approach has been appropriately chosen to rank these factors because of its simplicity and effectiveness. The tool has been used by taking perception of experts from the Indian manufacturing industry. Positive attitude and involvement of management, proactive employees, and good working conditions have been ranked as top three factors as per the experts’ opinion. The ranking of factors to enhance productivity, categorization of the factors into four perspectives, and hierarchy of perspective and action plan as a final outcome of the paper may help academia and operations managers toward effective management of “operations and production activities of firms/supply chains.”

Subjects: Economics; Finance; Business & Industry; Engineering & Technology; Environmental Studies & Management

Keywords: analytic hierarchy process (AHP); factors to enhance productivity; hierarchy of perspectives; manufacturing sector of India; productivity action plan; productivity perspectives; ranking of factors



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Sanjay has completed his research under the supervision of Abid Haleem in the area of Supply Chain. Presently, he is the principal of IITM Murthal, Haryana, India. His pursuit for research is visible by his joint publication of more than 55 papers with Abid Haleem in the last 10 years, using methodologies like systems modeling and empirical research in different areas of industrial engineering.

Manish is a bright student who has contributed in getting the literature, survey, and other support activities.

Haleem, is with Jamia Millia Islamia, a central University of Indian Government, has headed Mechanical and Management departments. He has supervised more than 18 researchers and more than 170 publications to his credit in core and upcoming areas of industrial engineering, technology management, and operations research.

This paper is a result of more than a year’s hard work of the three authors, who have also taken extensive support from learned experts.

PUBLIC INTEREST STATEMENT

Improving productivity is important to most of the stakeholders of the organization. This paper tries to address issues where organizations can learn to improve productivity. They can learn through this paper what are the important factors helping in improving productivity.

Analytic hierarchy process approach has been appropriately chosen to rank these factors. Here, perception of experts from the Indian manufacturing industry has been taken. Positive attitude and involvement of management, proactive employees, and good working conditions have been ranked as top three factors as per the experts’ opinion. This paper may help academia and operations managers toward effective management of operations and production activities of organizations/supply chains.

1. Introduction

The wealth of nations and our living standards is being determined by productivity development (Brynjolfsson & Hitt, 1998). It has been found that the development of productivity has a positive impact on poverty reduction and it has been done by two ways. First, salaries and earnings have been increased by increasing the productivity which results in poverty reduction and second, the rate of increase in prices has been controlled by productivity profits (Bernard & Jensen, 2004). Further, increase in profits and sales has been observed with increase in productivity (Zoltners & Lorimer, 2000). An organization gets high profit margin when the input cost is lower and the lower input cost obtained when the productivity is high. Customer has the central role to play and customer requirements need to be determined by a team made by the high productive firms (Blackburn, Scudder, & Van Wassenhove, 1996). To achieve financial and other objectives, for example, brand image; vendor integration; goodwill; and customer satisfaction, the management of operations is very important (Kumar, Luthra, Haleem, & Garg, 2014).

2. Defining productivity

Productivity has been defined in numerous ways; we have attempted in this section to compile a few of the available information from different websites as presented in Table 1 (with important key words highlighted in “bold font”).

It may be summarized from important key words, definitions, and concepts provided in Table 1 that: productivity is a ratio/measure/efficiency to evaluate outputs in terms of “extent of value addition”/“performance”/“economic gain” with respect to inputs in terms of resources pertaining to individual/sub-system/system/factory/firm/supply chain/sector/country/continent.

Table 1. Productivity concept and definitions from various websites

Concept	Computation/Implications	References
Average measure of efficiency of production	Ratio of output and inputs used in the production process	Retrieved February 12, 2015, from http://en.wikipedia.org/wiki/Productivity
Measure of efficiency of person, machine, factory, and/or system in converting inputs into useful outputs; Productivity may be a key determinant of cost efficiency	Productivity may be evaluated by dividing average output per period by the total costs incurred	Retrieved February 12, 2015, from http://www.businessdictionary.com/definition/productivity.html
Economic measure of output per unit of input; Inputs include labor and capital, there as output may be measured in revenues and other GDP components	Productivity measures may be examined collectively (across whole economy) or evaluated industry by industry to examine trends in wage levels, labor growth, and improvements in technologies	Retrieved February 12, 2015, from http://www.investopedia.com/terms/p/productivity.asp
Productivity is the effective use of innovation and resources to increase the value-added content of products/services	Productivity is the true source of competitive advantage that creates long-term economic viability and a better standard of living	Retrieved February 12, 2015, from http://www.hkpc.org/index.php?option=com_content&view=article&id=106&Itemid=270&lang=en
Productivity is often utilized at workplace; It may be described as performance of individual worker/department/industry	It can be evaluated in percentage; Sometimes, productivity is used in relation to farming	Retrieved February 12, 2015, from http://www.vocabulary.com/dictionary/productivity
Productivity is ratio of outputs and inputs	It may be referred to output volume from given inputs volume; If organization becomes more productive, then it may be implied as that organization is known more efficient	Retrieved February 12, 2015, from http://www.dineshbakshi.com/as-a-level-business-studies/operations-management/104-revision-notes/1409-meaning-of-productivity
Rate at which products/services are offered / produced	It can be referred as goal accomplishment measure	Retrieved February 12, 2015, from http://www.merriam-webster.com/dictionary/productivity

3. Identification of factors to enhance productivity

Fifteen factors have been identified after review of appropriate literature. Review of literature was carried out by searching keywords such as: factors to enhance productivity, productivity enablers, critical success factors of productivity, factors responsible for productivity increase, etc. Search was accomplished utilizing various primary and secondary sources. Information and communication technology played a very important role toward exploring the factors for enhancing productivity. The factors and frequency of occurrence in the literature as outcomes of this information exploring activity have been tabulated in Table 2.

4. Analytic hierarchy process (AHP) methodology application

Professor A.L. Saaty (the American operations researcher) introduced the AHP in 1970. Using this method, firstly, the complex problems decompose into some factors and then make a simple

Table 2. Identification of factors to enhance productivity from literature

S. No.	Factors to enhance Productivity	References
1.	Proactive employees	Campbell (2000), Cooper and Cartwright (1994), Erdogan and Bauer (2005), Burton, Conti, Chen, Schultz, and Edington (1999)
2.	Accountability	Tausky and Chelte (1983), Mamiseishvili and Rosser (2011), Cohen et al. (2012)
3.	Follow-up	Eriksson and Lindroos (2014), De Putter et al. (2012)
4.	Manage the work force but avoid micromanagement	Martin (2005), Head (2007), Wright (2000), Broedling et al. (1980), White (2010)
5.	Encourage, motivate, reward, and recognize	Bartol and Srivastava (2002), Fairbank and Williams (2001), Manzoor (2012), Chang and Mills (2013), Karia and Hasmi Abu Hassan Asaari (2006), Dike (2005)
6.	Reach out to employees by seeking them out	Eccles, Perkins, and Serafeim (2012), Gill, Koettl, and Packard (2013),
7.	Demand realistic targets	Kirk (1990), Caballero, Gómez, and Ruiz (2009), Donnellan and Hennessy (2007)
8.	Team work	Wheelan, Burchill, and Tilin (2003), Gallie, Zhou, Felstead, and Green (2012), O'leary, Mortensen, and Woolley (2011), Bartel, Beaulieu, Phibbs, and Stone (2014), Tohidi (2011)
9.	Break the monotony and rotate	Kumar, Kumar, and Haleem (2014), Kumar, Luthra, Haleem, Garg and Singh (2014), Diego-Mas, Asensio-Cuesta, Sanchez-Romero, and Artacho-Ramirez (2009), Synwoldt and Gellerstedt (2003), Nichols, Rosenberg, Majoni, and Mukanjari (2014)
10.	Courses and improvement options	De Grip and Sauermann (2013)
11.	Tools and equipment to raise productivity	Kumar, Kumar, Haleem, and Gahlot (2013), Cusumano (1988), Malmir, Khalili, and Damirchi (2012), Colak, Cetin, Yilmaz, Yildiz, and Korkmaz (2013)
12.	Availability of water, power, and other input supplies	Allcott, Collard-Wexler, and O'Connell (2014), Tersoo (2014)
13.	Positive attitude and involvement of management	Carmeli (2003), Karia and Hasmi Abu Hassan Asaari (2006), Alfes, Shantz, Truss, and Soane (2013), Holden (2011), Vail et al. (2012), Kumar, Luthra, Garg, and Haleem (2014)
14.	Encouragement to effective communication	Kupperschmidt (2000), Leblebici (2012), Ruck and Welch (2012), Daim et al. (2012), Aral, Brynjolfsson, and Van Alstyne (2012), Kumar, Singh, and Haleem (2014)
15.	Good working conditions	Luthra, Kumar, Kharb, Ansari, and Shimmi (2014), Locke and Romis (2012), Ali, Ali, and Adan (2013), Jaskiewicz and Tulenko (2012), Sandeep, Sanjay, Pardeep, and Abid (2013)

comparison and calculation between factors; accordingly, they can obtain the target weight of various programs. Best programs can be chosen by these target weights and this method also maintains consistency (Liqian & Jianming, 2012). For giving rankings, it is one of the most commonly used analytical methods. AHP has been extensively used in integrated manufacturing, in the layout design, evaluation of technology investment decisions, and related work. Following steps are included in AHP (Kumar, Luthra, & Haleem, 2015; Kumar, Luthra, Haleem, Mangla, & Garg, 2015; Kumar, Parashar, & Haleem, 2009; Saaty, 2000, 2008; Swaminathan & Anand, 2014):

Step 1: Pairwise comparisons made between decision alternatives and nine-point scales are used as criteria.

Step 2: A set of pairwise matrix are constructed and each element in the upper level compares with the elements of lower level.

Step 3: To ensure that the priority of elements is consistent, the maximum eigen values and the maximum eigen vectors are calculated.

4.1. Application of AHP for ranking of factors to enhance productivity

AHP methodology has been appropriately utilized to evaluate ranking of factors enhancing productivity in manufacturing firms and service organizations. Five experts from industry and academia were asked to reach to a consensus about rating of factors (as tabulated in Table 3). Two out of the five experts were senior professors researching the area of operations management for more than a decade. Other three experts were from manufacturing industry (one expert was holding top management position having a total experience of more than 30 years; and other two experts from industry were holding managerial positions with experience in a range of 8–15 years).

It may be further noticed that consistency ratio has been found acceptable (below 0.1). Resulting priority matrix and rank of various factors enhancing productivity have been presented in Table 4.

Table 3. Rating of factors assigned by experts

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1	3.00	2.00	4.00	2.00	3.00	4.00	1.00	5.00	2.00	1.00	1.00	0.50	2.00	1.00
2	0.33	1	1.00	2.00	1.00	2.00	1.00	1.00	4.00	2.00	0.50	0.50	0.33	0.50	0.33
3	0.50	1.00	1	0.50	1.00	3.00	1.00	1.00	3.00	0.50	0.33	0.33	0.20	1.00	1.00
4	0.25	0.50	2.00	1	0.33	1.00	0.50	0.50	2.00	1.00	0.33	0.50	0.20	1.00	0.25
5	0.50	1.00	1.00	3.00	1	3.00	1.00	1.00	1.00	1.00	0.50	0.50	0.33	0.50	0.50
6	0.33	0.50	0.33	1.00	0.33	1	0.33	0.33	0.50	0.33	0.25	0.25	0.17	0.33	0.20
7	0.25	1.00	1.00	2.00	1.00	3.00	1	1.00	2.00	0.33	0.33	0.33	0.25	0.33	0.50
8	1.00	1.00	1.00	2.00	1.00	3.00	1.00	1	2.00	1.00	1.00	1.00	0.50	1.00	1.00
9	0.20	0.25	0.33	0.50	1.00	2.00	0.50	0.50	1	0.33	0.25	0.25	0.20	0.25	0.20
10	0.50	0.50	2.00	1.00	1.00	3.00	3.00	1.00	3.00	1	0.50	0.50	0.33	0.50	0.50
11	1.00	2.00	3.00	3.00	2.00	4.00	3.00	1.00	4.00	2.00	1	1.00	0.50	1.00	1.00
12	1.00	2.00	3.00	2.00	2.00	4.00	3.00	1.00	4.00	2.00	1.00	1	0.50	1.00	1.00
13	2.00	3.00	5.00	5.00	3.00	6.00	4.00	2.00	5.00	3.00	2.00	2.00	1	4.00	2.00
14	0.50	2.00	1.00	1.00	2.00	3.00	3.00	1.00	4.00	2.00	1.00	1.00	0.25	1	0.50
15	1.00	3.00	1.00	4.00	2.00	5.00	2.00	1.00	5.00	2.00	1.00	1.00	0.50	2.00	1

Notes: Number of comparisons = 105.

Consistency Ratio CR = 3.8%.

Principal eigenvalue = 15.853.

Eigen vector solution: 4 iterations, delta = 3.8E-8.

Table 4. Priority matrix of factors

Factors	Priorities (%)	Rank
1. Proactive employees	10.1	2
2. Accountability	5.1	9
3. Follow-up	4.7	11
4. Manage the work force but avoid micromanagement	3.6	13
5. Encourage, motivate, reward, and recognize	4.9	10
6. Reach out to employees by seeking them out	2.1	15
7. Demand realistic targets	4.1	12
8. Team work	6.4	7
9. Break the monotony and rotate	2.3	14
10. Courses and improvement options	5.4	8
11. Tools and equipment to raise productivity	9.2	4
12. Availability of water, power, and other input supplies	8.9	5
13. Positive attitude and involvement of management	16.5	1
14. Encouragement to effective communication	7.1	6
15. Good working conditions	9.6	3

5. Findings and discussion

AHP applied to ratings (in pair wise mode) enabled us to point out the following observations:

- (1) Five top factors are “Positive attitude and involvement of management,” “Proactive employees,” “Good working conditions,” “Tools and equipment to raise productivity,” and “Availability of water, power and other input supplies.”
- (2) Bottom three factors are “Manage the work force but avoid micromanagement,” “Break the monotony and rotate,” and “Reach out to employees by seeking them out.”
- (3) The factor “Positive attitude and involvement of management” is most preferred in all these factors and “Reach out to employees by seeking them out” is least preferred.
- (4) CR ratio has been found within acceptable limit indicating satisfactory consistency of experts’ opinion.

5.1. Discussions on top five factors to enhance productivity

A brief analysis of five major factors as a perspective to enhance productivity is discussed in the following sub-sections.

5.1.1. Positive attitude and involvement of management

In an organization, efficient product has been produced by management skill (Carmeli, 2003). It has been shown that participative management positively affects employees’ job satisfaction. Management can set up regular focus group meetings with employees and supervisors from different work units to discuss issues of strategic planning related to operational system changes, relationship among work units, and organizational effectiveness (Kim, 2002). If management can take appropriate steps to positively influence the belief structures that bring about positive attitude formation that will then lead to more acceptance of the technology by the organization’s members (Amoako-Gyampah & Salam, 2004). Senior managers need to receive adequate training and support to provide effective vision and direction for the organization’s “people management” strategies and

there must be a congenial corporate culture, capable and assertive human resource leadership, and truly supportive top management. The importance of top management’s role must not be underestimated (Patterson, West, Lawthom, & Nickell, 1997).

5.1.2. Proactive employee

Employee loyalty must be earned through a culture of respect and integrity and learning and development. Established policies and practices that promote a workplace culture stimulate employee engagement. Listening carefully to what employees want and need, and providing opportunities and challenges to leverage the respective talents of employees (Lockwood, 2007) are important factors. It has been suggested that customer requirements fulfill in a better way when employees are engaged and to focus on work, it is a must that an employee trusts his management and it is also beneficial to that organization (Mayer & Gavin, 2005). An organization listen to the ideas of employees and take them into action if they are profitable to the organization, and the organization gives response to the employees by reward system or any other way to achieve better performance (Trkman, 2010). Engagement of employees with positive attitude toward value system and interests of the firm/supply chain has been pointed out important to improve performance of employee, department, firm, and the whole supply chain (Kompaso & Sridevi, 2010).

5.1.3. Good working condition

It has been studied that women want to work in good working conditions. However, women working in various sectors sometimes have been found compromising with working conditions (Loutfi, 2001). It has been emphasized that “the average person can think up twice as many ideas when working with a group than when working alone” (Diehl & Stroebe, 1987). Effective communication may also help in developing mutual trust among people working in an organization towards providing healthy environment (Porter, 1998). Individual labor is more productive than group labor in very rare situations, but in an organization, it is a must to develop an environment where people work in groups (Johnson, 1991).

5.1.4. Tool and equipment to raise productivity

It has been observed that the quality of raw materials and equipment affects the quality performance of a project (Enshassi, Mohamed, & Abushaban, 2009). Any company wants to avoid the equipment failure to reduce its maintenance cost and it is done by performing predictive and preventive maintenance strategies (Swanson, 2001). In an organization, a proper tool increasing or decreasing the productivity depends upon how the employees use the tool (Drucker, 1995). It has been stated that for European manufacturers, Japanese and North Americans provide more information and education is the most important tool (De Meyer, Nakane, Miller, & Ferdows, 1989). Highest quality of a product at lower cost can be obtained by standardizing the tools and equipments (Drucker, 1999).

5.1.5. Availability of input supplies

Worldwide, the main concern of many scientists, researchers, and farmers is the low-input, self-sustaining, energy-efficient, and diversified agriculture system (Altieri, 1999). There are many firms which can access stationary inputs. Efficiency and quality must be improved for increasing the productivity and the requirements of the firm better meet the input supplies by local suppliers (Porter, 2000). Using improved, new, and less costly inputs, a firm becomes more productive (Javorcik, 2004). In a denser, larger, and urban environment, a plant is more productive with the same input (Puga, 2010).

5.2. Perspectives of productivity enhancement

Fifteen factors to enhance productivity grouped together under four perspectives (Table 5): Human Resource Perspective; Task Perspective; Motivation Perspective; and Top Management Perspective were observed to be important factors that influence productivity. Top management perspective has been identified as the top most important perspective, sharing 44.2% of overall priorities followed by positive attitude and involvement of management; good working conditions; tools and equipment to raise productivity; and availability of water, power, and other input supplies (Figure 1). A hierarchy has been shown of the perspectives of factors to enhance productivity in Figure 2. An action plan has also been presented in Figure 3 toward helping the practicing managers of the manufacturing sector of India for achieving enhanced productivity.

Table 5. Priority matrix of perspectives

Perspectives	Factors	Priorities of factors (%)	Priorities of perspectives (%)	Rank of perspectives
Human resource perspective	Team work	6.4	24.0	II
	Reach out to employees by seeking them out (Humane approach)	2.1		
	Proactive employees	10.1		
	Courses and improvement options (Training)	5.4		
Task perspective	Accountability	5.1	17.5	III
	Follow-up	4.7		
	Demand realistic targets	4.1		
	Manage the work force but avoid micromanagement	3.6		
Motivation perspective	Encourage, motivate, reward, and recognize	4.9	14.3	IV
	Break the monotony and rotate	2.3		
	Encouragement to effective communication	7.1		
Top management perspective	Tools and equipment to raise productivity	9.2	44.2	I
	Availability of water, power, and other input supplies	8.9		
	Positive attitude and involvement of management	16.5		
	Good working conditions	9.6		

Note: Bold values show rank of perspectives which has been discussed in Section 5.2.

Figure 1. Perspectives' importance.

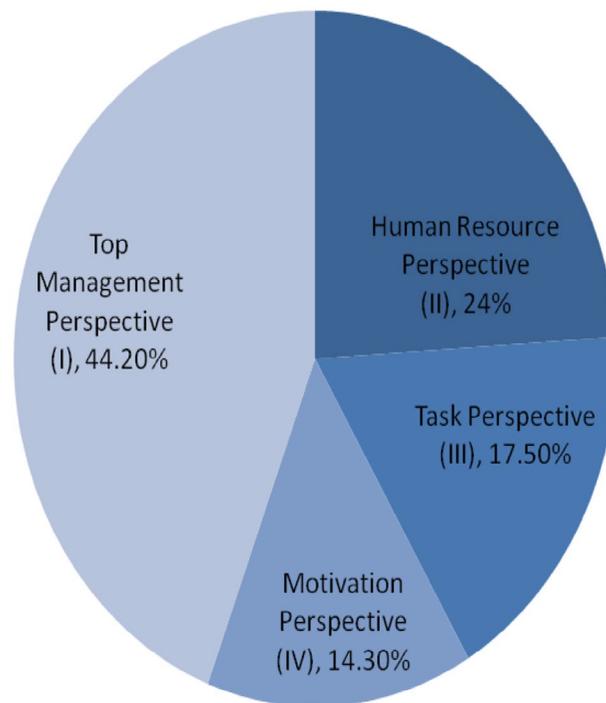


Figure 2. KUMADUHAL's hierarchy of productivity factors' perspectives.

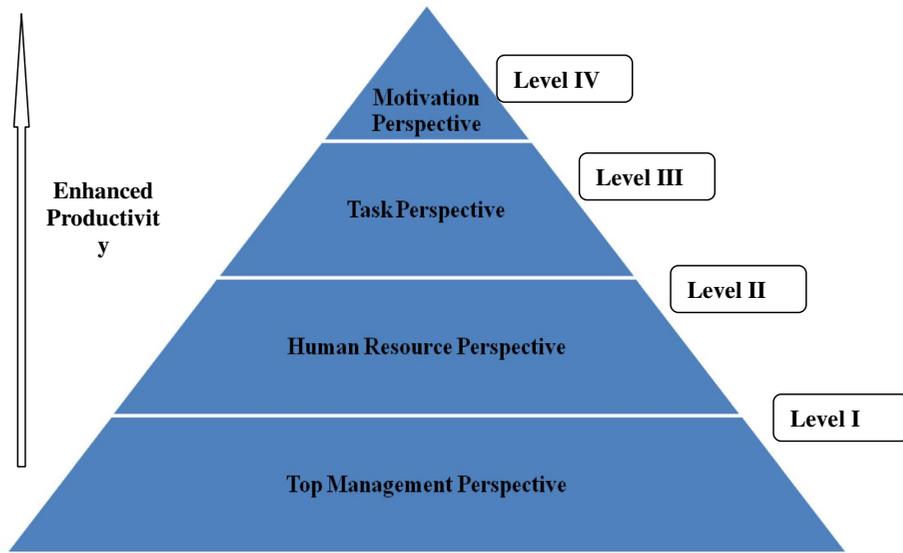
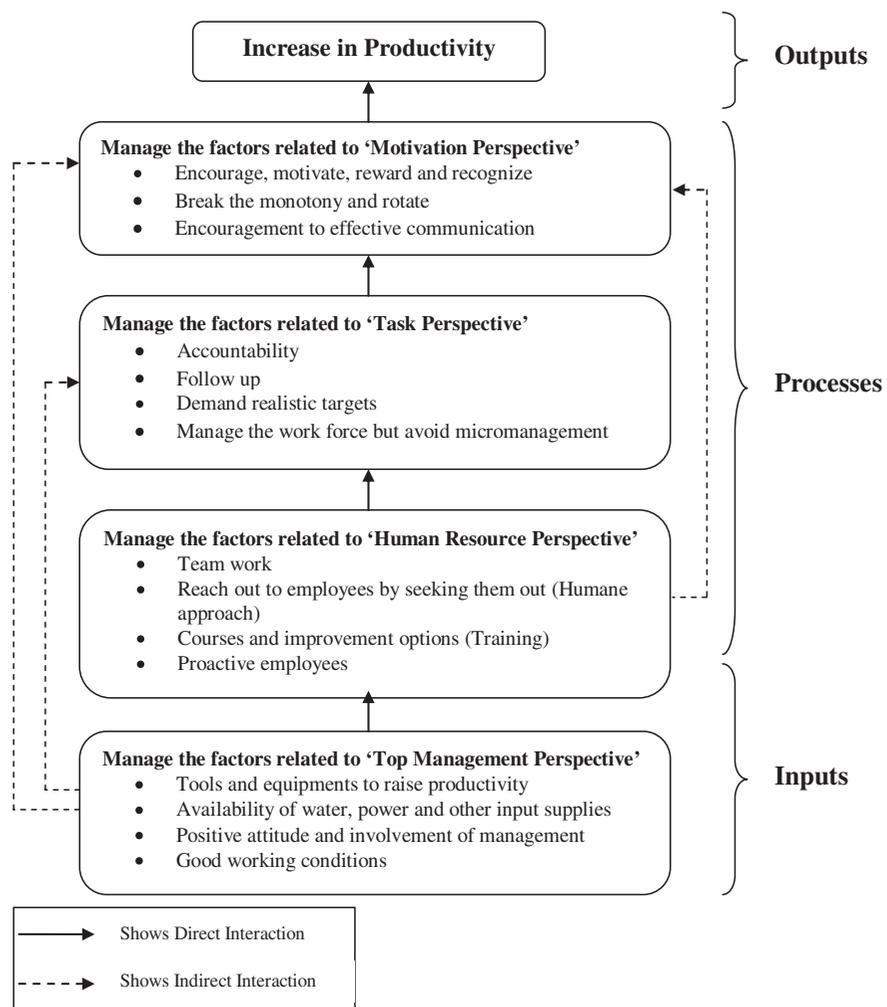


Figure 3. Action plan to enhance productivity.



6. Concluding remarks

With extensive literature review, we have identified 15 major factors that help in enhancing productivity. Further ranking of these factors has been carried out using AHP approach. “Positive attitude and involvement of management,” “Proactive employees,” “Good working conditions,” “Tools and equipment to raise productivity,” and “Availability of water, power and other input supplies” have been ranked as top five factors. The factors have been grouped into four perspectives and “Top management” perspective has been found to be the most important.

6.1. Limitations of study

The results as presented in the study are specific to the “Indian manufacturing sector;” further, there can be biasness in the experts’ judgments.

6.2. Scope of future research

This research can be extended to other sectors/countries/region. The results may be evaluated utilizing the “Case Study” approach. Also, an extended application of AHP approach may be applied to categorize the factors using FCAHP technique (Kumar, 2014a) as future research. Further, the interactions among the categories/perspectives may be evaluated using CIAHP approach proposed by Kumar (2014b).

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