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# AN ANALYSIS OF CRITICAL SUCCESS FACTORS FOR INDUSTRY 4.0: AN APPLICATION OF ANALYTICAL HIERARCHY PROCESS

**J. Singh**
**D. Garg**
**S. Luthra**

***ABSTRACT***

*This study aims to identifying and ranking of critical success factor for implementation of Industry 4.0. Analytical hierarchy process technique is used to prioritize and rank the factors to find the influence of each factor. It is found here that 'Cyber physical system' is ranked at number one followed by 'Labour laws' at number two, 'Internet of Things' at number three etc. The role of physical cyber system, Labour laws and Internet of Things has been identified as most important CSFs that may force industries to implementation Industry 4.0.The Government of India adoption industry 4.0 revolution and Industries push the technology in manufacturing through the "Make in India" initiative is creating strategies and policies to encourage the implementation of digitalised manufacturing.*

***KEYWORDS: Industry 4.0, Critical Success Factors (CSFs), Internet of Things (IoT), Cyber Physical System (CPS),Analytical Hierarchy Process (AHP), PESTEL analysis.***

## 1. INTRODUCTION

**Germany introduced a project under the name 'Industry 4.0' to digitalize manufacturing at the Hannover messe in 2011(Heng, 2014).** Industry 4.0 is a strategic technique for integrating control systems with internet technology permitting intercommunication among human, goods and complex systems (Anderl, 2014). Based on interaction via Internet that permits a continuous communication and interchange of data not only among humans (C2C) and human and machine (C2M) but also among the machines themselves (M2M) (Cooper and James, 2009). This interaction relation impacts the founding of knowledge organisation (Tani et al., 2016). Industry 4.0 is improvement of problem solving skills to autonomously dealing with unsuccessfully or completely new tasks is getting more and more significant in the industry (Bauernhansl et al., 2014). According to estimates of analysts at Gartner,26 billion "things" will be related to the Internet in the year 2020(Stamford, 2015).Industry 4.0 is development of problem solving skills to autonomously dealing with unsuccessfully or completely new tasks is getting more and more important in the manufacturing industry (Marks, A. et. al.,2015).

### 1.1 Objectives of The Research

This research has some objectives, as follows:

(I). To identify various Critical Success Factors (CSFs) to implement Industry 4.0 from industrial lookouts.

(ii). To identify and ranking relationship of CSFs using Analytical hierarchy process.

## 2. LITERATURE REVIEW AND TECHNICAL BACKGROUND

The globe is changing very quickly thanks to the technological revolution that greatly impacts our manner of living and the behaviour of together individuals and organizations. Following suggestions by Webster/Watson (2002), we used a concept-cantered approach and first identified key contributions and recent literature reviews in the field (Mark et al.,2015). We used references listed in this work. Afterwards, we tracked their subsequent citations and searched common databases, platforms, and search engines (EBSCO, OPAC, SSRN, Google Scholar) for relevant key words ("business model", "innovation business model", "Industry 4.0", "internet of people"," internet of things", "industrial internet", "cyber physical systems") etc.

### 2.1 India's current scenario in industry

The Government of India's push to technology through the "Make in India" creativity was promotion by India's Prime Minister Sh. Narendra Modi in September 2014 creating tactics and policies to encourage the adoption of digitalized manufacturing. To contribute16.5% to India's GDP in 2016 compared to 29.7% to China's GDP, so India's manufacturing has plenty new area to develop and contribute more to the country's GDP (Moreira,2017).The objectives of growth with employment it is important to growth the share of manufacturing in the country's GDP from 16% to 25% by 2022 and to create 100 million further jobs by 2022. Government should motivate IoT is still taking shape in India. While some are gradually and others are doing it forcefully, the goal is to have a higher efficiency, higher manufacture, minimum the cost and providing superior visibility to the management in terms of revenue.

### 2.2 Industry 4.0: Technical Background

Industry 4.0 has become a widely used synonym for ongoing and recent efforts to establish CPS and appropriate new Business models, which are realized as the foundation of a new "industrial 4.0 revolution" (Marks et al.,2015). Mainly Cyber-physical systems are networks of actuators, wireless sensors nodes and microcomputers that can be surrounded in materials, machines or devices; these are linked through the internet system (Wahlster et al.,2013). The technological potentials of industry 4.0 revolution have created the possibilities for

innovative offerings, too. Product and service innovations may be based on highly differentiated and customized products, synchronized product/service combinations, or value-added services (Burmeister et al.,2015). The current discussion of industry 4.0 has been mainly digital technology focused, conventional roles and capabilities of equipment and plant engineering, producers, and logistics providers will also be extended as high layers of technological infrastructure come into play e.g., by CPS suppliers, software providers, platform operators, network operators, data collectors/analysts, CPPS integrators or even an open community (Monostori, 2014)

## 3. IDENTIFICATION OF CSFS FOR ADOPT INDUSTRY

### 3.1 Political factors

Honourable Prime Minister of India launched the 'Make in India' program to creating strategies and plans to encourage the adoption of digitalised working in the industry. The manufacturing area especially MSMEs play an essential role in the Indian economical and afford the leading share of service after agriculture (Vanadan,2018).

#### 3.1.1 Enhancement by the government in industry

It aims to oblige latest technology forward by increasing digitization, intercommunication and interconnection of goods, value chains and business models (Schroeder, 2016). The goal of growth with employment it is essential to development the part of production in the country's Gross Domestic Product since16% to 25% by 2022 and to make hundred million extra employments by 2022.

#### 3.1.2 The role of administration and ministries

Ministries are formulating and implement the industrial rules and schemes for new business models development conforming to national growth requirements and objectives, take the various players jointly, initiatives with superior public burden and to support them economically. Ministries are sprightly and intensively occupied in these processes of Industry 4.0(Momin,2016).

#### 3.1.3 Social democratic pressure

These are thought of man increasingly digital civilization, the circumstances of financial and community modernization capacities and the structure circumstances for the success of Industry 4.0. The stronger addition of professional and academics education as well as study programmers should be assembles additional education potential (Schroeder, 2016).

### 3.2 Economic factors

Industry is more complex to economic factors such as variation in gross domestic product, interest rates, and exchange rates. Economic factors are also influenced by the assurance of joint employees in the industry, the economic status of a country and participation of government in the industry (Schmidt, R et. al 2015).

#### 3.2.1 Manufacturing Execution Systems (MES)

MES provide uniform workflows to operators to ensure the maximum possible manufacture and regulatory compliance. MES have been essential in the value, performances and agility need for the challenges created by globalized industrialized business and will most likely carry on to be (Almada-Lobo,2015).

#### 3.2.2 Business process

Business Process Management is a methodology that helps a manufacturing industry to Discover, Analyse and Design methods built around its human, assets and. Over the latest trend Business Process (BP) has become an established discipline, with a well-established set of techniques, methods and tools that associated knowledge from, management sciences, industrial engineering and information technology with the resolution of expand business processes (Van Hee et al.,2004).

#### 3.2.3 Economics efficiency

Economic efficiency suggests an economic state in which every source is optimally allocated to serve each individual or entity in the best way while minimizing waste and inefficiency. Internet of People (IOP) and Internet of Things (IOT) offered endwise precision nearly in actual time and permit for optimization crosswise plant place in the section of manufacture and deliver the better economics efficiency (Lees,2013).

### 3.3 Social factors

The social factors determined on the strength within the society. These factors can influence our outlook, judgment and attention. So**, they can impact sales of goods** and income earned (Armstrong et al.,2005).

#### 3.3.1 Strategic competence development

Strategic competence is defined as the determination of businesses long-term goals, then accepting courses of action and allocating resources needed to complete the goals (Armstrong and Taylor, 2014). Classify four main groups to classify competencies. Initially, technical competencies include all job-associated skills and information, while then; methodological competencies consist of all aptitude and capabilities for universal difficulty resolving and judgement creating. social competencies include capabilities as well as the outlook to collaborate and connect with another. Personal competencies consist of a person's motivations, community value and outlooks (Graßmann, 2005).

#### 3.3.2 Demographic change and changing social values

Capability to accepting work-task rotation, transfer knowledge and work related change (uncertainty tolerance), place and time flexibility, leadership skills (Beaumont, 1993).

#### 3.3.3 Increasing virtual work

Increasing virtual work options support business results and the essential of business customers and capability.

#### 3.3.4 Growing complexity of processes

The growing complexity in the creation method may stance various tasks to Engineering design actions, research areas and creating R&D projects gradually costly, time spending, and simply to fail, and creating innovation difficult and difficult to be reached (Bashir and Thomson, 1999). Growing complexity familiarize by the growing economics and regulatory necessity of the expanding universal life sciences environment.

### 3.4 Technological factors

Technological factors are one of many external factors that can

influence the businesses, which associate to the presence and improvement of technology, on either a local or universal scale. Industry 4.0 revolutions establish it in the technique data exchanges; technologies are hi-tech and digitized what we currently call the IoT (Posada et al., 2015).

### 3.4.1 Cyber physical systems

CPS is making to manufacturing fully computerization structures that enable many innovation functionalities complete in the networking cyber world, thus modified our everyday lives significantly and deliver the ability for automatic, synergistic systems integration with measureable security (NIST, 2012). Industry 4.0 revolution founded the CPS.

### 3.4.2 IoT technology

New market necessities and emerging separately technologies as IoT are transforming the industry nature in the direction of smart factories (Miragliotta et al.,2014)Industry 4.0 high-tech strategic plan of that we will make more usage IoT for interconnect and intercommunication between employees and machineries, which promotes the computerization of manufacturing. In future factories humans will have to work with a world of processes, networks of processes, machines, robotics and sensors. This system will require unique operational opinions for a better human-machine related operation (Majeed and Rupasinghe, 2017).

### 3.4.3 Smart factories

Smart factory describes a new technique in multi-scale engineering by utilizing the IOT and industrial wireless technologies, which involve of smart sensors, robotics and resilient control technologies (Lee, 2015). Current market necessities and push-up technologies such as IOP and IOT are transforming the industry nature for smart factories. So, IoT counts on both network and objectives (Tumino et al., 2012).

### 3.5 Legal factors

Legal factors are exterior factors which state to how the policies and strategies affect the approach industries task and customers act. Goods transportation, revenue margins and viability of assured markets are all cases of things which may be effects by legal factors.

### 3.5.1 Labour laws

Several studies suggest that Indian labour laws are extremely defending of labour. These laws apply only to the organised sector (Bhattacharjea, 2006). Digital technologies like as industry 4.0 being introduced, for example in the manufacturing technique, carry potential conflicts with existing labour laws and worker's representative groups. In order to avoid risk in digital transformation procedures from workers and their representatives, company administration must engage them early in the planning phase. Industry 4.0 will allow gradually flexible work time replica. Management, employees and their representative groups are asked to describe agreements that permit for more flexible working hours whilst at the same time acknowledging topics such as time implement and policies regulations concerning overtime in the industry. The qualifications of the existing employees towards the necessities of the new digital technology world will be crucial (Zimmermann,2017).

### 3.5.2 Intellectual property

**1)** Indian government has undertaken major improvements in the Intellectual Property law of the country. This is leading to a change of business strategies with liberalization and globalization; new possibilities for Intellectual property formation appear to be emerging for Indian organizations (Basant, 2004).Industry 4.0 will also have an impact on the safeguard of intellectual property. The company and its workers have to acknowledge that the official protection of R&D, manufacture and company data is insufficient. Industry 4.0 will have required that organizations following digital conversion need to make significant efforts to master legal modification in data protection, IT security, labor law and liability (Graham and Mowery, 2003).

### 3.5.3 Liability

Liabilities are officially required responsibilities that are due to another person or entity. Payment of a liability can be accomplished finished the transfer of money, goods, or facilities. If devices and machines (vehicles and robots for instance) intercommunication and interaction with respectively and if they are increasingly able of acting on their own, legal query regarding the duty for damage and injuries reason by such autonomous devices and machines will take place (*Häuser,2015*).

### 3.6 Environmental factors

Environmental factors play an important role in industrial location selection activities because of global consciousness of environmental problems. Eco-friendly factors to variables about the physical environment (the weather of Earth). This can contain things like customer health, weather variation, the accessibility of energy, or any straight penalties of these effects (IPCC,2002).

### 3.6.1 Global warming

According to the climate policy of the United Nations, global warming must be controlled up to two degrees related to the level earlier the industrialization. The values of this are intensive changes in environments of living. Some research findings prediction that this objective can be only reached by extreme reduction of CO2 release within a small time surround. Though we still face main troubling with pollution as a result of manufacturing industry, mainly in the developing universe, we have handle to decrease the quantity of uncontrolled pollution that take place as a direct result of manufacturing industry (*Greenberg,2014*).

### 3.6.2 Working environment

Working environment is defining industrial conditions that may be outside of finest. Working environments are usually harsher than normal work environments, such as company and organization. In an industrial atmosphere, people and equipment are showing to riskier condition. Reason of this research, attention will be located on the working condition, work characteristic and organizational associated categories

(Mustapha and Naoum, 1998).

### 3.6.3 Environmental clearances

Industrialization is an important requirement for fast and continuous financial development and social progress. But it makes environmental squalor like water, soil and air pollution. So, eco-friendly administration is necessary to reduction such environmental pollution and degradation. The Government was further permission to set up and represent to the pollution controller boards at Central and State Government level. No one could establish or run any industry without the concerned Board's clearance (Bush,2016).

## 4. METHODOLOGY

The Analytical Hierarchy Process (AHP) methodology, as established by Saaty, is a important approach in resolving various decision problems (Saaty, 1980). In this technique there is calculation and ranking of the various options for different criteria. Any difficult problem can be decayed into various sub?problems via the AHP, in conditions of hierarchical levels where every levels describes a set of standards or characteristics relative to every sub?problem.(AHP) methodology there is a comparison among criteria, or alternatives with regard to a criterion, in a natural, pair-wise mode. The transitional levels show the planned as well as effective factors and the final level typically show substitutions or activities to be counted to reach the goal. Outcome sections at every hierarchy level are associated pair wise and are allocated comparative rules that suggest the power with which unique element controls another. Based on these pair wise comparison matrices, local and global priority weights will be identifying and the ranking of the substitutes absorbing the last level of the hierarchy will be complete to satisfy the total objective of the problem. There are many cases explaining the strongly application of AHP method to solved ranking (Saaty, 1990; Saaty and Vargas, 1994; Tummala and Wan, 1994). Various steps are involved in the implementation of AHP and these are as given below.

**First Step:** To establish a hierarchical structure

A structure which is hierarchical in nature is also formed and a comparison, which is pair-wise is to be created. And the scaling of the various substitutes of the decision is done on a scale of nine points.

To identify the critical success factors for the Industry 4.0 suggestion from three experts from industry and three from academia taken and these factors were validated by expert's opinion and nineteen factors have been categorized in six dimensions depending upon their importance in implementation of Industry 4.0 in manufacturing sector.

**Second Step:** To construct a pair wise matrix of comparison

Prepare pair wise comparison matrix and in this matrix each factor in the superior point is exercised to assess the factors in the level directly under it.

**Third Step:** To calculate the consistency

In this step reliability or consistency of the factors is confirmed. And to do this calculation of these given terms is done in the following sequence

(a) Maximum Eigen vector

(b) Relative weights

(c) CI i.e. consistency index

(d) Random Consistency index

Given formulae are used to find the above said terms:

Consistency Index = $(\lambda max-n)/(n-1)$ ----(1)

Consistency Ratio = CI/RI -----(2)

And value of RI fluctuates according to the order of matrix for which CR is to be calculated. Following Table 1 gives the value of the Random Consistency index for matrix of order(N) 1 to 6 attained by assessing random guides by means of a 500 sample size (Saaty, 2000).

**Table 1. Random index**

| Order of Matrix | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Random consistency index | 0 | 0 | 0.58 | 0.90 | 1.12 | 1.24 |

The satisfactory CR span differs corresponding to the matrix size and these are given in the following table (Saaty, 2000; Cheng and Li, 2001).

**Table 2. Matrix size and CR table**

| MATRIX SIZE | 3 × 3 | 4 × 4 | For all larger matrices, n>= 5 |
|---|---|---|---|
| CR | 0.05 | 0.08 | 0.1 |

And level of consistency of the decision made is defined below.

Good level: If calculated consistency ratio is equal or lesser than the standard given in the above table.

Unsatisfactory: If consistency ratio is higher than standard given in the above table. And in this case there is need to review the decision making process (Kumar et al., 2009).

AHP method of ranking the CSFs is organized as a chain of importance and has been appeared in Figure 1:

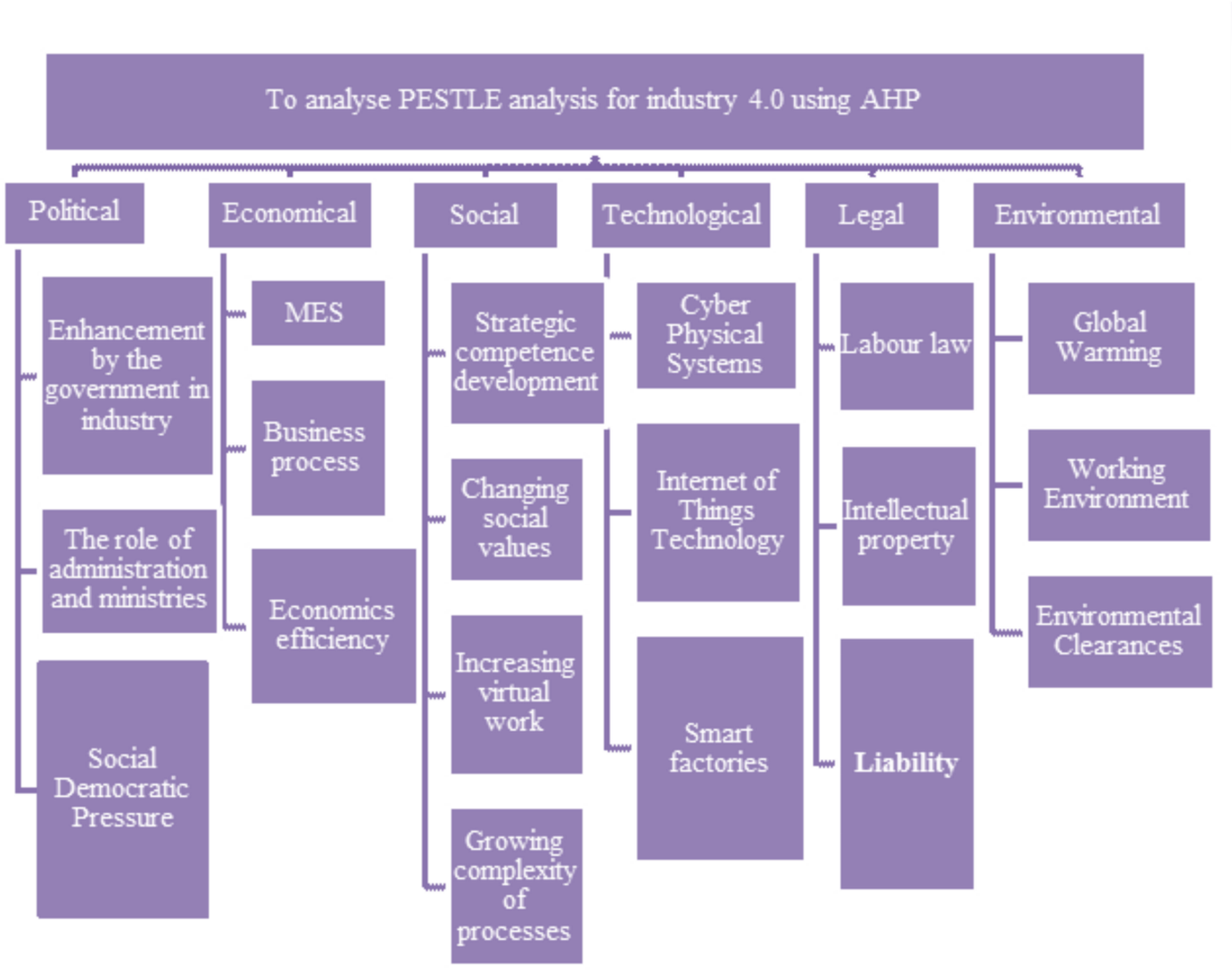


**Figure 1. Research frame work CSFs for industry 4.0.**

## 5. CONSTRUCTING THE HIERARCHY OF CSFS OF INDUSTRY 4.0

The maximum Eigen values, Consistency Index and pair wise comparison matrix of various challenges for the Make in India campaign are given and calculated below.

Maximum Eigen Value =6.53233,C.I. =0.106466,C.R. =0.08585

**Table 3.Pair wise Comparison Matrix of CSFs OF Industry 4.0**

| | (P) | (E) | (S) | (T) | (L) | (E) | Global Priority Weighting |
|---|---|---|---|---|---|---|---|
| Political | 1 | 3 | 2 | 1/5 | 1/3 | 2 | 0.137453 |
| Economical | 1/3 | 1 | 2 | 1/3 | 1/5 | 1 | 0.086759 |
| Social | 1/2 | 1/2 | 1 | 1/3 | 1/2 | 2 | 0.093045 |
| Technological | 5 | 3 | 3 | 1 | 2 | 3 | 0.354796 |
| Legal | 3 | 5 | 2 | 1/2 | 1 | 2 | 0.247671 |
| Environmental | 1/2 | 1 | 1/3 | 1/3 | 1/2 | 1 | 0.080275 |

Analytical results shown in Table 3, 'Technological Factors for Industry 4.0 (0.354796)'; was the most important factor followed by 'Legal Factors (0.247671)'; 'Political Factors (0.137453)'; 'Social Factors (0.093045)'; 'Economical Factors (0.086759)'; and 'Environmental Factors (0.080275).

**5.1 Constructing**

Maximum Eigen Value =3.0092C.I. =0.00460136C.R. = 0.007933

Pair wise Comparison Matrix

**Table 4.The hierarchy of Political factors for Industry 4.0**

| | (EGI) | (ROA) | (SDP) | Global Priority Weighting |
|---|---|---|---|---|
| EGI | 1 | 2 | 3 | 0.539615 |
| ROA | 0.50 | 1 | 2 | 0.296961 |
| SDP | 0.33 | 0.50 | 1 | 0.163424 |

Analytical results shown in Table 4, Enhancement by the government in industry (0.539615)'; was the most important challenges under the category of political factors followed by 'The role of administration and ministries. (0.296961)'; and 'Social Democratic Pressure (0.16342)

**5.2 Constructing the hierarchy of Economical Factors for Industry 4.0**

Maximum Eigen Value =3.05362, C.I. =0.0268108, C.R. =0.0462255,

**Table 5. The hierarchy of Economical Factors for Industry 4.0**

| | (ME) | (BP) | (EE) | Global Priority Weighting |
|---|---|---|---|---|
| **ME** | 1 | 2 | 3 | 0.527836 |
| **BP** | 0.50 | 1 | 3 | 0.332516 |
| **EE** | 0.33 | 0.33 | 1 | 0.139648 |

Analytical results shown in Table 5, Manufacturing Execution Systems (0.527836)'; was the most important factors under the category of Economical factors followed by 'business process (0.332516)'; and 'Economic efficiency (0.139648).

**5.3 Constructing the hierarchy of Social Factors for Industry 4.0**

Maximum Eigen Value =4.21371, C.I. =0.0712373, C.R. = 0.0791525

**Table 6.The hierarchy of Social Factors for Industry 4.0**

| | (SCD) | (CSV) | (IVW) | (GCP) | Global Priority Weighting |
|---|---|---|---|---|---|
| **SCD** | 1 | 3 | 2 | 5 | 0.49692 |
| **CSV** | 0.33 | 1 | 3 | 2 | 0.251336 |
| **IVW** | 0.5 | 0.333 | 1 | 1 | 0.138591 |
| **GCP** | 0.2 | 0.5 | 1 | 1 | 0.113154 |

Analytical results shown in Table 6, 'Strategic competence development (0.49692)'; was the most important challenges under the category of Social factors followed by 'changing social values (0.251336)'; 'Increasing virtual work(0.138591)'; and 'Growing complexity of processes (0.113154).

**5.4 Constructing the hierarchy of Technological Factors for Industry 4.0**

Maximum Eigen Value = 3.03851, C.I. = 0.0192555, C.R. = 0.033199

**Table 7.The hierarchy of Technological Factors for Industry 4.0**

| | (CPS) | (IOT) | (SF) | Global Priority Weighting |
|---|---|---|---|---|
| **CPS** | 1 | 3 | 5 | 0.636986 |
| **IOT** | 0.333 | 1 | 3 | 0.258285 |
| **SF** | 0.2 | 0.333 | 1 | 0.104729 |

Analytical results shown in Table 7, 'Cyber Physical Systems (0.636986)'; was the most important challenges under the category of Technological Factors followed by 'Iota Technology (0.258285)'and 'Smart factories (0.104729).

### 5.5 Constructing the hierarchy of Legal Factors for Industry 4.0

Maximum Eigen Value = 3.00369, C.I. =0.0018473, C.R. =0.003185

**Table 8.The hierarchy of Legal Factors for Industry 4.0**

| | (LL ) | (LP) | (L) | Global Priority Weighting |
|---|---|---|---|---|
| **LL** | 1 | 2 | 5 | 0.581552 |
| **LP** | 0.5 | 1 | 3 | 0.308996 |
| **L** | 0.2 | 0.333 | 1 | 0.109452 |

Analytical results shown in Table 8, 'Labour lawfor Industry 4.0 (0.581552)'; was the most important factor under the category of Legal factors followed by 'Intellectual property (0.308996)'; 'and Liability (0.109452).

### 5.6 Constructing the hierarchy of Environmental Factors for Industry 4.0

Maximum Eigen Value = 3.02906, C.I. = 0.0145319, C.R. = 0.025055

**Table 9.The hierarchy of Environmental Factors for Industry 4.0**

| | (GW) | (WE) | (EC) | Global Priority Weighting |
|---|---|---|---|---|
| **GW** | 1 | 3 | 5 | 0.658644 |
| **WE** | 0.33 | 1 | 1 | 0.185174 |
| **EC** | 0.2 | 1 | 1 | 0.156182 |

Analytical results shown in Table 9, 'Global warming for Industry 4.0 (0.658644)'; was the most important factors under the category of Environmental factor followed by Working environment (0.185174)'; and Environmental clearances (0.156182).

### 5.7 Complete Priority weighting and ranking of CSFs for Industry 4.0

From all above we have compiled a Table 10, given below. This table comprises of various dimensions, their Global Priority weighting and their rank, CSFs for Industry 4.0, their priority weighting, their initial ranking and their final ranking.

**Table 10. The overall hierarchy of CSFs for Industry 4.0**

| S.No. | Dimension | Global Priority Weighting (G) | Rank | S.N. | Critical Success Factors | Priority Weighting (PW) | GxPW | Ranking |
|---|---|---|---|---|---|---|---|---|
| 1 | Political Factors (P) | 0.137453 | 3rd | 1.1 | **(EGI)** | 0.539615 | 0.074171 | 5th |
| | | | | 1.2 | **(ROA)** | 0.296961 | 0.040818 | 9th |
| | | | | 1.3 | **(SDP)** | 0.163424 | 0.022463 | 15th |
| 2 | Economical Factors (E) | 0.086759 | 5th | 2.1 | **(MES)** | 0.527836 | 0.045794 | 8th |
| | | | | 2.2 | **(BP)** | 0.332516 | 0.028848 | 12th |
| | | | | 2.3 | **(EE)** | 0.139648 | 0.012115 | 18th |
| 3 | Social Factors (S) | 0.093045 | 4th | 3.1 | **(SCD)** | 0.49692 | 0.046235 | 7th |
| | | | | 3.2 | **(CSV)** | 0.251336 | 0.023385 | 14th |
| | | | | 3.3 | **(IVW)** | 0.138591 | 0.029643 | 11th |
| | | | | 3.4 | **(GCP)** | 0.113154 | 0.010528 | 19th |
| 4 | Technological Factors (T) | 0.354796 | 1st | 4.1 | **(CPS)** | 0.636986 | 0.226000 | 1st |
| | | | | 4.2 | **(IOT)** | 0.258285 | 0.091638 | 3rd |
| | | | | 4.3 | **(SF)** | 0.104729 | 0.037157 | 10th |
| 5 | Legal Factors (L) | 0.247671 | 2nd | 5.1 | **(LL)** | 0.581552 | 0.144033 | 2nd |
| | | | | 5.2 | **(IP)** | 0.308996 | 0.076529 | 4th |
| | | | | 5.3 | **(L)** | 0.109452 | 0.027108 | 13th |
| 6 | Environmental Factors (E) | 0.080275 | 6th | 6.1 | **(GW)** | 0.658644 | 0.052872 | 6th |
| | | | | 6.2 | **(WE)** | 0.185174 | 0.014864 | 16th |
| | | | | 6.3 | **(EC)** | 0.156182 | 0.012537 | 17th |

The ranking of factors is made in Table 10 and ranking will help in prioritising these CSFs.

## 6. DISCUSSIONS OF FINDINGS

The objectives of the research were to identify and ranking relationship CSFs, finding their appropriate relationships, to develop the Analytic Hierarchy process of CSFs to implement industry 4.0 concerning in Indian perspective. Their priority weighting, their initial ranking and their final ranking CSFs to implement industry 4.0 have been achieved by using Analytic Hierarchy process. To begin with, the category 'Cyber physical

system' grip the primary location in the rank, and accordingly, engages the maximum comparative importance in difference to other factors in Industry 4.0. Cyber physical system is an unexpected methodology that attention on the addition of computational engineering with using the physical component, actual designed and redesigned a structure of physical part in the manufacturing industry. 'Labour Law' holds second place among other categories of CSFs. Management, workers and their representative groups are asked to describe agreements that permit for more flexible working hours whilst at the same time acknowledging topics such as time implement and rules regulations concerning overtime in the industry. The category of 'Internet of Things' developed the third location on the importance scale. In this specific group, (Technology) holds the highest importance. In future factories humans will have to work with a complex world of processes, networks of processes, machines, sensors, robotics and devices AHP has been used for ranking and it is found here that CPS is ranked at number one followed by Labour law at number two, IoT at number three, Intellectual property at fourth number etc. as shown in Table 10. So, all these nineteen CSFs are ranked according to their impact on the effecting of Industry 4.0. By having these ranking practitioners can easily prioritise these factors to tackle and can remove all these factors by taking necessary action and implementation of industry 4.0 for Indian perspective.

## 7. CONCLUSIONS

Industry 4.0 has become a widely used synonym for on-going and recent efforts to establish cyber physical (production) systems (CPS) and suitable newest Business models, which are realised as the foundation of a new industrial 4.0 revolution. The Govt. of India push to manufacturing through the "Make in India" initiative is creating strategies and policies to encourage the implementation of digitalised manufacturing. These nineteen CSFs to implement Industry 4.0 revolution for sustainability are known by resources of the literature review and talks with experts. Analytical Process Hierarchy (AHP) analysis is used to evaluate these factors in order to determine their relative ranking order. The Ranking order of recognized categories of factors for Industry4.0 initiatives is given as C-L-I-I. According to the findings, the category 'Cyber physical system' possesses the highest importance, which implies that it requires focused attention from governmental bodies. Important statements have been made: Regulatory concerns observed as most important dimension indicating significance of appropriate legal and regulatory framework adoption and support at national and International level. 'International bodies'; 'Cyber physical system'; 'Labour law'; 'Internet of Things' and 'Intellectual property"; and 'Enhancement by the government in industry' have been identified highest rated CFs in their respective dimension considering local weight of CF. 'International bodies' has been rated most important top ranked (overall) critical factor based upon overall weight. Finally, in future studies, the identified CSFs in Industry 4.0 can be analysed using other decision making methods like ISM, ANP, ELECTRE, TOPSIS, and DEMATEL.

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**AUTHORS**

**Jaspal Singh,** M. Tech. Scholar, Department of Mechanical Engineering, National Institute of Technology, Kurukshetra 136119, Haryana, India

**Dixit Garg,** Professor, Department of Mechanical Engineering, National Institute of Technology, Kurukshetra-136119, Haryana, India

**Sunil Luthra,** Assistant Professor, Department of Mechanical Engineering, State Institute of Engineering *and Technology, Nilokheri-132117, Haryana, India.*