



# Industry 4.0 and HR 4.0: Technologies and Systems Collaboration

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**Abstract:** Industry 4.0 is greatly changing the method of work and the workforce by using ICT for digitalization. Significant changes are taking place in the process of training, handling, employing and communicating in the workplace. This study integrates the human resource management system with the industry 4.0 technologies for the purpose of upgrading the same to HR 4.0 level. The objective of this contribution is to find how to revolutionize people management adopting digital tools for HR operations. This exploratory review aims to provide valuable inputs to the limited research available on this topic. However, professionals in both the areas of work are organizing workshop, seminars, group discussions and interviews to address this important requirement. Other operations like marketing, sales and manufacturing are already undergoing full digital transformation in progressive industries. Therefore prevailing situation calls HR departments to adopt technologies into routine work rather than continuing manual work with paper based documents. The proposed HR 4.0 requires nurturing a culture of re-skilling, up-skilling and lifelong learning. HR professionals have unique opportunity to shift their function of being recruiter to being successful business leaders. This research paper examines in different sections the relevant aspects like the changes in HR roles, functions, practices and automation. Talent management and a model to steer the process of technologies and human resources collaboration provide the required insights. Results appear in section 5.

**IndexTerms - Industry 4.0, HR 4.0, Systems collaboration**

## I. INTRODUCTION

The concept of Industry 4.0 comes from a conference at Hanover. This initiative is named as 4<sup>th</sup> industrial revolution. Previous 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> emerged starting from power of steam, use of electricity, and adopting ICT respectively. Industry 4.0 commits to set-up fully digitalized factories called smart factories. Such a factory will be capable to produce even one piece product at a time profitably like a sports car on demand from individual customer. Changes in the product can be incorporated in case of emergency showing high level of flexibility [1] [2]. This upcoming revolution is unique also because it is the first time in the history that a revolution is predicted before it happened instead of described afterward [3] [4]. Aligning HR with Industry 4.0 will require changes in many aspects because HR functions and processes of today will undergo automation. This paper aims to answer research questions based on scientific methodology. The paper also investigates - how can industry 4.0 be characterized, which elements does it have and what will be its direct effect on existing HR roles. Before proceeding further, this section aims to focus and examine the fundamentals through the following subsections.

### 1.1 Industry 4.0: Characteristics and Elements

Industry 4.0 significantly reduces manual work but increases work efficiency. Now a term HR 4.0 is used for developing human resource strategy in collaboration with Industry 4.0. Other characteristic of Industry 4.0 includes; possession of fully automated machines, equipment and workstations [5] [6].

### 1.2 Industry 4.0: Key Technologies

Proper combination of many physical and digital technologies only can fetch optimum benefit. Literature review under conceptual framework provides following key technologies to support in the present research work of Industry 4.0 and HR 4.0 collaboration [7].

#### 1.2.1 Internet of Things (IoT):

IoT connects machines, appliances and many other objects in a wireless network and facilitates to establish communication among them.

**1.2.2 Cyber Physical System (CPS):**

CPS consists of computing and communicating devices integrated with each other to monitor and control the physical process system through sensors and actuators.

**1.2.3 Cloud Computing:**

Cloud computing technology provides users the ability to store and access data and programs over the internet connected devices like computers and smart phones instead of on a hard drive.

**1.2.4 Big data analytics:**

Big data analytics collect, process, and analyze large data to help organizations in the process of intelligent decision making.

**1.2.5 Additive manufacturing:**

Additive manufacturing produces objects layer by layer using a machine and CAD software to launch a product quickly responding market demand.

**1.2.6 Virtual Reality (VR):**

VR is a technology to produce computer generated three dimensional simulation of an object that appears to be real, for the advantage of user.

**1.2.7 Augmented Reality (AR):**

AR combines the real world and computer generated 3D object leveraging mathematical modeling and virtual reality to create an immersive environment.

**1.2.8 M2M:**

M2M enables devices to exchange information and data to perform actions without manual assistance.

**1.2.9 Artificial Intelligence (AI):**

AI is a set of technologies that enable computers to perform a variety of functions, including the ability to see, understand and translate language, and more.

**1.2.10 Cyber Security:**

Cyber security is the practice of protecting data, network programs and other information from unauthorized access or digital attacks.

**1.2.11 Robotics:**

Robotics in industry is the use of a robot for process like assembly, packing, welding and more. Robots provide high precision and speed for the task.

**1.2.12 Robotic process automation (RPA):**

RPA helps removing redundancies in office operation [8] or HR operation without lunch or tea break.

**1.2.13 Neuro-linguistic programming (NLP):**

NLP is predictive analytics based on assessment of past success records and available talent pool [9].

**1.3 Smart Factory**

Smart factory is cluster of dynamic organization with production facility operating simultaneously in many parts of the world using support and command from a common mother factory. It works through collaboration between different industrial and non industrial partners. Smart factory is globalized, localized, flexible, and agile. It works on lean manufacturing system.

A well known example of smart factory is Bosch Company at Blaichach, Germany that operates a smart factory and heads a group of 11 plants all over the world. They consider it as a smart mother factory for all the plants producing the same kind of automotive components. More than 5000 standard components have been already networked. Common knowledge database is created and utilized throughout the world for process as well as detection of faults in machine or the product. Provision is available to obtain on line advice on new problem. After the problem is solved, the solution gets entered in the database. Technologies used in smart factory include; Ubiquitous (omnipresent device), Cyber physical systems, Wi-Fi network, radio frequency identification (RFIDS) tags [10] [11].

**II. METHODOLOGY**

Research methodology concept was adopted in the present study that guided to select the appropriate method and module out of the various existing options found for the research work. The methodology provided the right procedure of describing, explaining and studying the core issue of the selected theme, 'Industry 4.0 and HR 4.0: Technologies and Systems Collaboration'.

## 2.1 Research questions

Formulation of the research question as appended below was done based on discussions with experienced professionals who had gathered together to share their views on the subject at Federation of Kutch Industries Association, Bhuj, Gujarat, India.

- **What** basic changes in traditional HR will transform it to HR4.0 so as to collaborate with Industry4.0?
- **How** can the work culture of Industry 4.0 and HR4.0 be built and sustained in an organization?
- **Whether** machines and technologies will replace human?

Answer to the last question was offered by a participant quoting words of Albert Einstein, “The human spirit must prevail over machines and technologies”. There was a unanimous acceptance of the thought.

Efforts have been made to answer these research questions using selected tools of research including; use of library, available resources like electronic journals, use of internet for finding literature and collecting secondary data, and also through verbal reasoning, argument, analysis and critical analysis of prior research. These answers are addressed partially in the subsequent sections. Some answers require future research work.

## 2.2 Model selected and re-modulated for transforming HR to HR 4.0

Figure 1 shows a model recommended by Dhanpat, N [12], and re-modulated for HR professional to drive Industry 4.0 to achieve the revolutionized HR 4.0. The model summarizes the working conditions of Industry 4.0. It provides insights to ensure that HR professionals take initiatives of; (i) Networking (ii) Development programs and (iii) Understanding the work environment. These initiatives develop competencies illustrated in four quadrants (iv) to (vii) of a circle. These 7 important factors support HR professionals to deliver HR work effectively by playing role of HR in the changing work conditions. The model at the tail end shows the transformed HR 4.0 providing output in terms of: (a) Effective HR's delivery (b) Re-skilling of employees (c) Strategic shift and (d) Effective talent management. The model further shows separate rectangular boxes identified as (iv) to (vii). These are important competencies factors such as:

(iv) The creative innovator has many opportunities as presented by Industry 4.0 like; innovative and improved system, enhanced talent management, delivery of HR work.

(v) The change agent has to handle the challenges presented by the emerging work conditions of Industry 4.0 like; uncertainty, and adopting change despite resistance.

(vi) The emerging technologies influence organizations in terms of; embracing technology, new ways of work, automation and HR agility.

(vii) Industry 4.0 has influence on HR strategy by digitalization of work, delivery of work on time, re-skilling strategy.

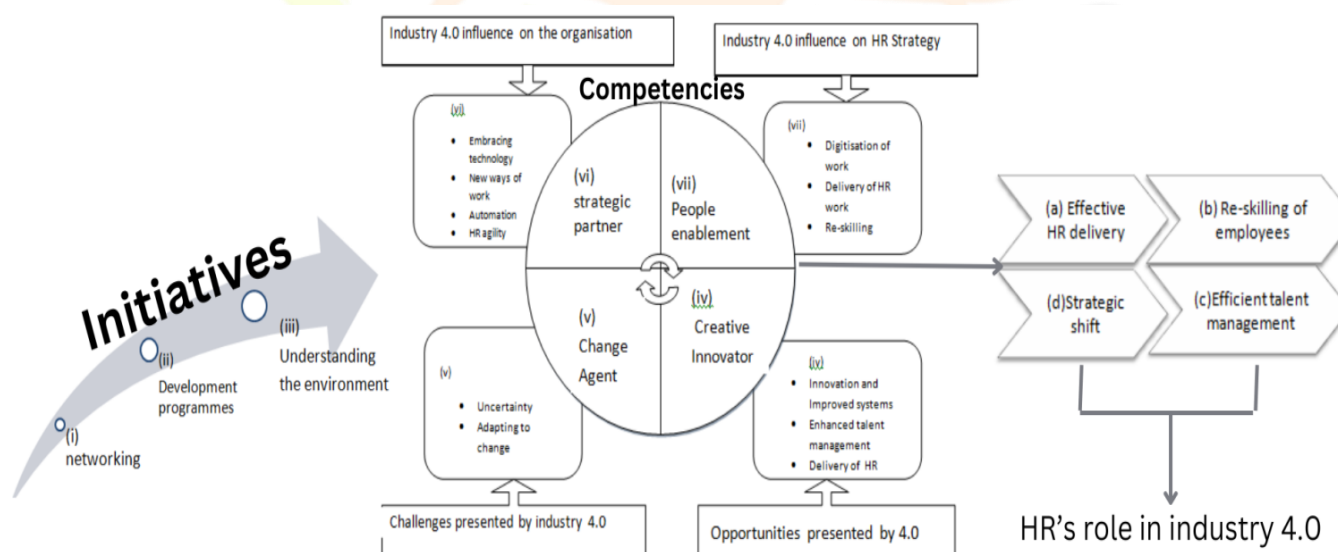


Fig. 1. Model for HR transforming to HR 4.0

## III. LITERATURE REVIEW

The process of reviewing relevant literature provided information available in books, journals, and internet during this research work on the topic, ‘Industry 4.0 and HR 4.0 Collaboration’. Literature with theoretical frame work has supported in indicating clearly how HRM is shifting its role, functions, and practices. It also highlights historical background and the need to examine the circumstances that bring changes and its influence for good or bad results. The other part of this literature review is conceptual framework to outline possible course of action. Accordingly the conceptual frame work has been used in different ways including action plan for transformation of HR 4.0 in collaboration with Industry 4.0 in various parts of this section.

### 3.1 Collaborating role of HR with Industry 4.0

In the emerging digitalization at workplace it is important for HR professionals to embrace specific roles like;

- (i) human capital developer fostering a culture of re-skilling, up-skilling, and lifelong learning
- (ii) function expert in selecting and hiring best candidate
- (iii) strategic partner such as consultant or business partner
- (iv) change agent to deal with employee's resistance to change[13].

HR 4.0 will focus on managing diversity and thinking globally to handle workforce. Accordingly, HR roles will be re-designated based on specialization like; IHRM i.e., international human resource management, SIHRM i.e. strategic international human resource management for acquisitions, mergers, selection and negotiation in other nations. HR roles will be further re designated including; cultural ambassador, HR data scientists, digital HR lead, diversity and inclusion officers, bot monitor, chief learning officer (CLO), employee experience specialist, chief human resource officer (CHRO) and so on [14]. The purpose of specialized role now is to enable effective interaction with counter parts like technological role players such as; web integrator, content curator, digital work expert and many others rather than earlier designations of departmental heads.

### 3.2 Aligning functions of HR with Industry 4.0

HR functions [15] [16] of today will change transforming the same as HR 4.0. Examples;

#### 3.2.1 Sourcing and recruitment:

AI (Artificial intelligence) is going to do resume and bio-data sourcing. NLP (Neuro linguistic programming) will search past success records creating talent pool, video based interviewing and more [8].

#### 3.2.2 Orientation program for new employees:

VR (virtual reality) and Google cardboard will make the orientation effective.

#### 3.2.3 Removal of redundancies in HR operation:

RPA (robotic process automation) will take over the mass documentation work[9].

#### 3.2.4 Taking HR services to different level:

This will be done with chat application like; slack, Face book messenger, robots answering the queries on phone, reducing load on HR resources.

#### 3.2.5 Re-defining learning making it more relevant:

Learning will be done through AI, Machine learning algorithms, you tube, and digital books.

#### 3.2.6 Employee engagement:

This will be done by "wellness Apps" through IoT i.e., Internet of Things.

#### 3.2.7 Performance Management:

The HR function of performance management is developed within a company as an employee enabler. According to Wayne F. (2010) [17], performance management is a strategic and integrated approach to increase the effectiveness of companies by improving the performance of the people and by developing the capabilities of teams and individual contributors who work there. Therefore, well designed system which is maintained and supported at every stage only can bring good performance. According to Brain Tracy (1993), performance is the accomplishment of a given task measured against standard of accuracy, competence, cost and speed [18]. Therefore a company ensures that employees or teams know what is expected to be accomplished. The company further ensures that three important elements like goal, measure, and assessment are made part of the performance management system of the organization.

It is found that traditional context-independent HR standards and practices are not enough to develop desired quality of workforce ready to meet the requirement of Industry 4.0. Section 3.3 further explores the subject under heading performance appraisal which will be termed as performance management in the new context.

### 3.3 Collaborating practices of HR with Industry 4.0

Human resource practices when designed well, improve productivity and growth of industry. Industry 4.0 adopts the method of digitalization throughout the value chain. Such a work culture of automation demands interconnection of machines, systems and more importantly a well trained workforce. Therefore, following HR practices have to be redesigned to collaborate with Industry 4.0

#### 3.3.1 Training:

Training sessions should be on-going and lifetime using virtual reality and AI for analytical thinking, enhancing the innovative capabilities, multi-skilling, re-skilling, up-skilling, problem solving and so on. On-job training is required more due to mismatch of education and job requirements. HR professional representing a company should partner with universities to provide digital education as part of career development program.

**3.3.2 Staffing:**

Well structured recruitment and selection procedure ensures hiring of right candidate for any job [19] [20]. As regards candidate's resume application, use of AI or full automation is needed for sorting and selecting practices. Types of tests for hiring include: psychometric test, test for active imagination, inner attentiveness, intelligent curiosity, creative and flexible thinking [21].

**3.3.3 Compensation:**

Reward system should be made more flexible and individualized. Compensation must be commensurate with the contribution of employees to the company. This could be performance at individual, group or organization level. Good performers should be rewarded by way of profit sharing or extra incentive pay [22]. Work environment should be inductive to innovation and learning in the organization to facilitate creative work. Competitive improvement schemes should be launched at workplace to motivate employees and also to attract potential employees from outside the organization.

**3.3.4 Job Design:**

Job design specifies the right method to carry out an activity, repetitive or otherwise to create value and good quality providing benefit to employees and employers. A good job design provides adequate information related to the job like specification, inputs, time standard, activity chronology, and output. Opportunities for on-job learning, job-rotation, multi-skill development are the motivating factors that are used while job designing. Further, job design should promote team work and collaboration [23]. Industry 4.0 uses job design to help organization in bringing quick changes through innovations demonstrating flexibility in business environment [24].

**3.3.5 Performance Appraisal:**

HR practices include performance appraisal which will change to Performance Management. There will be no annual review but real-time feedback will be monitored through smart analytics and AI enhanced Apps. There will be more use of Big Data, biomedical data or data from the machine employee operates. In any case, it is predicted that performance management will be strictly data-driven. Biomedical data will be analyzed through smart watches and technical data through the machine the employee operates [25] [26].

**3.4 Aligning talent management themes of HRM with Industry 4.0**

A systematic literature review and content analysis result provides clarity on talent management. 93 papers from 75 journals were subjected to theoretical and conceptual review suitably. The research work was conducted by da Silva and team (2022). The result shows that Industry 4.0 impacts the field of HRM in 13 different themes represented below in brief [15]. The talent management themes of HR to collaborate with Industry 4.0 consist of 4 different heads namely;

**3.4.1 HR – Competence**

It is the goal of acquiring talent itself.

**3.4.2 HR – Digitalization**

It can be considered as base of a talent pyramid house grouted on 4 elements; Future trends in HRM and workforce, HRM and technology, Human-Robot collaboration, and new ways of working.

**3.4.3 HR – Management**

It constitutes four strong pillars of the pyramid talent house. They are 4 in numbers; learning and training, recruitment and selection, reward and performance management, and talent management itself.

**3.4.4 HR – Strategy**

It can be considered as the roof of the pyramid consisting of 4 elements; Diversity and inclusion, leadership, organizational changes, and organizational culture.

Therefore, in 13 different ways Industry 4.0 impacts the field of HRM. In fact, these are the challenges for; HRM, the workforce and the organization. Talent with competence as its goal - is necessary to identify the change and trends in HR from the use of digital technology and disruptive groups in HR that will achieve this change. It is important to understand using talent and competence how technology can change HRM practices so as to collaborate with Industry 4.0 [15].

**3.5 Six new people strategies arising for HR with Industry 4.0**

According to the white paper published by the World Economic Forum (Dec 2019) six imperatives (prerequisites/compulsory and essential) are identified for the emerging HR 4.0. These imperatives are discussed with emerging HR practices and functions below [14].

**3.5.1 Developing new leadership capabilities for the 4IR:**

The newly designated Cultural Ambassador and Digital HR Leader jointly play the role of heading this function. The function of this imperative is to drive Industry 4.0 practices like; deal with confusion, collaborate technology with skill of the workforce, use new work culture analytics in the organization.

**3.5.2 Integration of technology in the workforce:**

Head of Re-skilling with head of 'Relevance and Purpose' function jointly work for this imperative to manage new practices like; plan for job re-skilling, identify re-skilling pathways for talent whose work is being transformed by automation, coordinate a combination of actions to address the impact of automation, build a talent to find alternative work models and methods of finding needed skills.

### 3.5.3 Enhancing the employee experience:

Employee Experience Specialist with Bot Monitor from emerging HR Function work for this imperative and drive Industry 4.0 practices like; create a holistic and purposeful employee experience, rethink and invest in employee well-being, align the employee experience with the agile operating model, use technology to engage employees.

### 3.5.4 Building an agile and personalized learning culture:

Cultural Ambassador as a functional head works for this imperative and drives emerging leadership practices like; create a culture of lifelong learning, sharing responsibility, engaging and pro-actively providing safety to employees in risky jobs, sharing the learning-mix that is right for the organization, track and measure level of skill often in the organization.

### 3.5.5 Establishing metrics for valuing human capital:

Head of insights and HR data scientist as functional head work jointly for this imperative and drive Industry 4.0 practices like; Use new technologies and data to develop new human capital metrics, use technology and data to drive the business decision making, create external reporting on the value added by human capital, include all forms of human capital within the organization's metrics.

### 3.5.6 Embedding diversity and inclusion:

Diversity & inclusion officer as a functional head works for this imperative and drive Industry 4.0 practices like; Carefully manage diversity in collaboration with business growth, place diversity & inclusion into concrete steps in culture and process, use data analytics strictly to measure diversity and evaluate inclusion, collaborate with stakeholders and knowledge sources beyond the organization.

## IV. DATA ANALYSIS

Documented data analysis reports including other from McKinney indicate that half of all existing work activities could be automated by currently existing technology. The situation suggests that it is worthwhile moving ahead with the implementation of automation in the field of HRM despite the prevailing uncertainties associated with Industry 4.0. Action plan may fully transform to collaborate with Industry 4.0.

Table 1. below shows a data analysis report based on the present research work. Before and after status of the four macro group of HRM present significant change after transformation so as to fully collaborate with Industry 4.0.

**Table1. HRM - Before and - After Industry 4.0 Transformation: Data Analysis report**

Macro Group HRM4.0	HRM-BEFORE – Industry 4.0 Transformation	HRM4.0 - AFTER – Industry 4.0 Transformation
HR Digitalization	<ul style="list-style-type: none"> <li>-Monitoring workforce performance non-automated way</li> <li>-Mental health promotion depends only on traditional work environment.</li> <li>-HRM considered as a manual or no digital area</li> <li>-Not flexible and non-automated system</li> </ul>	<ul style="list-style-type: none"> <li>- Performance monitoring from interactive digital platform</li> <li>-Digital work environment promotes mental health</li> <li>-Applying technologies like AI and Big Data for HRM activities</li> <li>-Flexible, interactive, collaborative between people and robots</li> </ul>
HR Management	<ul style="list-style-type: none"> <li>-Training only to develop hard skill</li> <li>-Recruitment based on qualification and face-to-face interview</li> <li>-Reward based on seniority / time span of work</li> <li>- Retention of talent based mainly on remuneration</li> </ul>	<ul style="list-style-type: none"> <li>-Re-skilling, up-skilling and developing digital age soft skill</li> <li>-Recruitment on competency via smart digital platform</li> <li>-Reward based on competencies-changed career and development</li> <li>-Retaining talent based on autonomy and self management</li> </ul>
HR Strategy	<ul style="list-style-type: none"> <li>-Lack of incentives to diverse groups within the company</li> <li>-Traditional leadership</li> <li>-Centralized organization structure, and no involvement of workers</li> <li>- Culture with an emphasis on continuous improvements</li> </ul>	<ul style="list-style-type: none"> <li>-Develop strategies to stimulate and inclusion using digital technologies</li> <li>-Leadership skill-fully designed for encouraging innovation and promoting mental health</li> <li>-Decentralized structure with direct involvement of the workers</li> <li>-Digital culture, dynamic and easily adaptable</li> </ul>
HR Competence	<ul style="list-style-type: none"> <li>-Increased importance of hard skill</li> <li>-Programmable Logic Controllers (PLC) and machine manipulation</li> </ul>	<ul style="list-style-type: none"> <li>-Emphasis on soft skill and new hard skills focused on digitalization</li> <li>-Digital Literacy, Problem Solving, Self Management</li> </ul>

	-Incentive based on employment period	-Encouraging skills development and lifelong learning
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## V. RESULTS

This review includes major research data bases on the topic together with several HR conferences at national level that provided opportunity to interact with experts in the field. As regards finding answer to research questions framed and documented in section 2.1, discussion is appended below.

### 5.1 What basic changes in traditional HR will transform it to HR4.0 so as to collaborate with Industry4.0?

The basic changes in traditional HR that will transform HR4.0 to collaborate with Industry 4.0 appear at section 4 under four different heads.

### 5.2 How can the work culture of Industry 4.0 and HR4.0 be built and sustained in an organization?

Solution to the second question has been drawn from the change that occurred in the near past during transition of lean management. Bill Costanto (2016) [27] advocates for creating a work culture of continuous innovation in a profession. Employee undergoes on-job training under the watchful eye of the mentor. Employees are empowered to make rapid decisions and innovations at the exact location where the work is being done. In fact, cultural transformation requires changing the minds and skills of the workforce to support the desired transformation. Digital culture change is equally or more complex compared to the Toyota Way Lean Culture which was developed in decade time by talented professionals. According to LIKER J. (2006), "People are most important asset. Machines depreciate and lose value. People appreciate with time and continue to grow acquiring talent [28]."

### 5.3 Whether machines and technologies will replace human?

The last question resulted in mixed responses. Opinion of Albert Einstein already quoted in section 2.1 emphasizes that human qualities should remain dominant even as technology advances. However, the HR function of today will definitely look different in future. People may not be replaced but their job will change in accordance with individual competence.

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