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Informatics: Foundation, Nature, Types and Allied areas— *An Educational &Analytical Investigation*

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ABSTRACT

Informatics is an emerging subject that concern with both Information Technology and Management Science. It is very close to Information Science, Information Systems, Information Technology rather Computer Science, Computer Engineering, Computer Application, etc. The term Informatics widely used as an alternative to Information Science and IT in many countries. Apart from the IT and Computing stream, the field 'Informatics' also available in the Departments, Units, etc. viz. Management Sciences, Health Sciences, Environmental Sciences, Social Sciences, etc., based on nature of the Informatics. Informatics can be seen as a technology based or also as a domain or field specific depending upon nature and thus it is emerging as an Interdisciplinary Sciences. There are few dimensions of Informatics that can be noted viz. Bio Sciences, Pure & Mathematical Sciences, Social Sciences, Management Sciences, Legal & Educational Sciences, etc. This is a conceptual paper deals with the academic investigation in respect of the Informatics branch; both in internationally and in India.

Keywords: Informatics, IT, Informatics Systems, Biological Informatics, Emerging Subjects, Academics, Development

Informatics is a developing field that cares about both technologies and information. Initially, it was treated as a practicing nomenclature and now it becomes a field of study and growing internationally in different higher educational institutes which are offering a program on simple 'Informatics' or any domain specific viz. 'Health Informatics' or 'Bio Informatics'. There are different Information Technology components and all these important to do information activities such as—

- ❒ Collection of Information.
- ❒ Selection of Information.

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- Organization of Information.
- Processing of Information.
- Management of Information.
- Dissemination of Information.

Informatics as a Science of Information also uses different Management tools, techniques, procedure, methods, etc. Moreover, as the branch is a little different from the existing Computer Science so it is also closely connected with the Social Sciences and Humanities as well.

Objective

The current paper is conceptual, analytical in nature and deals with mainly following aim and objective—

- To learn about the basics of Informatics; including its nature and characteristics.
- To gather information on background, foundation, evolution of Informatics and allied branches.
- To find out the types, nature of Informatics as a practicing area and a field of study as well.
- To learn about the Informatics related to the Bio Sciences, Pure & Mathematical Sciences, Social Sciences, Management Sciences, Legal & Educational Sciences.
- To learn about the academic programs, degrees and nomenclature offered in Informatics.
- To gather information about the traditional and emerging areas of research in Informatics and allied branches.
- To learn about the further potentialities in respect of Informatics field of study.

Informatics and Background

As far as historical background is concerned in the year 1956, Karl Steinbach, a German computer scientist first coined the word *Informatik* in a paper called *Informatik: Automatische Informations verarbeitung*. However, in the year 1962, the term *informatique* was coined by Philippe together with various translations.

If we search then it can be noted that Mikhailov was advocated the Russian term *informatika* in the year 1966 and later on in 1967 the English term *informatics* was coined and become popular. Then it was appeared as a *theory of scientific information* and argued for a broader meaning. Further, it is a field of study and also uses of information technology in different kinds of sectors or various communities[1],[9]. Further, it can be deemed as the interaction of technology with information with the human organizational structures (Refer Fig. 1 & 2).

Initially, the domain specific Health Informatics term got popularized and also many universities and educational institutes introduced and termed 'Applied Informatics'. From the study, it has been noted that in European countries it is a kind of information centric field whereas in the United States it is more concentrated on Computing or used as an alternative to Applied Computing or to show the applications from the Computer Science.

Informatics is an applied science and treated as both academic and practicing subject. It is close with Information Science and Information Technology in many contexts[2],[7],[9]. The field Informatics is a concern

with collection, selection, organization, processing, management, and dissemination of information. Information processing activities are the core jobs of the Informatics and emerged during 1970-90s.

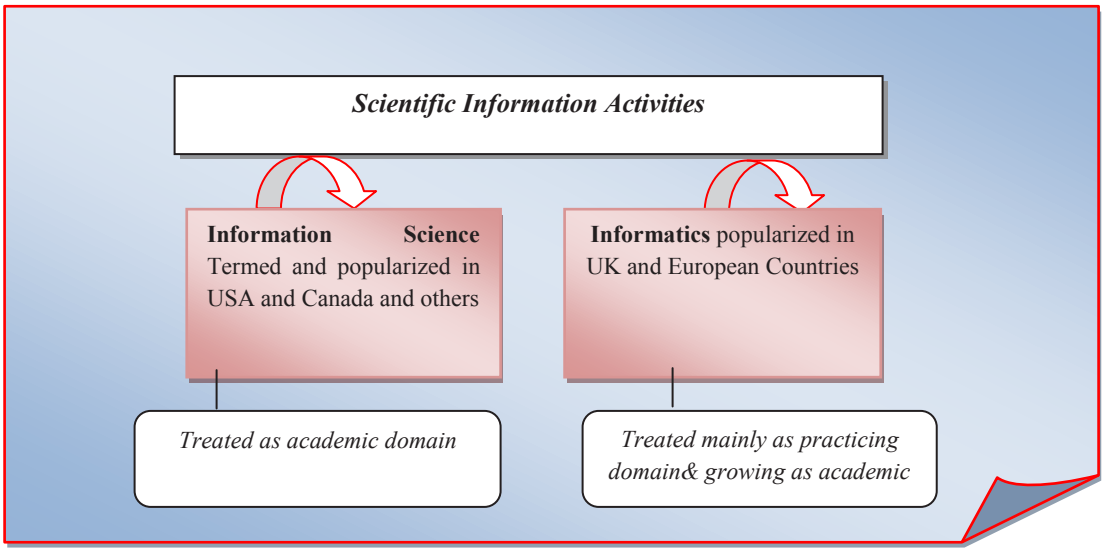

Fig. 1: Information Science Vs. Informatics

Informatics is treated as the alternative of the Information Technology and Computing field in many contexts. Informatics as a field can be seen with two foci, in first foci, it is the field with a concentration of information basics viz. information management, information processing,etc with a partial focus on technologies for doing these tasks; in another focus, the core concentration is on technologies[3], [13], [14].

Informatics is applicable not only in the IT organizations but also in educational Universities, Research Centers, Governments Department, and Ministries, etc. Here, *Fig. 1- Depicted Information Science vis-a-vis Informatics- similarities and dissimilarities.*

Informatics, Information Science and Other Allied Fields

The branch 'Information Science' is broad enough and evolved as a scientific study of information. Gradually it was considered as a branch of study and concentrated on other subjects and among these Library & Information Science can be treated as important[09], [23].

However, the major difference between 'Informatics' and 'Information Science' is that, first one of practicing based (and now developed as a field as well) and the second one as an academic branch of study. We can see different types of Information Sciences similar to Informatics and among these major or important are—

- ❒ Medical Information Science
- ❒ Health Information Science
- ❒ Geo Information Science

Other subjects which have other domain concentration viz. in Chemistry (Chemo Informatics), in Bio Science (Bio Informatics) and other are not commonly available as Chemo Information Science or Bio Information Science[4],[17],[18],[19]. So, it is clear that Informatics and Information Science; both are very close as well. Apart from this, some other very close fields are—

Information Systems

Information Systems is another branch close to Informatics. This field is responsible for the evolution, designing, development of overall information infrastructure of organizations, institutions whereas Informatics is not only instituted specific but also domain/ sector specific viz. Bio Informatics, Media Informatics. Though this branch is also using the tools, technologies as mentioned in Informatics[5],[24],[25].

Information Technology

Information Technology is another close field of Informatics. And it is related, as this uses various components and technologies such as Database Technology, Network Technology, Web Technology, Multimedia Technology, Software Technology. This is less information centric than Informatics or Information Science or Information Systems.

Computing

Computing is another branch and doing the affairs of computation and computer and similar devices use. Further, Computing is less focused on hardware design and development.

Though,Computer Science, Computer Engineering is far different from the Informatics. As such branch deals with mathematical and hardware designing and development related affairs mostly.

Informatics and Components

As an Applied Science, Informatics deals with various Computing and Information Technological components for the task of following—

- Knowledge Management.
- Documentation.
- Information Analysis, Consolidated, and Repackaging.
- Knowledge Organization, etc.

It is worthy to note that for the job and objective fulfillment of the branch 'Informatics', among the useful technological components few important are Database Technology, Network Technology, Web Technology, Multimedia Technology, Software Technology, etc. Within these technologies, many emerging tools and sub components are also using and rapidly growing viz.—

Network Technology the emerging and super specialty areas are Network Security, Cyber Security, Wireless Networks, Cloud Computing, Converged Network, and so on[6], [10], [11].

Web Technology is composed of different emerging areas viz. Usability Engineering, User Experience Designing, Human Computer Interaction, Web Designing and Development, Content Management, etc.

Whereas, *Multimedia Technology* deals with various areas viz. VFX, Usability Designing, Animation, Interactive Information Systems.

Software Technology is the most traditional area of IT and it deals with software and application development using various high level programming languages.

Database Technology is currently dealing with traditional Database Management, Data warehousing & mining, Advanced Information Management, Big Data Analytics, Data Science, etc.

Security Technology, combines with Web & Database Security, Network Security, including the latest Cloud and Mobile Security, etc. The issues such as IT Security Policies, Governance, etc are also important.

Types of Informatics

Based on the nature of the Informatics, it can be classified into differently and internationally based on academic institutions.

Informatics applications or integration with the Pure Science related areascan be considered as following—

- *Computational informatics.*
- *Engineering Informatics.*
- *Evolutionary informatics.*
- Hydro informatics.
- Energy Informatics.
- Irrigation informatics.
- Materials informatics.

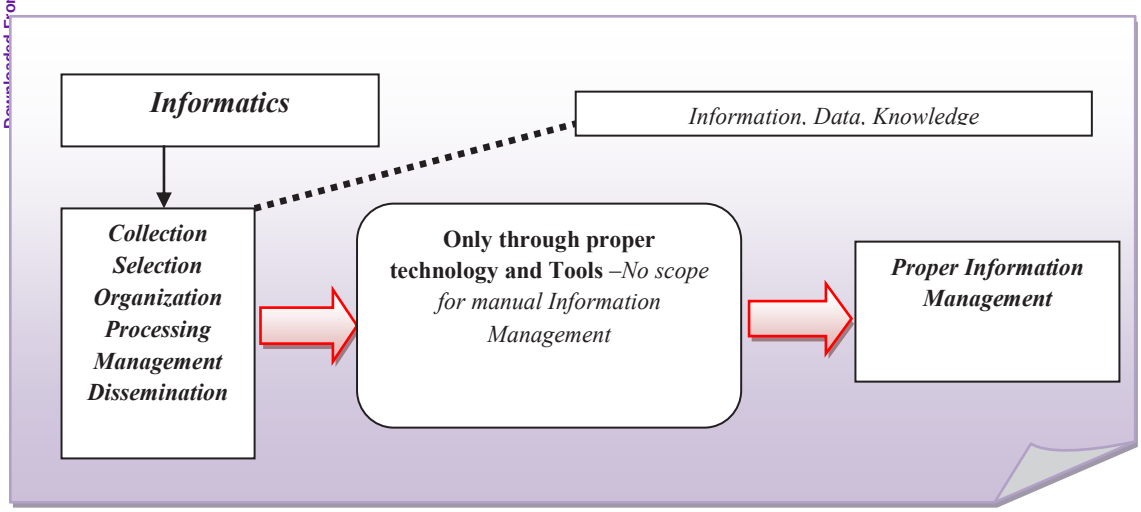

Fig. 2: Fundamentals of Informatics. (Paul, PK)

Informatics of Biological Sciences are also very popular and widely available[4],[12],[15]. The development of this approach is higher than that of Pure Science around the world.

- Environmental informatics.
- Disease informatics
- Forest informatics
- Bio Informatics
- Health informatics
- Laboratory informatics
- Neuro informatics
- Forest informatics.
- Geo informatics.
- Brain Informatics.
- Behavior Informatics.
- Cognitive Informatics.

Some researcher advocated and introduced different other Informatics namely—

- Cloud Informatics
- Legal informatics
- Pervasive Informatics
- Data Informatics
- Security Informatics.

Informatics and Academics

The field Informatics is broad enough and internationally different organizations, institutions, universities offers educational programs on Informatics ranging from Certificate, Diploma, Bachelors, Masters, Research Degrees[8],[16],[20].

It is worthy to note that among the Post Graduate Programs most available are Post Graduate Certificate, Post Graduate Diploma, Post Graduate Degrees leading to following—

- MSc
- MS
- MTech/ ME by Coursework
- MTech/ ME by Research
- MPhil, etc.

Similarly, in Bachelors also programs are offered in the above mentioned degrees and this trend differs from country to country. In some institutes even innovative subject & informatics programs available viz. BS Biology and MS Bio Informatics.

As far as India is concerned, general Informatics is not available though, domain specific Informatics is available in many subjects viz.

- Health Informatics,
- Bio Informatics,
- Geo Informatics.

Most of the universities have started to offer the programs in the concerned nomenclature department viz. Department of Health Informatics[7], [17], [22]. There are different areas evolving as research emergences & frontiers Fig. 3.

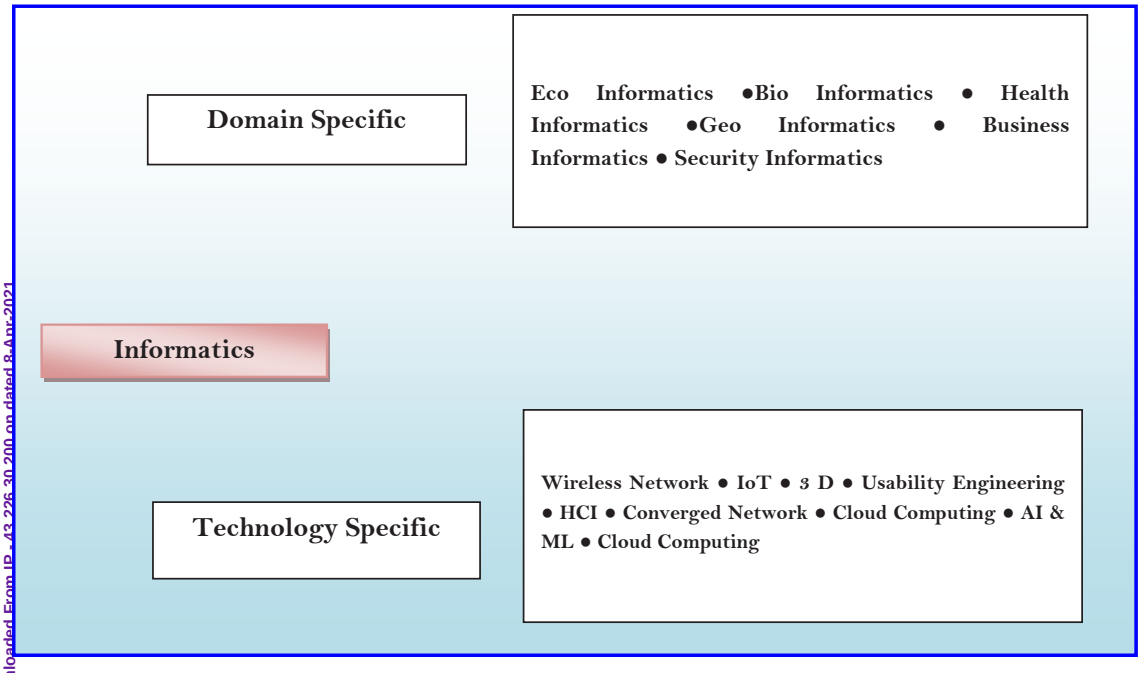

Fig. 3: Emerging Research areas in Informatics.

Findings

- The branch Informatics is broad and interdisciplinary in nature and focused on Information.
- Informatics may be in-general or domain specific.
- Informatics is very close to Information Science, Information Systems, Information Technology rather Computer Science, Computer Engineering.
- Informatics is offered in the dedicated 'Informatics' or allied departments or units or domain specific viz. Environmental Informatics in the Schools/ Units/ Departments in Environment & Ecology, etc.
- Informatics is very much related to different components and sectors viz. Physical Science, Bio Science, Social Science, Management Science, etc.
- In India, common Informatics programs are mainly Geo Informatics, Bio Informatics, Health Informatics.

CONCLUSION

Information is an important and vital source for each and every kind of organizations, institutions and so on. Information is very much close to the data and knowledge. Previously only information related affairs viz. collection to dissemination performed by the manual tools and techniques but the development of science and technology played a vital role in respect of information affairs. Informatics also started with different nomenclature viz. Informatics & Analytics, Informatics & Communication, Informatics and Information Management, Bio Medical Informatics, Informatics & Information Systems, etc. Even in domain centric Informatics, the merged title noticeable viz. Bio & Health Informatics, Geo & Environmental Informatics, etc. In India also use of the term Informatics is increasing both at Government and Private categories.

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Hydrothermal Synthesis and Spectroscopic Characterization of one-dimentional Rod-like Hematite (α-Fe_2O_3) Mineral in Alkaline Medium

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ABSTRACT

Rod-like α-Fe_2O_3 was synthesized by hydrothermal method and characterized using spectroscopic methods of analysis. X-ray diffraction (XRD), Fourier transform infrared (FTIR), X-field emission scanning electron microscopy (FESEM), elemental diffraction X- ray (EDX), transmission electron microscopy (TEM) and dynamic light scattering (DLS) methods were used to characterize the synthesized mineral. XRD analysis shows that the single-crystalline sample indexed as the pure rhombohedra α-Fe_2O_3 material was formed while the DLS and zeta potential analysis indicated average particles sizes of about 1300.9 nm and 31.2 mV respectively. The morphology and shape of the synthesized mineral was studied with FESEM and TEM while the elemental analysis was done with EDX. FESEM and TEM analysis show that the synthesized **α-**Fe_2O_3 minerals were rod-like in shape while EDX analysis gave a good composition of the elements of the synthesized material. Therefore, this method may be applied to synthesize other forms of iron minerals or other inorganic materials at industrial scale especially when rod-like materials are needed.

Keywords: Synthesis, Hematite, characterization, rod-like

Iron based minerals have been used for centuries in many applications such as in science, technology and engineering. The use of iron oxides, hydroxides and oxohydroxides in different scales or sizes has been applied in medicine, as coloring pigment and in environmental remediation. Other areas where iron minerals have been utilized include microbial sciences, imaging systems, pharmaceutical sciences, biological products, civil engineering, immobilization techniques, and chemical industries. Among these

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iron based minerals, α-Fe_2O_3 is a major component of various types of sediments, soils and iron ores and has gained prominent use as catalysts, electrodes, gas sensors, magnetic materials, photo catalyst, corrosion protective paints and for red pigment (1). Fe_2O_3 has shown a special property in the adsorption of metal ion wastewater in different research work (2). As a result of its wide areas of applications, efforts have been made by various researchers to find the easiest and fastest method to synthesize it. Some of the methods that have been applied to synthesize α-Fe_2O_3 include hydrolysis (2), co-precipitation [3, 4, 5], electrical explosion of iron [6], sol-gel method [7] and others. These synthesis methods have been used as templates by many researchers with many disadvantages including low yield of pure α-Fe_2O_3 and multi-dimensional synthesized materials.

In this research work, we have designed an easy and simple hydrothermal approach for synthesizing pure rod-like α-Fe_2O_3 in an alkaline medium using a hydrated salt of iron without any hard template or surfactants.

MATERIALS AND METHODS

Rod-like Fe_2O_3 was synthesized with $Fe(NO_3)2.9H_2O$ (98.0%) and NaOH (97.0 %). A 20 ml of ferric nitrate solution (0.2 M) with was prepared in a beaker with constant stirring at 600 rpm to a clear solution. Similarly, a 10 ml solution of 2.5 M NaOH was prepared in a beaker and stirred till the NaOH pellets completely dissolved in solution. The alkaline solution was gradually added to the nitrate solution in the beaker with continuous stirring at the same speed. After complete addition of the NaOH solution, the stirring is allowed to continue for 5 minutes and then transferred to the autoclave and water was added to make up about 80 % of the volume of the autoclave. The autoclave and its contents were transferred to an oven that was earlier put on to attain a temperature of 160 ˚C for hydrothermal reaction for 46 hours including the 1 hour that the autoclave was allowed to attain the temperature of the oven environment. After the reaction time, the autoclave was brought out and allowed to cool naturally to prevent change in the composition and morphology of the content. After cooling to the ambient temperature, the precipitate was filtered and washed for several times with ethanol and doubly distilled water thoroughly till free of nitrate ions and other impurities and then dried in an oven at 100 ˚C for 20 hours and the synthesized material was stored in a reagent bottle while a little quantity was taken for XRD, FTIR, FESEM, EDX, TEM, DLS and Zeta potential analysis.

Spectroscopic Characterization of α-Fe_2O_3

The phase identification of the synthesized mineral was characterized by X-ray diffractometer (XRD) with type empyrean series 2. The XRD pattern were recorded with 2θ in the range of 10 – 90 ºC with panalytical X-Pert high score (POM) equipped with Cu-Kα (λ = 1.54606 Å) at a scan rate time of 24.765 seconds with a generating set of 40 mA and 45 Kv at a temperature of 25 ºC. The morphology of the synthesized material was characterized by field emission scanning electron microscopy (FESEM) with type ZEISS evolution series 2000, 25 kV and transmission electron microscopy (TEM) with type tecnai G2 20 twin, FEI Netherland, 80 kV. The Fe and O elemental analysis of the samples was performed by energy dispersive spectroscopy (EDS) type Anton paar Lenovo litesizier 500. All the measurements were carried out at room temperature.

Table 1: List of XRD peaks for the synthesized rod-like α-Fe_2O_3 by hydrothermal method

Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]	Tip Width	Matched by
17.7153	5.66	0.4488	5.00260	0.38	0.5386	98-016-1283
24.2008	402.68	0.2856	3.67464	27.36	0.3427	98-016-1283
33.1810	1471.92	0.2652	2.69779	100.00	0.3182	98-016-1283
35.6822	1174.09	0.2448	2.51421	79.77	0.2938	98-016-1283
40.8855	429.13	0.2448	2.20544	29.15	0.2938	98-016-1283
49.4759	564.92	0.2856	1.84075	38.38	0.3427	98-016-1283
54.0560	845.28	0.2652	1.69510	57.43	0.3182	98-016-1283
62.4567	486.36	0.2448	1.48577	33.04	0.2938	98-016-1283
64.0193	539.70	0.2856	1.45322	36.67	0.3427	98-016-1283
71.9109	123.88	0.4896	1.31192	8.42	0.5875	98-016-1283

RESULTS AND DISCUSSION

X-ray diffraction spectroscopy (XRD) of the synthesized α-Fe_2O_3 material by hydrothermal method at 45 Kv and 40 Am was used to identify crystalline phases of the sample. Fig. 1a shows the XRD pattern of the powdered material which shows that α-Fe_2O_3 was the only phase present.

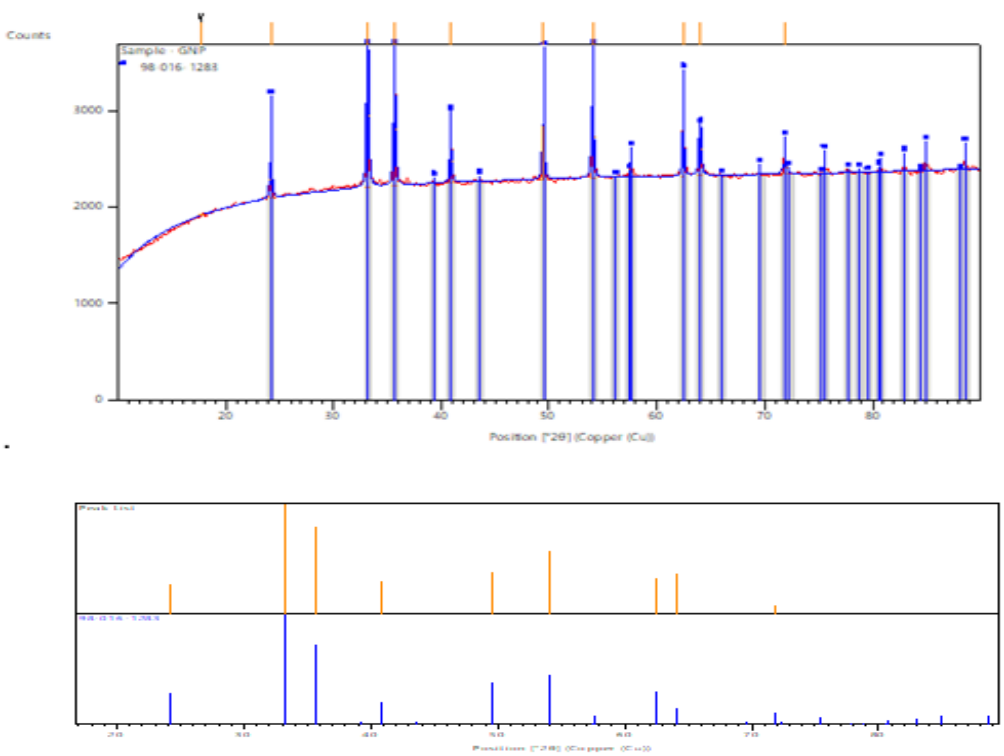

Fig. 1: (a) XRD pattern **(b)** Plot of identified phases of rod-like α-Fe_2O_3 synthesized by hydrothermal method

The XRD peaks at 2Θ = 17.7153, 24.2008, 33.1810, 35.6822, 40.8855, 49.4759, 54.0560, 62.4567, 64.0193 and 71.9109 represented in Table 1 correspond to the crystal planes (012), (104), (110), (113), (024), (116), (018), (214), (300) and (101) indexed as pure rhombohedra structure of α-Fe_2O_3 (a = 5.0380 A°, c = 13.7720 A°) which is identified using the standard data file No. 98-016-1283 (JCPDS). The plot of the identified phases of the prepared material is also represented in Fig. 1b. The peaks in the identifier plot correspond to peaks of pure phase of α-Fe_2O_3 mineral [8, 9, 10].

The surface morphology of the synthesized material was studied using field emission scanning electron microscopy (FESEM) method of analysis. The images of the α-Fe_2O_3 material as represented in Fig. 2 shows that α-Fe_2O_3 samples prepared by hydrothermal method are rod-like in nature with little agglomeration.

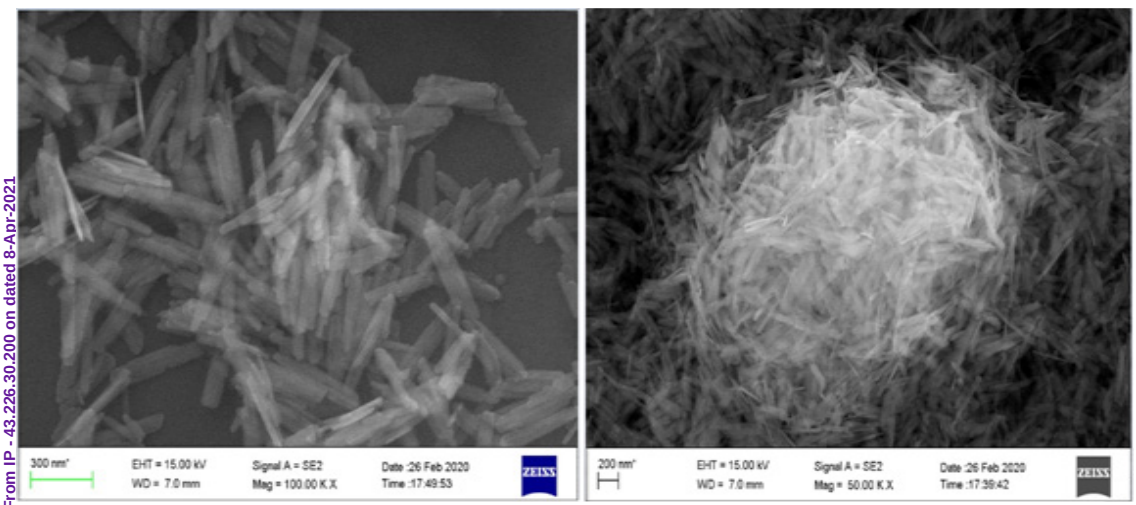

Fig. 2: FESEM pattern for the rod-like α-Fe_2O_3 synthesized by hydrothermal method

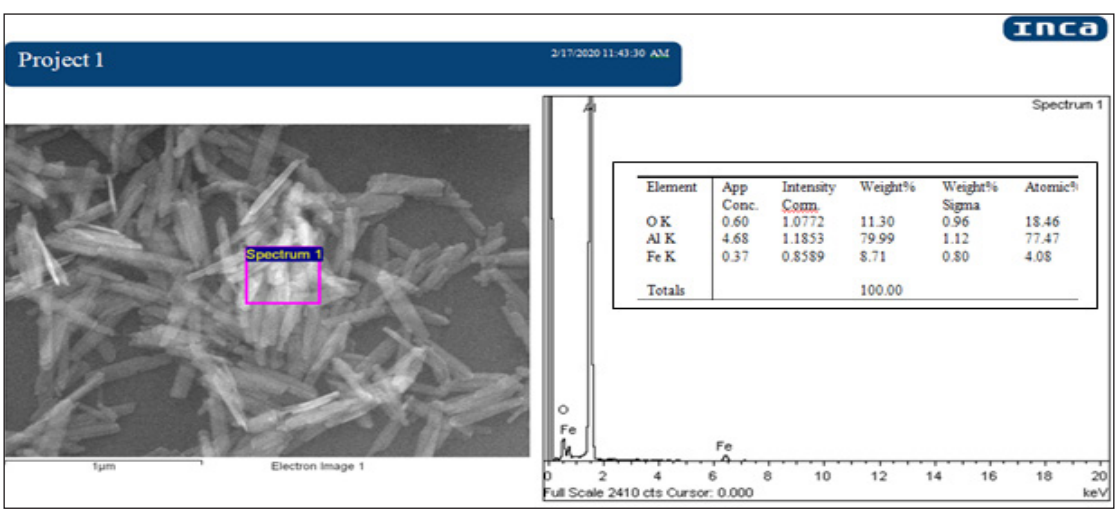

Fig. 3: EDS analysis for the rod-like α-Fe_2O_3 synthesized by hydrothermal method

The transmission electron microscopic (TEM) method of analysis was carried out after the synthesis of α-Fe_2O_3 mineral to confirm the growth pattern and the distribution of the crystallites sample. Figure 4 shows that the TEM image of the synthesized material by hydrothermal route is rod-like in structure which confirms the result obtained by FESEM analysis above. It can also be seen that the materials were prepared with less aggregation.

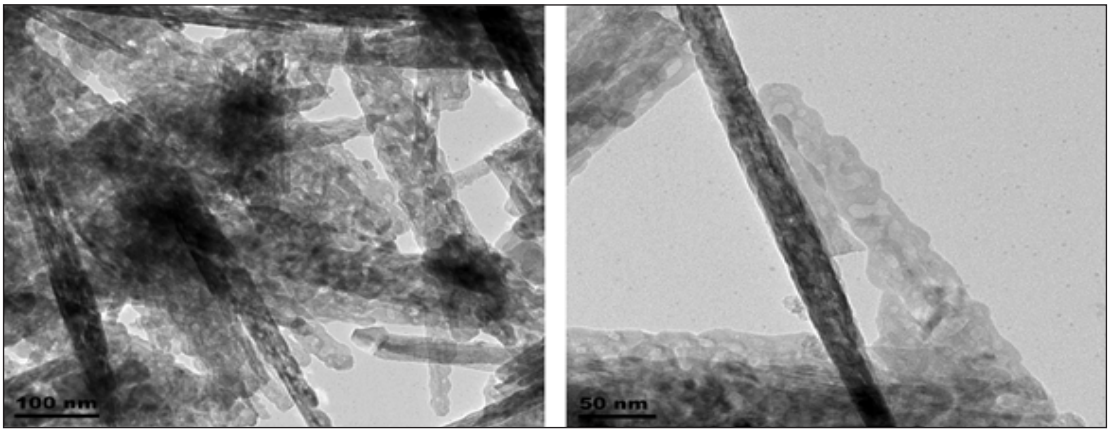

Fig. 4: TEM images for the rod-like α-Fe_2O_3 synthesized by hydrothermal method

Elemental diffraction spectroscopy (EDS) was used to analyze the chemical composition of the material prepared by hydrothermal method under FESEM analysis. Fig. 3 shows the EDS analysis of the synthesized rod-like α-Fe_2O_3 which confirms the presence of Fe and O with weight percent. The EDS result shows the peaks of iron and oxygen without any other elements present except the peak due to aluminium as a result of aluminium foil used to prepare the samples before analysis. The EDS result shows the degree of purity of the rod-like α-Fe_2O_3 prepared by hydrothermal method.

The mean size of the ordered rod-like α-Fe_2O_3 prepared by this method as represented in Fig. 5 was determined by using dynamic light scattering (DLS) method and was found to be about 1300.9 nm with a zeta potential of 31.20 mV as represented in Fig. 6.

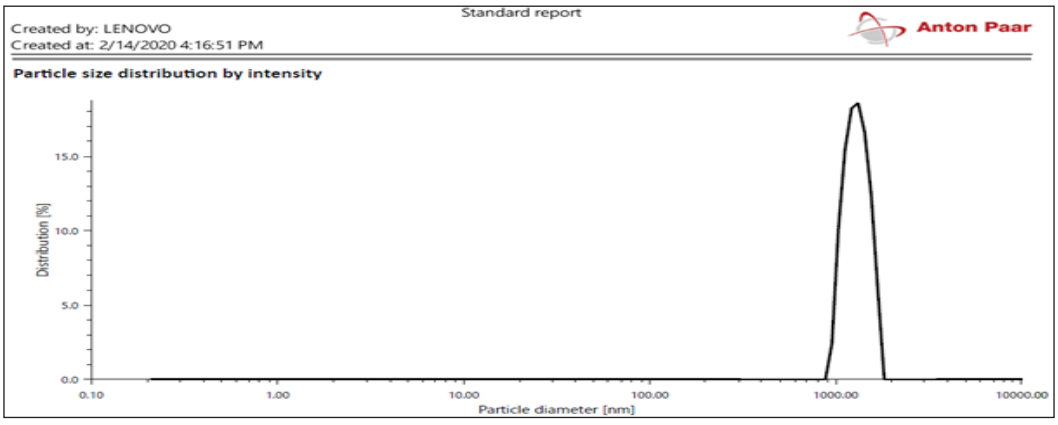

Fig. 5: DLS analysis for the rod-like α-Fe_2O_3 synthesized by hydrothermal method

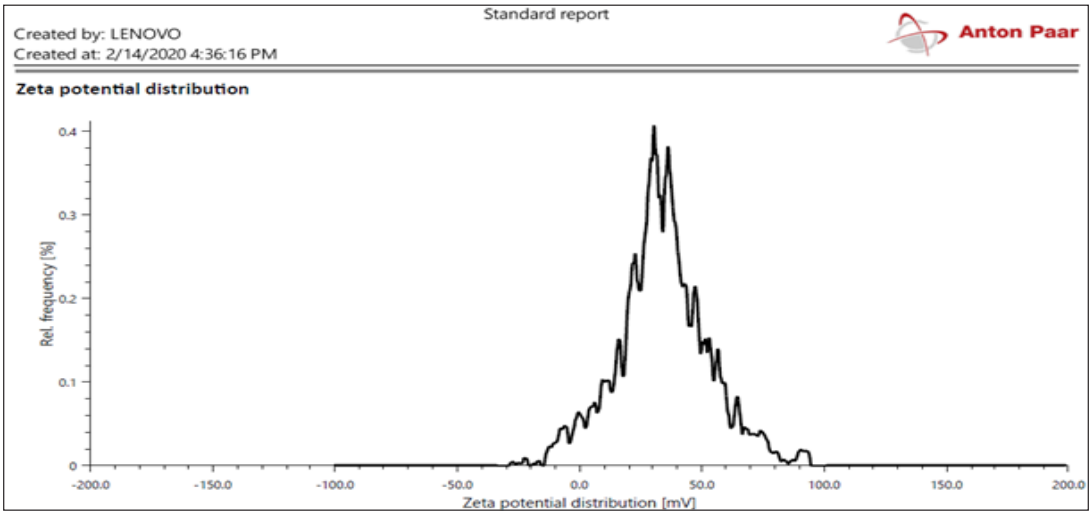

Fig. 5: Zeta potential analysis for the rod-like α-Fe_2O_3 synthesized by hydrothermal method

CONCLUSIONS

Simple hydrothermal method has been successfully carried out to synthesize α-Fe_2O_3. XRD pattern shows rod-like structure of α-Fe_2O_3. A SEM image clearly shows that the morphology of the synthesized material is rod-like in shaped with less agglomerate. The TEM image also shows that the synthesized α-Fe_2O_3 prepared by hydrothermal route has an average diameter of about 1300.9 nm and a zeta potential of 31.20 mV with less aggregation. The EDS result shows only peaks of iron (Fe) and oxygen (O_2) in the absence of other impurities in the synthesized rod-like α-Fe_2O_3.

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Wind Energy System Load Analysis with Voltage Regulator Controller based STATCOM

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ABSTRACT

The RMS values of the voltage outputs from the wind energy system where the speed of wind varies between 0 to 25 m/s has been observed. It is made to drive the heavy loads and the drop in the voltage outputs is being observed and compared with the system having the STATCOM with AC DC voltage regulation controller. The load has been varied continuously to observe the optimum value of load up to which both the systems are compatible. The waveform of the open circuit voltage output has a variation up to 800 to 1000 volts. This voltage should be maintained when it is made to drive any load without dropping in its value. It was observed that the voltage dip in system without STATCOM is more while driving 1000 KW load. However, the Optimum value of the system upto which it can drive load is 18KW and with STATCOM having AC DC voltage regulation controller It has improved to 50KW.

Keywords: Wind Energy, DFIG, Voltage Regulator, STATCOM, MATLAB

Electricity is the most common source of energy for families, workplaces and industry. Population and industrial growth have led to a significant increase in electricity consumption over the past three decades[1]. Natural resources such as coal, oil and gas, which have powered power plants, industries and vehicles for many decades, are running out very quickly. This serious problem has prompted nations around the world to consider alternative forms of energy that use inexhaustible natural resources[2].

The burning of conventional fossil fuels worldwide has caused an increase in pollution. Numerous international conventions and forums have been established to address and solve the problem of climate change. These forums prompted countries to develop national energy policies that address pollution control, energy saving and energy efficiency and the development of alternative and clean energy sources[3].

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(A) DFIG Configuration

The generator is configured using a wound rotor induction generator (WRIG) with the stator windings connected directly to the network and the rotor windings connected to the stator terminal via the AC / DC / AC converter. A transformer is used to regulate the voltage levels between the network and the converter on the network side. The layout of the DFIG configuration is illustrated in Fig. 1.

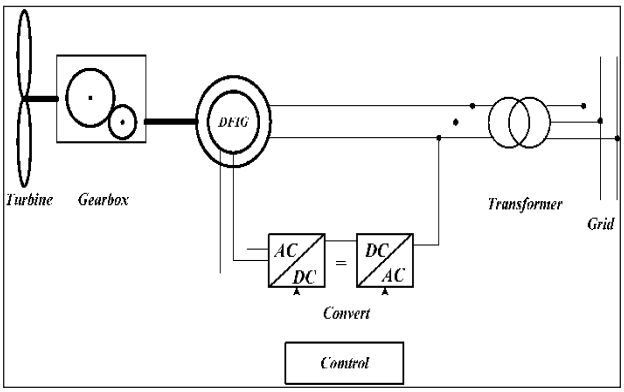

Fig. 1: DFIG Configuration[1]

The back-to-back converter is a bidirectional power converter consisting of two conventional voltage source converters with pulse width modulation (PWM) and a common DC bus with an intermediate circuit capacitor. Back-to-back converters are often used in DFIG-based systems for wind applications to generate more energy. Depending on the decoupled control strategy and complexity, DFIG can operate in both the sub-synchronous and super-synchronous speed range. This type of conversion system consists of two PWM converters with an intermediate circuit capacitor. The GSC must be checked so that the DC link voltage remains constant and is also responsible for controlling the reactive power of DFIG and the grid. The rotor side converter control strategy (RSC) essentially takes into account the control of the electromagnetic torque and the excitation currents of the rotor.

LITERATURE REVIEW

Zhao Xu *et al.*[2] proposed an extended control strategy for the line side rotor and converters of the double power wind turbine (DF) based on an induction generator (DFIG) in order to improve the low voltage throughput capacity (LVRT) in accordance with requirements network connection. As part of the new control strategy, the rotor side control can convert the unbalanced power into the kinetic energy of the WT by increasing the speed of its rotor in the event of low voltage due to a mains error, e.g. the common coupling point (CCP). The proposed line side control scheme introduces a compensation term which reflects the instantaneous intermediate circuit current of the converter on the rotor side in order to attenuate the fluctuations of the intermediate circuit voltage during the line failure.

Ammar F. *et al.*[3] proposed suitable designs of integrated proportional controllers (PI) for rotor side converters (RSC) and grid side converters (GSC) of the wind turbine type with double power induction generator (DFIG) to control current, voltage and power on the RSC side and the performance on the GSC side of the wind energy conversion system (WECS). Furthermore, the proposed controls have

been designed to reduce the overshoot fault current when different types of disturbances have occurred. The optimal design of the parameters of the proposed PI controllers is also represented by intelligent techniques, namely: optimization of bee colonies (BCO). The first step in this document is to limit the PI controller based on the trial and error method to examine the full performance of the WECS system.

Guo, Y. *et al.*[4] proposed an improved voltage control strategy (EVCS) based on the predictive control model (MPC) for high voltage direct current converted to voltage (VSCHVDC) connected to offshore wind farms (OWF). In the proposed MPC-based EVCS, all wind turbine generators (WTG) and the VSC on the wind farm side are optimally coordinated in order to maintain tensions within the achievable range and reduce system performance losses. Given the high ratio of the OWF sensor system, the effects of the active power produced by wind turbines on voltage regulation are also taken into consideration.

Sudhasmita Behera *et al.*[5] shown renewable, reliable and clean energy, wind energy attracted more attention. In this article, the analysis and modeling of the variable speed DFIG (induction generator with dual power supply) were presented and the control strategy was examined in two operating modes. Depending on the wind speed, the DFIG-based wind turbine can operate in sub and super synchronous operating mode with a back to back PWM converter.

Bharti *et al.*[6] analyzed the driving force and main causes of voltage instability. Different methods and devices used to enhance voltage stability are also explained. The steady-state and dynamic modelling of the power system devices including wind generators and photovoltaic units have been discussed.

METHODOLOGY

The model has been developed in MALAB/SIMULINK environment. This is a high-level matrix/array language with control flow statements, functions, data structures, input/output, and object-oriented programming features. It has following key features:

- High-level language for scientific and engineering computing
- Desktop environment tuned for iterative exploration, design, and problem-solving
- Graphics for visualizing data and tools for creating custom plots
- Apps for curve fitting, data classification, signal analysis, control system tuning, and many other tasks
- Add-on toolboxes for a wide range of engineering and scientific applications
- Tools for building applications with custom user interfaces
- Royalty-free deployment options for sharing MATLAB programs with end users

The modeling of Dual Voltage Source Inverter system is done which is capable of feeding the load with either solar or wind resources depending on the availability thus making the system more reliable

(B) Wind Energy System Modelling

Model of wind turbine with PMSG Wind turbines cannot fully capture wind energy. Output aerodynamic power of the wind-turbine is expressed as in equation (i):

$$P_{\text{Turbine}} = \frac{1}{2}\rho \mathrm{A} C_p(\lambda,\beta)\upsilon^3 \qquad \ldots\text{(i)}$$

where, ρ is the air density (typically 1.225 kg/m^3), A is the area swept by the rotor blades (in m^2), C_P is the coefficient of power conversion and v is the wind speed (in m/s). The tip-speed ratio is defined as in equation (ii):

$$\lambda = \frac{\omega_m R}{v} \qquad \ldots\text{(ii)}$$

Where ω_m and R are the rotor angular velocity (in rad/sec) and rotor radium (in m), respectively.

The wind turbine mechanical torque output $m\ T$ given as in equation (iii):

$$T_m = \frac{1}{2}\rho \mathrm{A} C_p(\lambda,\beta) v^3 \frac{1}{\omega_m} \qquad \ldots\text{(iii)}$$

The power coefficient is a nonlinear function of the tip speed ratio λ and the blade pitch angle β (in degrees). Then Power output is given by,

$$P_{\text{Turbine}} = \frac{1}{2}\rho \mathrm{A} C_{p_{\max}} v^3 \qquad \ldots\text{(iv)}$$

A generic equation is used to model the power coefficient C_P based on the modeling turbine characteristics described in equation (v):

$$C_p = \frac{1}{2}\left(\frac{116}{\lambda_i} - 0.4\beta\right) e^{-\left(\frac{21}{\lambda_i}\right)} \qquad \ldots\text{(v)}$$

For each wind speed, there exists a specific point in the wind generator power characteristic, MPPT, where the output power is maximized[5]-[7]. Thus, the control of the WECS load results in a variable-speed operation of the turbine rotor, so the maximum power is extracted continuously from the wind.

This mechanism uses the variable torque output w_m and tries to optimize the output current and voltage waveform to its maximum value.

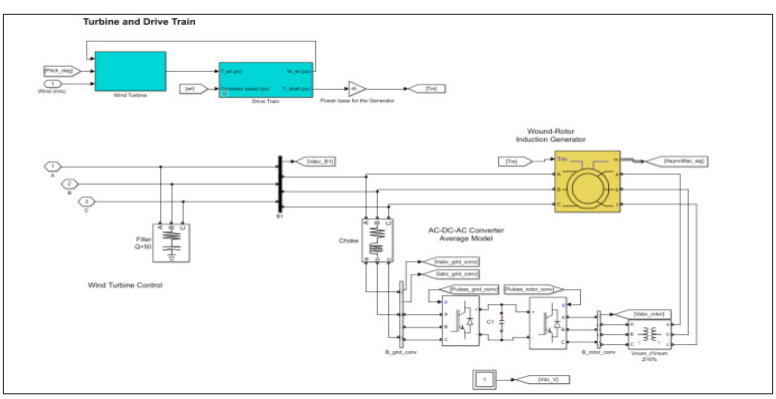

Fig. 2: MATLAB/SIMULINK Model of DFIG

Wind Energy System

The generator side converter controls the generator speed for maximum energy consumption. The converter on the network controls the voltage on the intermediate circuit and the reactive power flow between the wind turbine and the network. Another control for the WT is the height control. It is applied to the rotor blades and modifies the angle of attack of the blades so that the output power can be controlled at high wind speeds[8] - [10]. The rotor of the turbine converts the floating wind energy into mechanical energy, which is converted into electrical energy via the generator, then transferred to the network via a transformer and transmission lines.

Wind turbines record wind force using aerodynamic blades and convert it into rotating mechanical force. The generator converts mechanical energy into electrical energy, which can be injected into a network via an electronic power converter and a transformer with automatic switches and electric meters.

(C) Modelling of STATCOM

In this document, a STATCOM is added to the power grid to provide dynamic voltage regulation for the wind farm. FACTS are an aspect of the power electronics revolution that has taken place in all areas of electricity. These controls offer better adaptation to different operating conditions and improve the use of existing systems. The FACTS controller is an electronic power supply system that allows you to control one or more parameters of the AC transmission system (serial impedance, shunt impedance, current, voltage, phase angle).

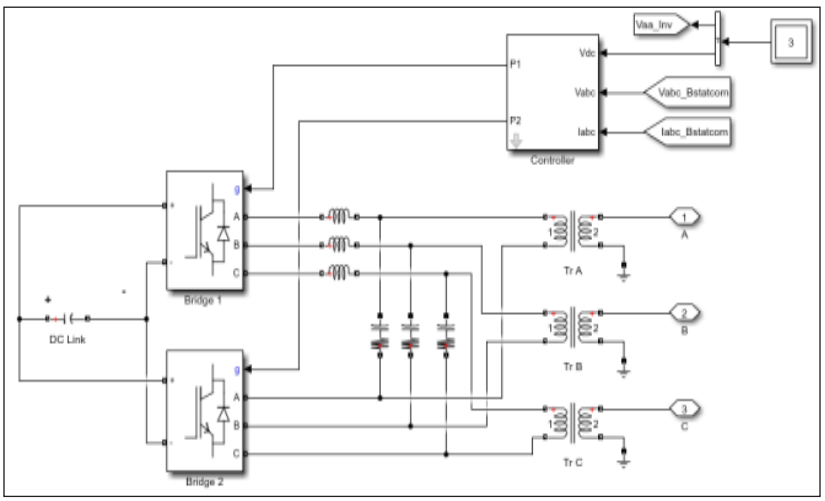

Fig. 3: MATLAB/SIMULINK model of the STATCOM used

STATCOM is a new generation of VSC-based reactive power compensators. It has a property similar to a synchronous capacitor, but since it is an electrical device, it has no inertia and is superior to the synchronous capacitor in several respects. STATCOM consists of a VSC with a capacitor on the DC side of the converter and a shunt transformer. The voltage source converter is generally built with interruption thermistors such as door closers (GTO) or today door switching thermistors (IGCT) or with IGBT-based converters (isolated gate bipolar transistors). The configuration of the STATCOM circuit is presented.

As already mentioned, STATCOM can be treated as a synchronous voltage source because its output voltage can be controlled as desired. STATCOM works in bus voltage control mode. In this model, the D-STATCOM regulates the voltage of the B3 bus by absorbing or generating reactive power. The power is transmitted through the leakage reactance of the coupling transformer generating a secondary voltage in phase with the primary voltage.

As already mentioned, STATCOM can be treated as a synchronous voltage source because its output voltage can be controlled as desired.

(D) AC DC Voltage Regulation Controller

The voltage regulation of the controller operates by taking the output voltage of the transformer as a AC reference signal. The signal is first passed through second order filter to eliminate the harmonics and then dq form is obtained from abc form. The control will begin if, $V_m(t) \neq Vss$. The measured bus voltage $V_m(t)$ is compared with $V_{\text{ref}}(t)$.

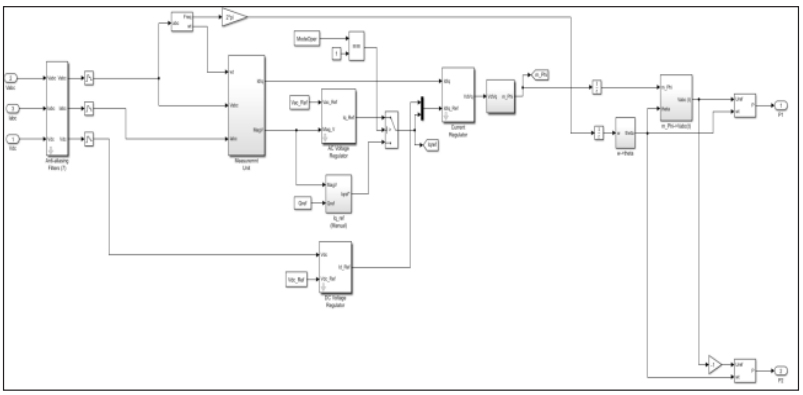

Fig. 4: MATLAB/SIMULINK Model AC DC Voltage Regulation Controller for STATCOM

Then, gain adjustments on Kp_V and Ki_V are done in the outer loop i.e., voltage regulator block and thereby an updated Iqref is obtained through the current limiter as shown in Fig. 4. Then, this Iqref and measured q-current Iq are compared. The control gains Ki_I(t) and Kp_I(t) can be adjusted. At last the phase angle α is determined and given through a limiter for output. Kit is then fed as pulses to the universal bridges for regulation.

Table 1: Control System Parameters

System Parameter	Values
AC voltage set point (V_{ref})(pu)	1
V_{ac} regulator gains $K_{p,}$	0.55
V_{ac} regulator gains K_i	2500
V_{dc} regulator gains $K_{p,}$	0.001,
V_{dc} regulator gains,K_i	0.15
Current regulator gain $K_{p,}$	0.8
Current regulator gain $K_{i,}$	200

RESULTS AND DISCUSSION

(A) Simulation Environment

MATLAB stands for MATrix Laboratory, which is a programming package exclusively designed for speedy and effortless logical calculations and Input/output. It has factually hundreds of inbuilt functions for a large form of computations and plenty of toolboxes designed for specific analysis disciplines, as well as statistics, optimization, solution of partial differential equations, information analysis.

In this research work MATLAB platform is used to show the implementation or simulation of implemented algorithm performance. Measurement toolboxes are used and some inbuilt functions for generating graphs are used. Simulation results and comparison of the performance of implemented model with some existing ones are calculated by MATLAB functions.

(B) Model Description

The first model was created by modeling of wind energy system integrated with the grid and feeding a balanced load and is compared by varying its condition. In the first model the system is made to drive the load without using AC DC voltage regulator controller based STATCOM via transformer. Further in this work the voltage profile of the wind energy system has been improved using a STATCOM based on AC DC voltage regulator controller. The voltage profile of the output from the system was again analyzed to observe the difference in the two models. Load analysis of the two system has been done by checking the amount of load it can handle independently and how AC DC voltage regulator controller proves to be beneficial in handling high loads. Also further the wind energy system model has been integrated with the grid in order to enhance the efficiency and reliability of the system.

(C) Only Wind Energy System Driving 1000KW Load

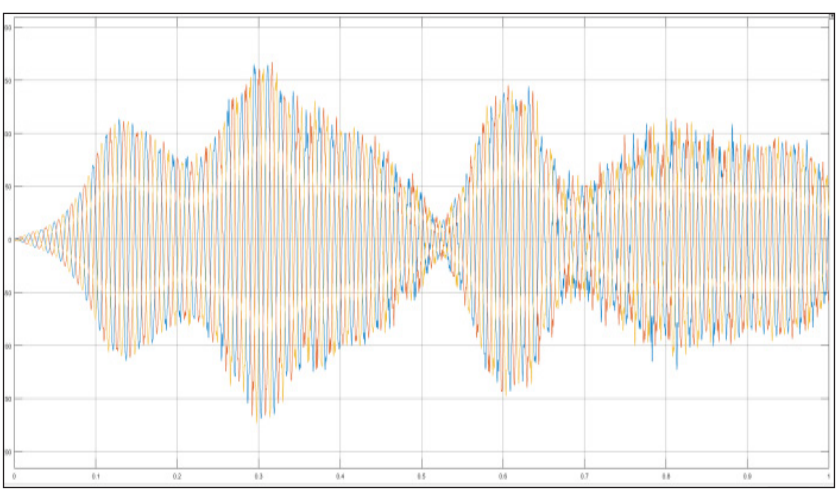

Fig. 6: Voltage Output from Wind Energy System only with 1000KW Load

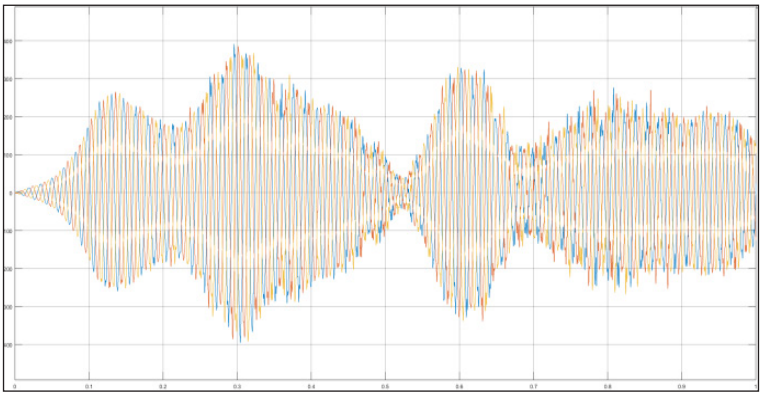

Fig. 7: Current Output from Wind Energy System only with 1000KW Load

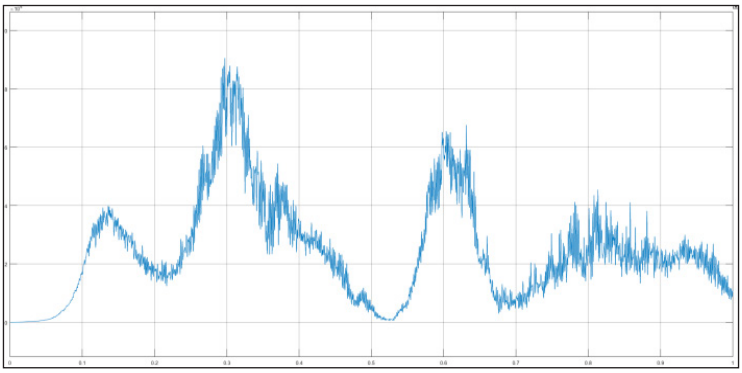

Fig. 8: Active Power Output from Wind Energy System only with 1000KW Load

(D) Wind Energy System Driving 1000KW Load with Voltage Controlled AC DC Regulator

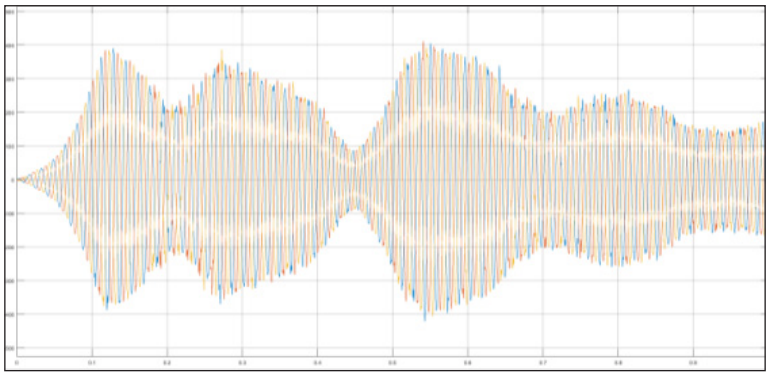

Fig. 9: Voltage Output from Wind Energy System with Voltage Controlled AC DC Regulator and 1000 KW Load

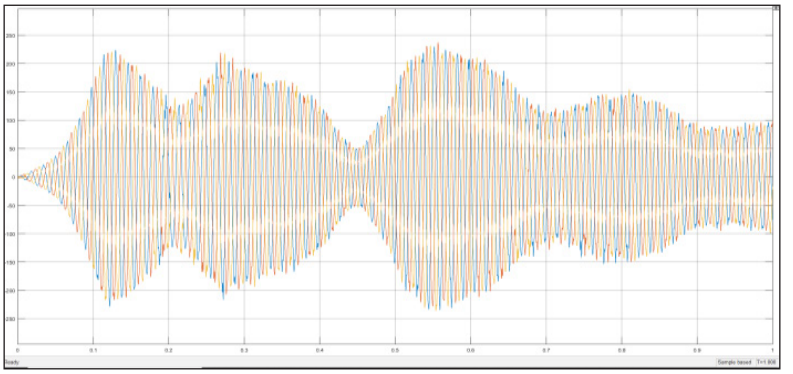

Fig. 10: Current Output from Wind Energy System with Voltage Controlled AC DC Regulator and 1000 KW Load

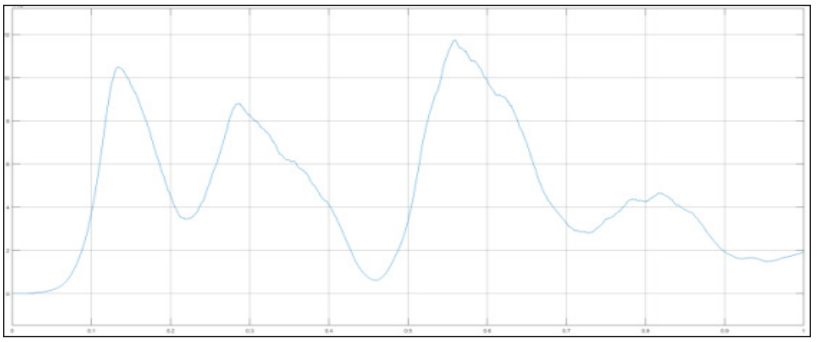

Fig. 11: Power Output from Wind Energy System with Voltage Controlled AC DC Regulator and 1000 KW Load

(E) Outputs with optimum Load

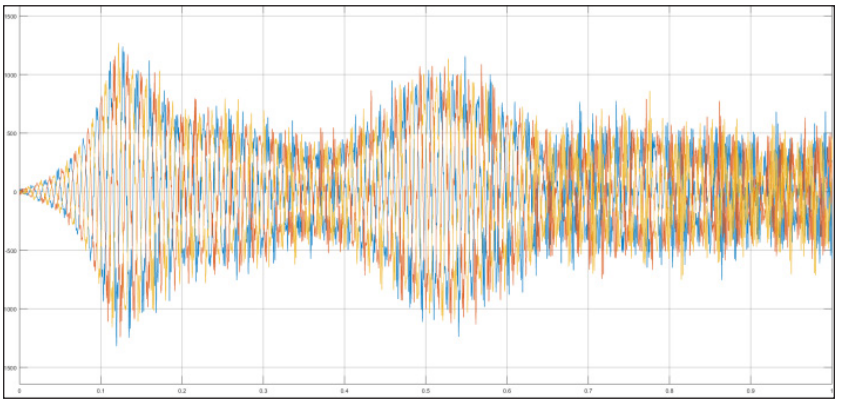

Fig. 12: Voltage with 18 KW in System having No STATCOM

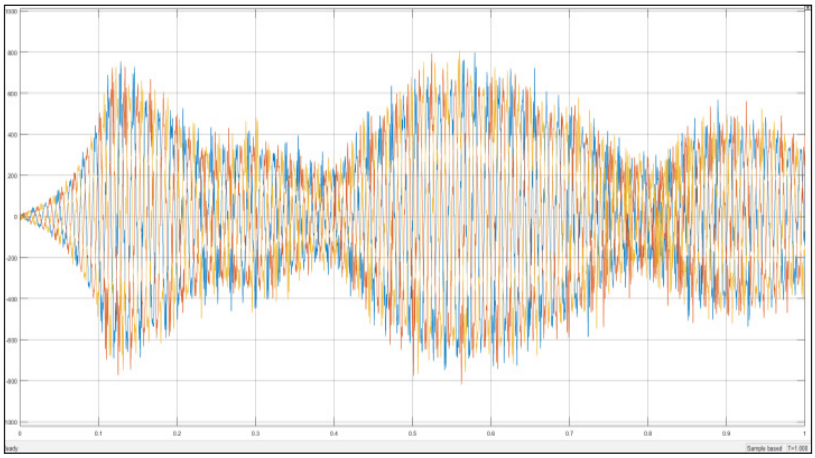

Fig. 13: Voltage with 50 KW in System having STATCOM

From the above two waveforms of the two systems it is clearly observed that the voltage output of the system at the load terminal is maintained with their respective loads without experiencing any dip from the open circuit voltage waveform. The system with STATCOM having AC DC voltage regulation controller can drive the load of up to 50 KW as compared to the system without the device which can drive a load of up to 18 KW.

(F) Final Integration of the Systems with Grid

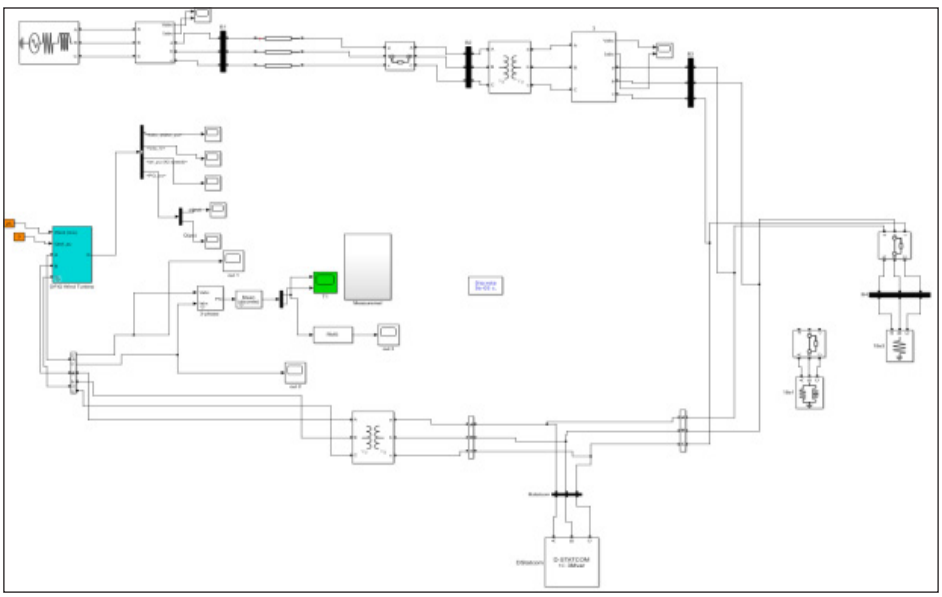

Fig. 14: System Integrated with Grid

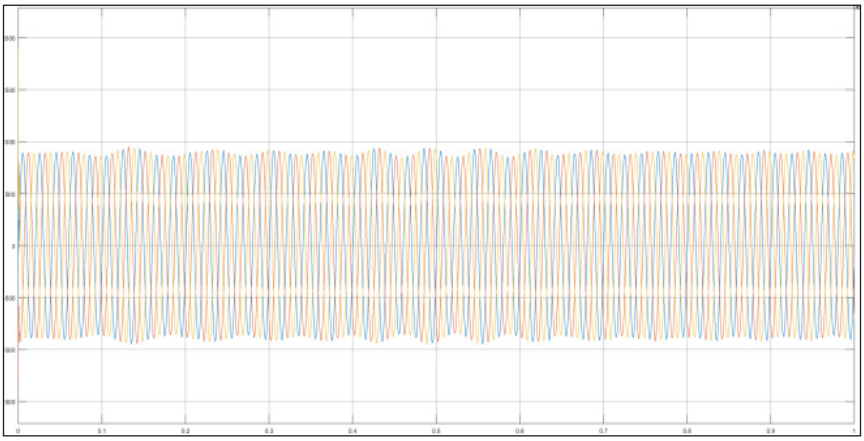

Fig. 15: Voltage Output with system connected with the grid

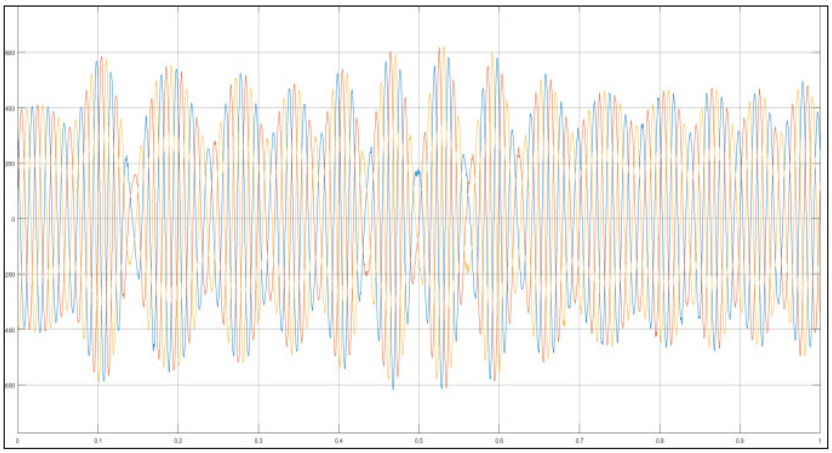

Fig. 16: Current Output with system connected with the grid

The output from the grid system has maintained the grid voltage of about 1100 volts. This voltage is the final grid voltage which is constant. When we change the load connected to it the power demand changes and hence the output current can vary according to changes in the load.

(G) Validation

In this work while validating the outputs following waveforms were observed. The RMS values of the voltage outputs from the wind energy system where the speed of wind varies between 0 to 25 m/s has been observed. It is made to drive the heavy loads and the drop in the voltage outputs is being observed and compared with the system having the STATCOM with AC DC voltage regulation controller. The load has been varied continuously to observe the optimum value of load up to which both the systems are compatible.

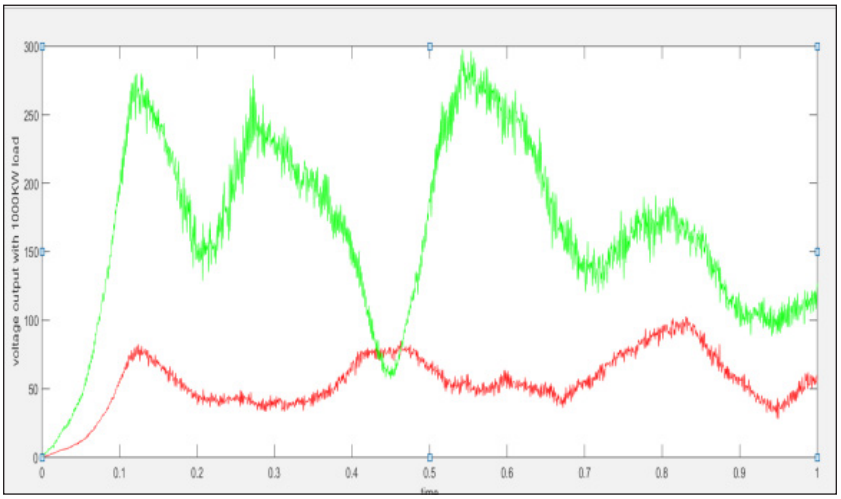

Fig. 17: Comparative values of Voltage Waveform from the System Driving 1000KW load

While driving heavy loads with 1000KW power requirement it was observed that the voltage dip in system without STATCOM is more where the voltage has been dropped in between 50 volts to 100 volts. The system with STATCOM has variation between 150 volts to 300 volts and hence is maintaining the voltage level to certain extent.

The system with STATCOM with AC DC voltage regulation has variation between 150 volts to 400 volts and hence is maintaining the voltage level to certain extent according to the wing speed variation.

Hence it can be concluded that the voltage profile is improved with the STATCOM with AC DC voltage regulation. Later this system is integrated with the grid.

CONCLUSION

The work here discusses the main component of a grid connected wind energy conversion system includes wind turbine, gearbox, generator, power electronic interface and a transformer for grid connection.

The speed of wind varies between 0 to 25 m/s and with this variation voltage outputs from the wind energy system has been observed. It is made to drive the heavy loads and the drop in the voltage outputs is being observed and compared with the system having the STATCOM with AC DC voltage regulation controller. The following conclusions were drawn:

Table 2: Comparative Table for Voltage Outputs with Different Loads

Variation in load	Voltage level		Drop from open circuit voltage (800 to 1000 volts)	
	Without STATCOM	With STATCOM	Without STATCOM	With STATCOM
1000KW	50 to 100 volts	150 to 300 volts	Approx. 700 volts	Approx. 500 volts

Hence, it can be concluded that the voltage profile is improved with the STATCOM with AC DC voltage regulation. Later this system is integrated with the grid.

- The system with STATCOM having AC DC voltage regulation controller can drive the load of up to 50 KW as compared to the system without the device which can drive a load of up to 18 KW.
- It was found clearly that the voltage output of the system at the load terminal is maintained with their respective loads without experiencing any dip from the open circuit voltage waveform.
- System efficiency is enhanced after its integration with the grid. The voltage level is constant and current shows variation according to load demand.

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A Review on Success Factors of Agile Software Development

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ABSTRACT

Nowadays, Agile software development methodology is adopted by many companies to develop good quality software. It makes easier for the developers to remove the errors and bugs at the time of development of software. In Agile development, bug prediction is used to predict the errors, faults, bugs on the basis of historical data. By which most of the bugs are resolved before software compiles. Machine learning approach is used to predict the bugs in agile, by which agile methodology reduces the cost of maintenance and increase the project success rate. There are some factors for the project success which are discussed in this paper.

Keywords: Agile, Bugs, Methodology, success rate

Agile is the ability to create and respond to change. Agile development process is used to make frequent changes in software. In this process large module is divided into small modules and these modules are assigned to the development team. Each module takes 1-4 weeks to complete. Agile development process is based on incremental and iteration approaches. If the user's requirements are changing very frequently, then agile method is best to use. Nowadays many companies are shifting to agile development process.

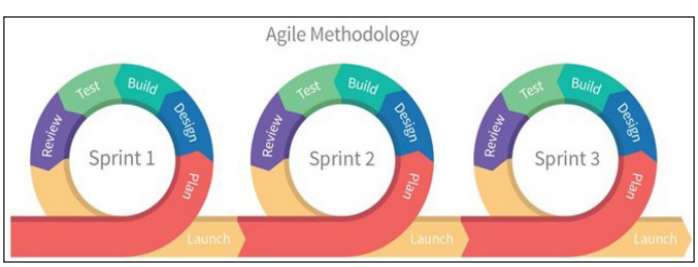

Fig. 1: Agile Development Process

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In Agile development process, a single task is divided into sprints. These sprints can vary for different projects. Each sprint works as a small project which can be done by the development team.

There are mainly five phases are used in a single sprint. The first phase of sprint is planning in which the team decides how to proceeds the work. In second phase software designing is being done. The third phase of sprint is to build the software. After that the software is being tested by the development team itself. The final phase is review phase in which feedback is submitted regarding the software.

In this way all the sprints works and together make a good quality products with less cost of maintenance.

DIFFERENCE BETWEEN TRADITIONAL AND AGILE METHODOLOGY

Software development life cycle is defined as a process by which software can be developed systematically. It provides a step by step procedure to achieve a good quality product. Traditional development is suitable for any size of project where agile is used for small size projects. In traditional software development life cycle, quality product is made in an efficient manner where as Agile methodology uses iteration as well as incremental approach to develop software. Traditional SDLC supports any kind of product or software application development where as agile also supports all kind of products by splitting into incremental builds. It is easier to manage in agile methodology than traditional methodology. Agile development is more flexible for the developers as well as for the entire team than traditional methodology. There is a testing team available to test the software in traditional SDLC whereas the development team itself tests the software after every sprint of the project. The cost of maintenance is also less in agile development as the bugs are resolved at the time of development. In this way, agile development provides good success rate of software than the traditional development.

Table 1: Comparison of success and failure of agile and traditional SDLC[8].

Project Size	Method	Success	Failure
Small	Agile	58%	4%
	Traditional	44%	11%
Medium	Agile	27%	11%
	Traditional	7%	25%
Large	Agile	18%	23%
	Traditional	3%	42%

In the above table comparison of success and failure rate of agile SDLC and Traditional SDLC is discussed. Agile development provides better success rate and less failure rate than the traditional SDLC. That's why most of the industries are shifting to agile software development.

LITERATURE REVIEW

Agile development introduces the new process of developing software which makes a great change in realistic development.There are many studies about success factors of agile software development. For example, study[6] proposed the critical success factors of agile development. As the industries are shifting to agile methodology, the last ten year research is analysed on the bases of People, Process, and Technical etc. On the bases of this empirical study critical success factors of Agile can be analysed. For a better

success rate of software developing team should be well trained and communication with whole team should be good. So that the chances of bug arisen will be less. Bug prediction plays an important role in project success rate. Less number of bugs and failure means the success rate will increase. For predicting the bugs in agile software there are many techniques are introduced like machine language. There can be different algorithms and tools are used to increase the accuracy of the bugs based on historical data.

The study[5] proposed a theoretical review on success factors of agile development, in which the people factors and organizational factors are analysed on the bases of theoretical study.

According to the Chaos Report[8], there are some factors provided which helps in increasing the project success rate of agile methodology. Some of the Factors are given below in the table with the percentage of responses.

Table 2: Project success factors of Agile Methodology[8].

Project Success Factor	% of Responses
User Involvement	15.9%
Executive Management Support	13.9%
Clear statement of requirements	13.0%
Proper Planning	9.6%
Realistic Expectations	8.2%
Smaller Project Milestones	7.7%
Competent Staff	7.2%
Ownership	5.3%
Clear Vision and Objectives	2.9%
Hard-Working, Focused staff	2.4%
Others	13.9%

CONCLUSION AND FUTURE WORK

Agile development is a type of software development life cycle which provides a systematic manner to build software. Agile development uses incremental as well as iteration approaches which helps to make efficient software. Agile development performs better than traditional software development life cycle. While developing software in agile, the development team itself tests the software and on the basis of historical data, errors and bugs are removed easily at the time of development. This affect the maintenance cost of the software. Project success rate depends on the various factors like planning, team communication, ability of development, etc.

In Future work, there should be more factors are analysed on the basis of agile work. More techniques should introduce to predict the bugs and errors. Development team should develop software to keep these factors in mind so that it may increase the project success rate and decrease the failure rate of project.

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Industrial Internet of Things (IIoT) – An IoT Integrated Services for Industry 4.0 : A Review

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ABSTRACT

Internet of Things (IoT), an inter-connecting technology comprising devices, objects, information, people and data, as a global internetwork for building intelligent systems. Such systems play a vital role in automating data sensing, machine and manufacturing process monitoring, product quality checking and lactation based smart shipping in real world industrial environment with integrity and interoperability. Industrial Internet of Things (IIoT) provides the integrated development environment for industries to build intelligent interconnected systems that uses the various IoT devices and bring the cyber and physical world together with higher level of availability and scalability. In this paper, we reviewed the transition of various IoT based systems to IIOT with the insights of concepts, devices and technologies of IoT and IIoT integrated applications which outlines the various trends and applications of Industry 4.0.

Keywords: Industrial IIoT, Industry 4.0, IoT Integrated service, Smart factory

In recent years a huge amount of work has been carried out in IoT for real-life application. It is defined as a technology that interconnects physical devices along with its inter-relation of data via internet without intervene of human or human to human interaction[1-2]. The idea was often known to be as "embedded internet"[3]. But the actual term "internet of things" was introduced by Kevin Ashton in 1999. In 2011, Gartner, the market research company included a new emerging phenomenon on their list: "The Internet of Things"[4]. The IoT supports to build systems for commercial sector, and IIoT for the industrial sector. IIoT technology made it possible to integrate all this data - sensor output, user input, service provider availability and knowledge to provide accurate and effective real-time responses.

Due to the usage of smart devices, mobiles phones, laptops have expanded so too the internet of things.

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IIoT devices are installed in industry / machinery environment to sense huge amount of data from a productive system which can be analyzed to understand, monitor and control the underlying events in an effective way. In IIoT, devices can be installed for a dedicated purpose (fixed) or re-configurable where the device setting can be changed w.r.t its sensing parameters and it is re-used for a similar but different purpose. In support of computing technologies, IIoT eases the mutual exchange of data or information between the users and the industrial equipment for service support and effective solutions to user problems[5]. Different kinds of smart applications are supported by IIoT such as smart city, smart houses, smart farming and smart factory and manufacturing[6]–[8].

IIoT applications require relatively small throughput per node without the concern on the capacity. Instead, the need of connecting internet with a very large number of devices at low cost, with limited hardware capabilities and efficient energy resources, security, reliability, and cost more desired features[9].

IoT - IIoT

IoT connects the physical things or devices through wired and wireless network whereas, IIoT deals with the complex physical machinery which are connected with industrial sensors and its relevant software. Industrial internet of things connects machines with human-interfacing unit for error-free system[10]. IoT focuses on the design, connect and communication standards into the Internet ecosystem through a friendly and flexible end- user application. In contrast, the IIoT focuses on integration and interconnection of remote plants and production machineries, thus offering a more efficient predictive production and services. For this reason, IIoT can be considered more an evolution rather than a revolution, in comparison with IoT. Table I gives a comparison of IoT and IIoT in the perspective of the technologies sector, model, data volume, communication and connectivity model.

Table 1: Comparison on Internet of Things (IoT) and Industrial IoT (IIOT)

IIOT	IIOT
IoT for Commercial Sector	IIoT for Industrial Sector
Human centred model	Machine centred Model
Volume of data is Medium	Volume of data is very High
Machine to Human communication.	Machine to Machine(M2M) communication.
Supports Infrastructure Less Mobile *Ad-hoc* connectivity	Structured Infrastructure based centralised connectivity is required.
Human and Things integrated Technology	Machine-to-Machine Integrated Digital Manufacturing and Operational Technology

IIoT ARCHITECTURE

The structure of a IIoT architecture highlights scalability, modularity, and interoperability with various devices and platforms using different technologies. Recently, the "Reference Architecture" document[11] released by the Industrial Internet Consortium, which highlights on different viewpoints on business, usage, functional and implementation views and provides models. Technologies and the system components were focused in implementation viewpoint, and it describes the components structure and the interconnecting

topology and the protocol stack of the architecture. IIoT mainly focuses on the transfer and control of mission critical information and responses, and relies on machine-to-machine communications.

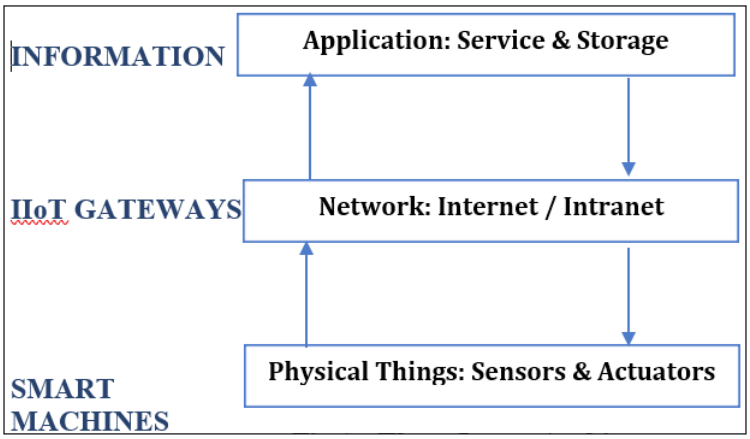

Fig. 1: Three Layer Architecture

The above figure shows the abstract level of IIoT Architecture design with three layers - Physical, Network and Application layer. There are two types of layer models in IIoT solutions (i) Analytical Model and (ii) Data Model. The data models provide a structure to the data while the analytical models are structured to meet industry specific needs The analytical models are trained using a historical data set or using advanced machine learning.

(A) Physical Things : Sensors & Actuators – Smart Machines

In the physical layer, some industry-specific devices like Sensors, Interpreters, Translators interfaces with ICS placed in the real-world environment. These devices enable the machines in industry environment as Smart Machines[12]. Several heterogenous physical things are deployed in the real-world environment like Sensors for monitoring environment, reading temperature, gauging pressure, proximity, location, smoke, humidity, chemical reaction, gas, and so on. Transient Data Stores, which stores the data temporarily to ensure durability during the system or network failure. Local Processors (data transformation, complex event processing, etc..) are also used to provide data to the application user end from the Physical things.

(B) Network : Internet / Intranet – IIoTGateways

Network Channels act as a medium to connect and for data transfer between Physical Layer to the application end. The channel can be an Intranet if the smart environment has to be monitored within an industry closed monitoring system, known to be private IIoT channel. The smart environment can be built by connecting and monitoring the smart physical things at different locations of various industries on a production pipeline, there the channel supported through internet, known to be Public IIoT channel. The channels deploy different Network Protocls and API's for connectivity between machine to machine and machine to the application end. These channels interface with heterogeneous sensors and receive unstructured data, a sophisticated gateway is required, called to be IIoT Gateway. This gateway can be part of the middleware architecture – a cloud computing environment. Since the data would be huge,

unstructured and with high velocity of retrieval, the IIoT can filter the captured data and send the structured data over the Internet to the service end.

(C) Application : Service & storage –Information

A collection of large amounts of context information from the Real-world IIoT environment to support different application domains are stored, processed and analysed in cloud computing environments. Some of the popular IoT based cloud environments like Thingworx[13], Xively[14], CISCO IoT cloud, AWS IoT Platform, etc.. supports for IIoT application development. Cantaloupesys[15] supports remote stock tracking service in vending machines, HiKoB[16] collects real-time measurements for the analysis parameters such as temperature gradients within the road, current outdoor temperatures, moisture, dew and frost points from sensors deployed in roads and provides traffic management, real-time information on traffic conditions, and services for freight and logistics. It is also evident that IoT based cloud platforms are allowed to build their own ecosystems with third party extension support for development and distribution through app store. The most user-end service support is extended through the Mobile Applications which allows users to interact and take or perform actuation tasks from any location at any point of the product development cycle in the industry environment, Mobile-based applications are also support the location-awareness service, i.e., service support based on the geo-graphic location specifically in Smart Enterprises – Transportation and Logistics, Energy and power production, Safety & Smart Infrastructure support. Wearable devices with gesture-based interactions also plays a significance role in IIoT applications also.

INDUSTRY 4.0 – IIoT INTEGRATED APPLICATIONS

The integration of IoT technology with industrial automation results in fourth industry revolution - Industry

4.0 for an objective to attain a high level of productivity with effective operational and maintenance track. Digital optimization of production, Automation with industry environment adaption, Intelligent Data communication for remote action and effective and ease of Human-Machine interaction (HMI) are the major features of industry 4.0[21]. Industry 4.0 makes a disruptive change in the traditional supply chain process and business models by integrating the IoT enabled services in the industry environment to build a smart industry ecosystem, for achieving the objective of the Industry 4.0.

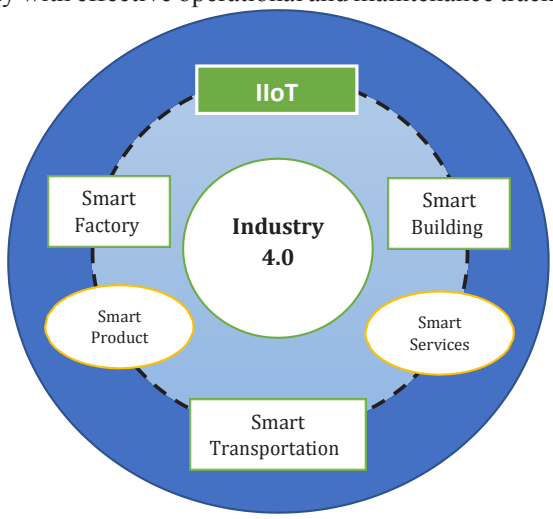

Fig. 2: Industry 4.0 – IIoT integrated Applications

Fig. 2, shows the integrated IIoT applications for Industry 4.0, builds a smart productive environment, where different types and forms of massive amount of data is generated by the integration of sensor devices and communication technology for smart

services and product development in manufacturing sectors. Smart manufacturing are equipping machines with sensors, actuators, microchips and automatic recognition & detection in support with the computer-vision based system. Agile software engineering technique is transferred to the manufacturing domain describing an agile factory prototype[18]. The developed smart product requires a smart logistics support for transportation by tracking the location and predicting the delivery-time with automated routing applications by sensing the roadway parameters like temperature, mist, humidity etc.. Smart Building[17] combines the Internet, Telecommunication networks, Short distance networks (like Bluetooth, NFC etc..), Broadband networks and Sensor networks to build a smart living environment that ensures the quality of day-to-day life, connected with technology, safety & security of living place with recognition, detection and prediction systems and effective energy consumption with atmosphere sensed adaptive electric or electronic devices.

CONCLUSION

This paper presented an overview of the integration of Internet of Things (IoT) and Industrial Internet of Things (IIoT) for the fourth industry revolution – Industry 4.0. This review provides a comparison study on IoT and IIoT and a three-layer IIoT architecture which describes the detailed functional operations and challenges. We have also discussed on the Smart Factory, Smart transportation and Smart Building systems which plays a vital role in the industry 4.0 applications. Further research work needs to be carried out related to IIoT cyber security issues and potential future directions of security threats and attacks that can be addressed in integration with computer-vision and AR/VR based industrial systems.

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CNN-SICE Learner Based Image Contrast Enhancement

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ABSTRACT

Producing the natural scene with good contrast, vivid color and rich details is an essential goal of digital photography. The acquired images, however, are often under-exposed or over-exposed because of poor lighting conditions and the limited dynamic range of imaging device. Contrast enhancement is thus an important step to improve the quality of recorded images and make the image details more visible. Many research work have been done for image enhancement. In this paper, different techniques and algorithms using machine learning approach are studied and Block based CNN Learner is designed for contrast enhancement.

Keywords*:* Image enhancement, Image quality, Machine learning approaches, Digital image processing.

Image processing is an essential and promising research area in various real time application fields such as medical imaging, video surveillance, industrial X ray imaging, oceanography etc.[1]. Image enhancement is a preprocessing technique in many image processing applications that can produce an improved quality image than the original image so that the output image is more suitable for analysis by human or machine in specific applications. In general, image enhancement techniques are divided into two broad categories, such as spatial techniques and frequency domains. In spatial domain techniques, the pixels themselves are modified directly to improve an image. In frequency domain method, modification is done on the Fourier transformed image and inverse Fourier transform is applied to the modified image to get the enhanced image. Quality of the image gets affected by uneven or poor illumination, external atmospheric condition such as fog or haze, wrong lens aperture setting of the camera, noise etc.

So, these degraded quality images are improved by increasing the brightness and contrast, by de-noising the image through various enhancement techniques. Researchers have developed numerous enhancement techniques that are good in enhancing the contrast of an image, while some are good for de-noising the images. In real time applications an enhancement technique should be capable of enhancing real color images in lesser time with lesser computational cost by reducing (i) the effect of haze or fog, (ii) poor or

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uneven illumination effect on an image and (iii) noise introduced in an image. This research review work focus on various color image enhancement techniques that improves the contrast of real time images. Requirements of real time image enhancement techniques[2] are; (i) It should be adaptive in nature (i.e.) should be able to enhance any type of images for a specific application, (ii) Should enhance a image in less processing time, (iii) It should utilize less computational resources.

Image enhancement techniques have been widely used in many applications of image processing. Contrast is an important factor in any subjective evaluation of image quality. Contrast is created by the difference in luminance reflected from two adjacent surfaces. In other words, contrast is the difference in visual properties that makes an object distinguishable from other objects and the background.

In visual perception, contrast is determined by the difference in the color and brightness of the object with other objects. If the contrast of an image is highly concentrated on a specific range, e.g. an image is very dark. The information may be lost in those areas which are excessively and uniformly concentrated. The problem is to optimize the contrast of an image in order to represent all the information in the input image.

Low contrast: Image values concentrated near a narrow range (mostly dark, or mostly bright, or mostly medium values).

Contrast enhancement: Change the image value change the image value distribution to cover a wide range Contrast of an image can be revealed by its histogram.

Fig. 1: Contrast Enhancement of Image

Histogram of a monochrome image with L possible gray levels,

$f = 0, 1, \ldots, L\text{-}1.$

$= P(l) = n_l / n$

Where,

n_l = Number of pixels with gray level l. n = Total number of pixels in the image

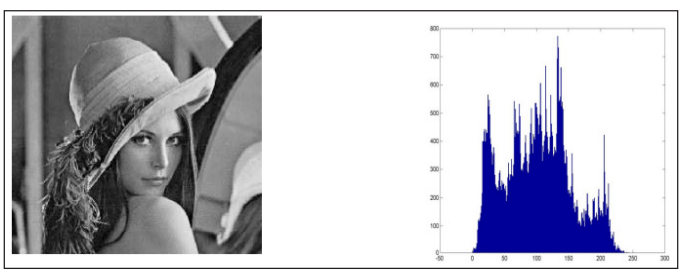

Fig. 2: Histogram of an Image

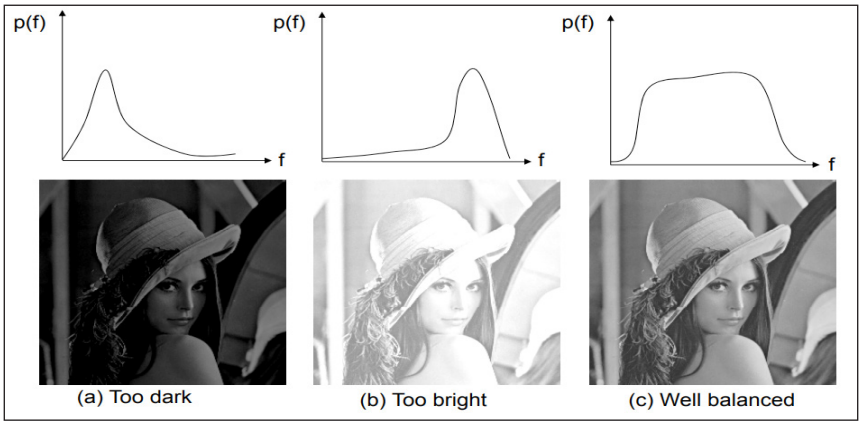

Fig. 3: Examples of Histograms

Related Work

Image enhancement is a process by which we can improve the quality of the digital image which makes it easier for identifying features. This can be done by removing noise, sharpening, or brightening an image. The techniques identified in the paper to enhance an image are contrast stretching and image sharpening, nonlinear image enhancement technique, genetic algorithm, generalized fuzzy enhancement, wavelet transform technique, multi-scale and single-scale retinex improvement technique, etc.[3].

In[4], Negi *et al.,* discussed contrast stretching and image sharpening techniques. It is an approach that concurrently adjusts contrast and enhances boundaries of an image. On the gray-scale image contrast stretching is applied and then it proceeds to Laplacian mask, and finally, Laplacian image is appended to the original gray-scale image to obtain the desired sharpened image.

In[5], Wu *et al.,* proposed image enhancement using wavelet-based contourlet transform with cycle translation. In this, wavelet transform is used for decreasing the redundancy occurring in the original method of contourlet transform. WBCT and cycle translation are merged. At last, to magnify the images, adaptive enhancement function is selected. The proposed method can efficiently magnify the images and decrease the flecked at the background region, the image edges.

In[6] Gupta *et al.,* discussed image enhancement and segmentation techniques. The paper concluded that segmentation is considered as one of the main steps in image processing. It divides a digital image into multiple regions in order to analyze them. It is also used to distinguish different objects in the image.

In[7], Wang *et al.,* discussed NIE (Nonlinear Image Enhancement). Simulation and identification processes are used along with the proposed NIE method. This process uses clipping and scaling parameters which are an appropriate combination of various images. This process enhances the quality of blurred image and a better quality is achieved, and PSNR (signal-to-noise ratio) performance is obtained than other nonlinear enhancement techniques.

In[8], Premkumar *et al.,* discussed the color image contrast enhancement technique. Firstly, RGB image is transformed to HSV (hue, saturation, and value) color space. Hue color channel is selected for DST decomposition. The lower directional sub band is used for reformation. By transforming HSV to RGB

color space, the enhanced image is acquired. From proposed DST-based contrast image enhancement approach, the satisfactory result is attained.

In[9], Shanmugavadivu *et al.,* discussed a contrast enhancement technique using the basic concept of histogram equalization. In this proposed technique, the image histogram is first divided into two parts using the Otsu threshold. Thus, a series of optimized weighing conditions formulated using particle optimization (PSO) is applied to both parts. The two parts are then independently balanced and then combined to produce an optimized contrast image that preserves brightness.

Weaknesses of existing image enhancement techniques

- Existing image enhancement algorithms are very computation intensive and require a large amount of memory to store the intermediate data.
- Algorithms are quite complex to understand and implement.
- Very few techniques are practically used for image enhancement which leaves a large scope for new enhancement techniques.
- Due to the poor lighting condition and limited dynamic range of digital imaging devices, the recorded images are often under/over-exposed and with low contrast.
- Most of previous single image contrast enhancement (SICE) methods adjust the tone curve to correct the contrast of an input image.
- Those methods, however, often fail in revealing image details because of the limited information in a single image. On the other hand, the SICE task can be better accomplished if we can learn extra information from appropriately collected training data.

METHODOLOGY

Single image contrast enhancement (SICE) aims to enhance the visibility of the scene in a very given single low-contrast image. It provides the way to boost the low contrast pictures captured from a high dynamic range scene. several histogram and Retinex based SICE ways are projected within the past decades. Histogram-based ways[4],[5] are wide used due to their simplicity in enhancing low contrast pictures. Those ways plan to distribute the bright intensity on bar chart in a very international or native manner. However, such easy redistribution operations could turn out serious unrealistic effects within the enhanced pictures since they ignore image structural information.

Recently, ways[10] are projected to train a CNN network to map the low dynamic range (LDR) pictures to HDR pictures. In[10], a CNN is trained to line the parameters of SICE, that are then used to enhance an input image to a desired image.

With the constructed dataset, the proposed work will designed a block based CNN-SICE enhancer to learn a mapping function between the low contrast input image I(x, y) and its corresponding reference image Iref (x, y). Further, the work train a deep CNN H(I,W). The network is trained with Structural dissimilarity (DSSIM) loss. The DSSIM loss function can be formulated as:

$$DSSIM(W) = \frac{1}{n}\sum_{i}^{n}\left(1 - ssim\left(I_{ref}^{(i)} - H\left(I^{(i)}, W\right)\right)\right)/2$$

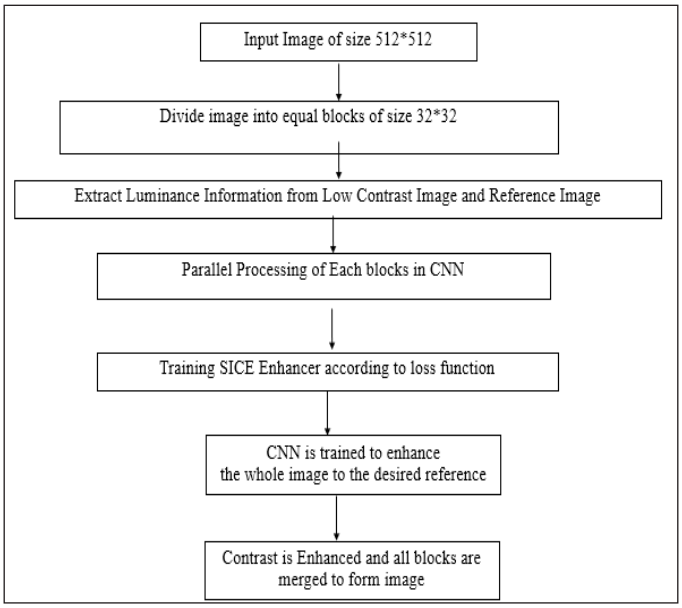

Fig. 4: Proposed Methodology

CONCLUSION

Image enhancement is an essential preprocessing step in many real time image processing applications. Enhancement of Images is done by many approaches and choice of every approach depends on the type of images. Among all histogram equalization techniques multi histogram equalization techniques improves the contrast and brightness of the images. As analyzed, there are various factors which can affect image quality. Some of them are noise, sharpness, distortion, contrast, color accuracy, dynamic range, exposure accuracy, lens flare, etc. These factors must be kept in mind while choosing or designing any image enhancement algorithm. The proposed CNN-based SICE enhancer, which is capable of adaptively generating high quality enhancement result for a single over-exposed or underexposed input image and may significantly outperforms better to existing work. On processing block parallelly, time complexity is reduced. This work will also be enhanced on videos.

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Human Resource Management Practices Affecting Organizational Commitment: A Study on HR Managers Transformational Leadership in the Middle East

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ABSTRACT

This research aims to explore the moderating effect of HR Managers transformational leadership on the relationship between human resources management practice and employee organizational commitment. A total of 3,185 samples were surveyed of the top six out of 11 financial control groups in Middle East. Results indicate that, aside from performance management, the remainder of the variables, including education and training, salary and remuneration, benefits, career development, and communication, have significant positive effects on employee organizational commitment. A HR Manager transformational leadership, on the other hand, yielded no significant effect on employee organizational commitment. However, HR Manager's transformational leadership has significant positive moderating effect to the influence of performance management, salary and remuneration on employee organizational commitment, and significant negative moderating effect to the influence of communication on employee organizational commitment.

Keywords: Human resource management practices, HR Managers transformational leadership, organizational commitment, moderating effect

Human resource management practices affect an organization's performance. From the past empirical studies of strategic human resource management, we found that the firm-level human resource management practice is effective in improving organizational performance [5], [19], [20], [27], [42], [43], [63], [64], [26], furthermore, pinpointed the links between firm-level human resource management practices and corporate performance. He proposed that human resource management practices at the firm level affect employee's attitude, improve personal performance, and eventually enhance the company's overall performance. [5] human resource management practices were divided into two types: control and commitment. The control type, on the one hand, emphasizes efficiency, low labor cost, strict working

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rules, and result-oriented rewards, meaning regulating employee behaviors with rules and policies. The commitment sort of human resource management practices, on the opposite hand, reinforces modifying employee behaviors and attitudes through linking personal goals with the organizational goals. Under such system, employees are willing to trust the organization and thus, have high organizational commitment [9]. Therefore, this research aims to further explore the effect of human resource management practices on the worker organizational commitment. A company's management practice affects the employees' commitment to the organization.

The HR Manager's leadership stands as a part of this management practice. When a HR Manager has transformational leadership, he improves team competitiveness for the organization and is capable of conveying the organization's vision and goals to the employees and of making the workers identify themselves with the organization, get entangled within the organization's operations, and have high commitment to the organization. This inclination stands as the reason why many empirical studies have also found that transformational leadership style has significant positive effect on employee organizational commitment [28], [31], [35], [38], [39].

However, it is not necessarily true that firm-level human resource management practice yields an equivalent effect on all organizations. Empirical studies found that different organizational cultures [13], organizational climate [31], [38], [47], and organizational strategies [13], [19] [36], [40], [47], [65] have different effects on organizational performance. And at the individual level, [18] found that employees at different stages of career development have various cognitions and attitudes towards the different human resource management practices. Other factors, like employee comprehension of the organization's strategies, can also affect the organizational performance. A HR manager with strong transformational leadership style conveys the organization's goals and strategies to the employees [8]. Simultaneously, for the employees, since the human resource management practice is done based on organizational strategies, the practice would be closer to the organization's goals. This contributes to the development of organizational commitment. Therefore, if a HR manager has a strong transformational leadership style, he will be able to strengthen the effect of the human resource management practice (perceived by employees) on organizational commitment.

The three variables explored in this research, human resource management practice, HR Manager's transformational leadership style, and employee organizational commitment, are of three different levels: the firm level, group level, and individual level; therefore, they ought to be studied with cross-level analysis methods. However, changes of employee attitudes are reflected on the basis of their sensing of facts rather than facts themselves [54], therefore, the precise understanding of the effects of human resource management practices or HR Manager's leadership styles should be built upon the employees' cognitions. Furthermore, firm-level human resource management practice effectively upgrades employee cognition on the overall human resource management practices [14]. From this, we can see that implementation of the practice in an organization influences individuals' attitude through employee's cognition [16], [30], [23], [24] otherwise, change in the employees' attitudes is not likely to occur if the employees are unable to feel the benefits of the practices in their work or goals. For example, within the aspect of firm-level education and training systems, a number of these systems being considered more advanced could also be suitable to the workers consistent with the employees' positions and work styles.

Thus, even within the same organization, employees may have different cognition towards the same training. Their various attitudes or behaviors are consequently constructed. Many discussions regarding

the effect of human resource management practices on employees' attitude also use individual-level cognition to represent the overall human resource management practices [11], [30], [18], [24], [25] , [40], [48] [50]. Even when the HR manager treats different employees with the same behavior, the employees respond differently according to their personal considerations. Therefore, using employees' cognition to measure the HR manager's leadership style will be more obvious and direct than measuring it at the group level. This probability stands because the reason why during this research all three variables explored during this research are going to be measured at the individual level.

The "universalistic approach" is an orientation of the "best practice", considering that good or commitment sort of human resource management helps to realize high organizational performance. "Configurational approach" considers human resource management as a system and, to realize high organizational performance, all the practices must be "internal fit". And "contingent approach" considers that the workers maximize the organization's performance when those practices are fitted with the contingent factors (external fit).

Objectives of Study

The first objective of this research is to explore whether employees' cognitions of the individual human resource management practice affect employees' organizational commitment from the universalistic approach. From the test, we will also verify which practice has the foremost significant effect on organizational commitment.

The second objective of this research is to verify whether employees' cognitions on the HR Manager's transformational leadership reinforce organizational commitment.

The third objective of this research is to verify whether HR Managers' transformational leadership has moderating effects on the interaction between human resource management practices and the employees' organizational commitment.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Human resource management practices and employees' organizational commitment

Employees' organizational commitment reveals the psychological link between them and their organization [12]. With a high level of commitment, they will have a robust belief within the organization's goals and values, wish to optimistically represent the organization, and eventually have intense desire to continue being members in it [46]. The concept of employees' organizational commitment in the past studies is a complex and diversified subject, but it is now considered as a multidimensional work attitude [2], [39]. Employee organizational commitment consists of three dimensions: affective commitment, continuance commitment, and normative commitment. Affective commitment refers to identification, involvement, and emotional link to the organization. Continuance commitment signifies the employees' cognition of the value involved in leaving the organization: they need to estimate the sacrifices when leaving the organization and remember of whether they could find another job. And normative commitment refers to the obligations to the organization as recognized by the workers.

Organizational commitment is an important employee attitude. It affects personal job performance [33], [40], [39], [44], [34], [64], and consequently affects the organization's performance [10], [26], [27], [42]. However, the relationship between organizational commitment and performance is rather weak [15]. Some past researches using multidimensional approaches found that affective commitment has more notable relationship with performance [3], [28], [45], [58], [64], continuance commitment has no or negative relationship with performance [3], [45], [56], and normative commitment has no relationship with performance [28]. According to these studies, we can see that affective commitment is the most reliable for prediction of performance [36], [37].

The past empirical studies indicate that employees' organizational commitment and satisfaction are affected by the bundled policies in the human resource management practices [4], [19], [51],[64]. These policies include internal promotion, formal training system, and result oriented assessment. Employees' commitment and satisfaction are also influenced by employees' cognition towards these policies [16], [23], [40], [39], [64].

In the modern studies on strategic human resource management, human resource management practice is seen as a system; therefore, the effect of the entire system on organizational commitment is discussed nowadays, no matter the more conventional model of utility analysis. However, [34] the estimate of individual human resource management practice should not be abandoned. [57] also supports [34] by pointing out that the conventional utility analysis still has its practical values if it is properly adjusted. Thus, it is necessary to debate the effect of every individual human resource management practice. And the effect of every human resource management practice must undergo the method of employees' cognitions before it forms positive or negative attitudes of behaviors.

Human resource management practice also affects the results of human resource management (organizational commitment, quantity, flexibility) [26]. When a corporation has good performance management, employees are clear about their goals, the results, or feedbacks. When employees regard the performance assessment as fair, they need trust within the organization, willing to figure hard and consequently having high organizational commitment. Education and training help to enhance the employees' skills and abilities [26]. The more education and training employees receive, the more they think that the organization is willing to invest in employees. Therefore, the workers perceive that their organization sees them not because the tools for production but partners to get older together.

Employees identify themselves with the organization and thus have higher organizational commitment. Meanwhile, when the organization features a personalized reward system, its employees know that they're going to be rewarded if they exerting to realize the organizational goals, in order that they agree with the goals and have higher organizational commitment [26]; [40], [39]. An organization benefit system represents the organization's investment in the employees [61]. So, when the investment is enhanced, employees are willing to face by the organization, improving their organizational commitment. If the planning of the benefit system allows the workers to settle on freely, such participatory decision-making model helps the workers to regulate the progress of their work, so the employees have higher job satisfaction and therefore higher employee commitment [29], [30].

Employees identify themselves with the organization if they can see that their future career development inside of the organization if the organization is willing to develop the employees and facilitate for their growth. Especially, internal promotion directly affects the employees' motives or organizational commitment [26], [40], [39]. Otherwise, if the employees' opinions are always unaccepted or ignored

or the organization has never communicated with the employees in terms of implementation of the company system, the employees would think that their organization doesn't value them. They will alienate themselves from the organization. Therefore, good communication brings organizational commitment. Implementation of the individual human resource management practice features a certain effect on the employees' organizational commitment.

Many past empirical studies have found that individual human resource management practice has direct correlation with employees' organizational commitment. In the area of performance management, the performance management system has significant effect on employees' organizational commitment [22]. The performance assessment has significantly positive and direct effect on employees' organizational commitment [50]. In the aspect of education and training, the relationship between employees' attitude towards training and employees' organizational commitment [7]. He found that the accessibility of cognitive training, social support on the training, motives, and therefore the benefits of cognitive training (job related) promote organizational commitment. In the area of salary and bonus, the bonuses have a significantly positive and direct effect on organizational commitment [50], and the performance bonuses significantly predict employees' organizational commitment [49]. In the area of benefits system, the satisfaction of the benefit system contributes to the prediction of employees' organizational commitment [60]. In the aspect of career development, the fairness in promotion could significantly reveal organizational commitment [49]. The internal labor market has significant and positive effect on the employees' organizational commitment [48].

The career development may significantly and positively present the direct effect of the employees' organizational commitment [50]. In the aspect of communication, the satisfaction with communication has significant connection with employees' organizational commitment [21], [53], [41] found that the level of satisfaction with communication relationship has strong correlation with the employees' organizational commitment. Based on the above studies, this research proposed the following hypothesis:

H1: Organizations that have better human resource management practices have higher employee organizational commitment

Employees' organizational commitment and the interaction between human resource management practice and the HR Manager's transformational leadership

The first to propose the concept of transformational leadership, believing that transformational leadership is a process. Leaders inspire their followers with a high ideology and moral values. Transformational leaders must be able to define and convey the organization's vision, while the follower must be able to accept the leader's creditability.

Some amendments to this concept of transformational leadership was made [7]. Generally, the concept of transformational leadership is divided into four dimensions: charisma or idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration [33], [34], [35].

Leaders of the charisma or idealized influence style demonstrate the followers' admiration. Charismatic leaders exhibit trust and firm stance and attract followers emotionally. Leaders of the inspirational motivation style set out a vision to attract and inspire people. An inspiring leader sets the highest standards for the followers appropriately to achieve the goals and provide meaning to their hardworking. The followers thus feel the sense of achievement in a serial of challenges. Leaders of the intellectual stimulation

style challenge assumptions, take risks, and inspire the followers. Such leaders stimulate creativity and encourage followers. A leader of the individualized consideration style listens to and takes care of each follower's personal need like a mentor or coach.

Because a transformational leader must convey the organization's vision to the followers, he/she makes the employees reach the identification with the organizational vision and then the organization itself, which will in turn result in input. And these results are manifestations of employees' organizational commitment. Empirical studies [28], [31], [35], [40], [39], indeed confirmed that transformational leadership style has a positive relation with the employees' organizational commitment.

From the foregoing, we can see that the source of organizational commitment is not limited to human resource management practices. The perception of transformational leadership can be regarded as the precursor of organizational commitment. Thus, if transformational leadership is absent in an organization, employees' organizational commitment will be reduced because the HR manager is not able to convey the organizational visions to the employees. The first two assumptions verified the main effects of organizational commitment. Because the organization's vision guides the strategies of the entire organization, and thus, guides the design of human resource management strategies as well as the practices themselves, when the leaders can clearly convey the vision of the entire organization to the employees, human resource management practices perceived by the employees is consistent within a HR Manager's leadership style. So, a HR Manager's transformational leadership behavior enhances the effect of human resource management practices on employees' organizational commitment. Better performance management in an organization makes employees know their job goals and expected feedback. A fair and objective assessment method helps to motivate employees; and once the employees maximize their potential, they tend to identify themselves with the organization and develop emotional dependence on the organization.

HR Manager's transformational leadership can be inspiring, of which the results of performance management enhance employees' organizational commitment. Education and training not only improve skills but also stimulate the potential of employees. When an education and training system is improved, the employees' skills are further complicated and made heterogeneous. Similarly, when the employees have better performance, they will be inclined to think that the organization sees the employees as assets, rather than liabilities; thus, the employees become more willing to stand by the organization.

If the HR manager can guide his or her subordinates to find their own answers to the problems in the workplace as a passage of intellectual stimulation, the employees' problem-solving skills will be reinforced and in turn they will have consensus with the organization at an even higher level. Therefore, this study expects that transformational leadership style can enhance the positive relationship between education and training organizational commitment. If an organization has an advanced reward system, such as the performance pay system, the employees know that they will be rewarded if they work hard to meet the organizational goals. If a HR Manager can influence the employees through an ideology, employees' identification with the organization will be strengthened.

A HR Manager's transformational leadership style will enhance the effect of the reward system on organizational commitment. When an organization has a comprehensive and flexible benefit system, employees are willing to stay in the organization because they think that the organization is willing to make consideration for their individual needs. They will consequently develop an emotional attachment

to the organization. If a HR manager makes considerations to the employees' individual needs, the employees have more flexibility in their working.

Transformational leadership can enhance the effect of the benefit system on employee organizational commitment. If an organization has a transparent and objective system of career development, the employees are aware of their opportunities for development and will be more willing to stay within the organization. One of the transformational leadership dimensions, inspirational motivation, enhances the employees' willingness to remain in the organization, because, when the employees sense that they have opportunities for self-fulfillment and growth within the organization, they would be more willing to identify with and develop emotional attachment to the organization. Therefore, transformational leadership could improve the effect of career development on employee organizational commitment. When an organization has established more communication channels linking the management to the employees, information, including employee opinions and organizational goals, will be transferred faster. In such a case, the employees feel being valued and thus, reach the consensus with the organization.

A transformational leader can define and conveying organizational goals to the employees and such behavior is seen as an effective communication channel. When the leader in an organization can convey the organization's goals to the subordinates, a transformational leader should be able to reinforce the effect of communication on organizational commitment. Based on the above, this research proposes the following hypothesis:

H2: The HR Manager's transformational leadership has a positive moderating effect on the relationship between human resource management practices and employee organizational commitment. When the HR manager has high-level of transformational leadership, the human resource management practice have greater impact on organizational commitment; on the contrary, when the HR manager has lower level of transformational leadership, the human resource management practices have less impact on the employees' organizational commitment.

METHODOLOGY

Data source and sample attributes

The main data used in this study comes from the 2017 employee satisfaction survey of the top six financial holding companies in the Middel East (there are a total of 11 financial holding companies in the Middle East). The employees of the top six financial holding companies fill out the entire questionnaire. A total of 3,617 copies of the questionnaire were sent out and 3,185 valid copies of the questionnaire were retrieved. The return rate is 88.10%. Data collection is conducted through onsite testing. The research assistant sent out and collected the questionnaire onsite. All questionnaires were completed anonymously. On the attributes of the samples, males take up 52.3% and females 47.7%. Age distribution: 26 to 30 years old, 25.3%; 31 to 40 years old, 31.2%; 21 to 25 years old, 16.9%; over the age of 41. 24.3%, and under the age of 20, 2.3%. Years of service: less than one year, 15.1%; over one year but less than two years, 18.2%; over two years but less than three years, 22.7%; over three years but less than five years, 26.4%; and over five years, 17.6%. Job categories: full-time employees take up 83.9% and part-time employees take up 16.1%.

Variable measurement

Independent variables

The measurement for human resource management practices was developed with references to [32] and [55]. Human resources management practices are classified into performance management, education and training, salary bonuses, benefit system, promotion and career development and communication system. Likert's five-point scale is used to survey the employees. Performance Management contains 9 questions, including "According to the company rules, the company's HR manager conducts two performance evaluations each year in January and before the end of July." Education and training contain five questions, including "The Company has a comprehensive education and training system". Salary and remuneration contain five questions, including "Compared with other financial companies, I am satisfied with my salary". The benefit system contains five questions, including "When working overtime as requested by the Company, the company pays overtime or gives me a compensatory leave day according to my choice". Career development has five questions, including "I am very clear about all the promotion and transfer opportunities in the company". Communication system has six questions, including "I believe the company's complaint handling system can really help me". From the effect of reliability analysis, we found that, excluding the benefit system, questions of other human resource management practices have internal consistency falling in between 0.82 and 0.91, which are considered to have high reliability. Performance Management: $\alpha = 0.8663$; education and training: $\alpha = 0.8284$; salary and remuneration: $\alpha = 0.910$; benefit system: $\alpha = 0.8661$; career development: $\alpha = 0.8742$; and communication system: $\alpha = 0.8690$.

Moderator variables

The employees measure the transformational leadership based on the HR Manager's behavior. The scale is developed with reference to the transformational leadership dimensions used in Multifactor Leadership Questionnaire (MLQ) proposed by [6]. Six questions were developed. The five-point Likert scale was used to investigate the extent of agreement to each of the descriptions. Questions include "The Company's HR Manager gives the correct target and teaches me the necessary knowledge and skills needed for work and career development." The internal consistence of the questions is α=.9328, which is considered to have high reliability

Dependent variables

Dependent variables are adjusted with reference to the questions survey on employee organizational commitment[1]. Five questions are used for measurement, including "I am willing to work hard for and grow with the company." Likert's five-point scale is used to investigate the extent of agreement for the descriptions of each question. The internal consistence of the questions is $\alpha = 0.8758$, which is considered to have high reliability.

Controlled variables

From the pre-factor meta-analysis [44] in a survey on the subject of organizational commitment, we found that personal characteristics, that is, age, gender, years of service, and level of position, have significant

effect on employee organizational commitment. somepast researches on organizational commitment demonstrated differences between full-time and part-time workers[59], but others found no differences between the two variables. Results of the meta-analysis are found to have differences. Therefore, this research classifies sex, age, years of service, and job type (full-time and part-time) as the controlled variables.

Handling interactive variables

To avoid occurrence of collinearity between the multiplication entries of interacting independent variables and the moderator variables, each interacting variable, including the six human resource management practices and HR Manager's transformational leadership, is standardized as a single variable before multiplying and, after multiplication, the variables are subjected to a regression analysis [17].

Validity analysis

There are eight variables in this study, including six human resource management practices, plus HR manager's transformational leadership and employee organizational commitment. To further understand the fitting between the factors and the questions in the measurement, this study uses Confirmatory Factor Analysis (CFA) to test the degree of fitting between the variables and measurement items. In this study, the eight-factor, three-factor, and one-factor models are used to compare the level of fit of the models:

Model 1 is a one-factor model and 46 items in the eight variables are treated as a single factor.

Model 2 is a three-factor model. Since human resource management practices have been considered as a system in human resources management related researches, this research sees six human resource management practices as a factor. Together with HR Manager's transformational leadership and employee organizational commitment, a total of three factors are subjected under a factor analysis.

Model 3 is the model we wish to validate in this research. Therefore, this research divides human resource management practices into six variables for study alongside the factors of HR Manager's transformational leadership and employee organizational commitment.

The results are shown in Table 1. The eight-factor model is the best factor structure model. Chi-square value divided by the degrees of freedom is less than 2. In addition, the rest goodness-of-fit indexes are up to the best possible standard. The reason why the result of the chi-square value divided by the degrees of freedom is too small may be the effect that the number of samples is too large. Compared with other models, the eight-factor model is the best factor structure model.

RESULTS

Descriptive statistics and correlation analysis

Table 2 shows the descriptive statistics of all independent variables, moderator variables, the descriptive statistics of dependent variables, and the relations among the correlation coefficients of all variables. The correlation of the six human resource management practices and employee organizational commitment falls in between 0.50 and 0.70, which indicates a significant positive correlation ($P < 0.001$). The correlation

of HR Manager's transformational leadership and employee organizational commitment comes to 0.557, which also indicates asignificantly positive correlation ($P < 0.001$). From which, we can see that all dependent variables have significant positive correlation with the moderator variables and independent variables. Thus, we will move to the next step - regression analysis.

Table 1: Results of goodness-of-fit from the confirmatory factor analysis

Model	χ^2 (df)	$\Delta\chi^2$ (Δdf)	χ^2 /df	CFI	GFI	AGFI	RMSR
One-factor	243.56(968)		0.285	1.00	0.99	0.99	0.078
Three-factor	217.94(965)	30.14(2)	0.251	1.00	0.99	0.99	0.071
Eight-factor	149.78(937)	89.91(26)	0.168	1.00	1.00	1.00	0.053

Note: N=3183; $\Delta\chi^2$ and Δdf represent the variances of χ^2 and degree of freedom (df) between models. CFI=Comparative Fit Index; GFI=goodness of fit index; AGFI=adjusted goodness of fit index; RMSR=root mean square residual.

Table 2: Descriptive statistics and correlation coefficient of the independent variables, moderator variables, and dependent variables

Variables	A. V	S. D	1	2	3	4	5	6	7	8
Performance Management	3.92	0.621	0.8252							
Education and Training	3.88	0.651	0.502*	0.8149						
Salary and Bonus	3.37	0.723	0.523*	0.519*	0.8813					
Benefits	3.72	0.592	0.512*	0.542*	0.531*	0.8721				
Career Development	3.70	0.626	0.573*	0.572*	0.597*	0.613*	0.8537			
Communication	3.61	0.672	0.629*	0.562*	0.672*	0.635*	0.629*	0.8473		
HR Manager's T. Leadership	3.85	0.692	0.647*	0.506*	0.512*	0.523*	0.541*	0.519*	0.9186	
Employee Org. commitment	3.84	0.638	0.611*	0.597*	0.578*	0.602*	0.698*	0.675*	0.557*	0.8675

Note: *$P < 0.001$. The α value inside of the () at the diagonal position is the value of internal consistency analysis. Sample number falls in between 3122 and 3183. (A.V: Average Value and S.D: Standard Deviation).

The effect of human resource management practices and HR Manager's transformational leadership on employees' organizational commitment

The hypotheses of this study are mainly verified by the hierarchical multiple regression analysis. From Table 3, we can see that Model 1 is a regression analysis with input of the controlled variables. Model 1 shows significant effect. $F = 14.336$ and $P < 0.001$, which indicates that Model I reach the significant level. In addition to gender, the controlled variables, including age and job type, yielded significant positive results ($P < 0.01$).

Years of service, on the other hand, has a significant negative effect; $P < 0.01$. Model 2 is added with seven independent variables, including performance management, education and training, salary and bonus, benefits, career development, communication, and HR manager's Transformational Leadership, as well as the moderator variables, to test the main effect. From the regression analysis, we found that F value of model 2 is 179.666, which reached the significant level ($P < 0.001$), and ΔR2also reached the significant level ($P < 0.001$).

Through the regression coefficients of each individual independent variable and the moderator variables, we found that no significant effect is shown in performance management and the HR Manager's transformational leadership, but five of the perceptions on human resource management practices, including education and training, salary and bonus, benefits, career development, communication, etc., have a significant positive effect; $P < 0.001$. Therefore, most of the hypotheses proposed by this research are supported by the results.

The moderator effect HR Manager's transformational leadership

In Table 3, Model 3 shows the results of validation on Hypothesis II. Model 3 has an F value = 148.733, which reached the significant level ($P < 0.005$) and $\Delta R2$ also reached the significant level ($p < 0.005$). After testing the regression coefficient of the cross-multiply items of the individual human resource management practices and the HR Manager's transformational leadership, we found that the cross-multiply items of performance management and HR Manager's transformational leadership yielded a positive significant effect ($p < 0.05$), but the cross-multiply items of communication and the HR Manager's transformational leadership has a significant negative effect ($P < 0.01$), and part of the cross-multiply items of salary and bonus, as well as benefits, have a significant positive correlation with HR manager's transformational leadership ($P < 0.10$).

Education and training and career development, on the other hand, do not have significant correlation with the cross-multiply items of HR Manager's transformational leadership. So, HR Manager's transformational leadership regulate the effect of human resource management practices on employee organizational commitment in positive terms, as proposed in Hypothesis II, which also means that Hypothesis II is partly supported by the results.

Table 3

Variables	Model 1 β	Model 2 β	Model 3 β
Controlled Variables			
Gender	-0.015	0.042	0.042+
Age	0.179***	0.086***	0.084***
Years of Service	-0.093**	-0.017	-0.008
Job Type	0.145***	0.017	0.017
Independent variables			
Performance Management	—	0.042	0.049
Education and Training	—	0.261***	0.262***
Salary and Bonus	—	0.126***	0.126***
Benefits	—	0.157***	0.158***
Career Development	—	0.182***	0.183***
Communication	—	0.286***	0.276***
Moderator variables			
HR-M's transformational leadership	—	0.026	0.026
Interactive items			
Performance management x HR Manager's transformational leadership	—	—	0.078*

Education and training × HR Manager's transformational leadership	—	—	-0.024
Salary and bonus × HR Manager's transformational leadership	—	—	0.065+
Benefits × HR Manager's transformational leadership	—	—	0.053+
Career development HR Manager's transformational leadership	—	—	-0.051
Communication × HR Manager's transformational leadership	—	—	-0.096**
R2	0.053	0.701	0.728
ΔR2	0.503***	0.612***	0.008*
F	14.336***	179.666***	148.733***

Note: β value is a standard regression analysis coefficient. ***P < 0.01; **P < 0.01; *P < 0.05; +P < 0.10.

DISCUSSION AND CONCLUSION

Researches on human resources management practices in the past are focused on one single practice or study on the effect of some practices on employee attitude or performance. However, when more and more studies confirm the relationship of cause and effect, discussions on the intermediary factors and moderator factors will be a refined discussion on the formation of the cause-and-effect relationship and facilitate in-depth understanding of the relationships among the phenomena. From past empirical studies, we found that human resource management practices affect the attitude of the employees, particularly organizational commitment. This study added the factor of HR Manager's transformational leadership to explore the effect of human resource management practices on employee organizational commitment. We use the HR Manager's transformational leadership as the contingency factor to explore whether there are differences in the degree of effect among the various human resources management practices as on the variable of employee organizational commitment within the context of the HR Manager's transformational leadership.

From the foregoing analysis, we can see that, in Hypothesis I, in addition to performance management, the other five human resource management practices are supported. Human resource management practices have significant positive effect on employee organizational commitment. As for Hypothesis II, on the one hand, the interactive effect of performance management and the transformational leadership has a significant positive effect on employee organizational commitment. The interactive effect of communication and the HR Manager's transformational leadership, on the other hand, shows a significant negative effect. The interactive effect of salary and bonus, benefits and the HR Manager's transformational leadership, shows significant positive effect partly, and the interactive effect of education and training, career development, and the HR Manager's transformational leadership does not have significant effect on employee organizational commitment. Therefore, Hypothesis II is partly supported.

Results of this empirical study show that education and training, salary and bonus, benefits, career development, and communication have significant positive effect on employee organizational commitment. This finding is consistent with those of [21], [48], [50], [53], and [49]. In addition to performance management, the individual human resources management practice affects the employee's attitude. The Study pointed out that the relationship between performance management and employee organizational commitment [22]. They found that, in fact, not all performance management practices have correlations to employee organizational commitment. They found, in their research, the difficulties in achieving the

performance goals, which stressed that none of the factors, including peer competition, emphasis on short-term goals, the link between effort and performance, and the understanding in development, shows significant effect. This study measures performance management practice as a variable; therefore, some measurement questions (that is, the Company's HR Manager's provides guidance on how to improve my job performance during performance evaluation) is consistent to the concept. This caused weakening in the effect of performance management on employee organizational commitment and insignificant effect was shown.

Other human resource management practices have positive effect on organizational commitment. When an organization's training system is more complete, the more it will allow the employees to learn the skills needed and use the skills in their work, as well as develop the ability to solve problems, because the training system enables the employees to grow and have more control of their work and reduce frustration. The employees therefore become more willing to remain in the organization and develop emotional attachment. If an organization can provide better salary and bonus, this means that the organization can provide better economic rewards to the employees, so the employees are more willing to stay in the organization. If an organization can provide flexibility in the benefit policy, the employees would feel that they have more autonomy and are more respected, so they are more willing to identify with the organization. When an organization provides fair opportunities and a transparent promotion system, the employees' development can be anticipated and thus they become more willing to identify with the organization. Effective, moderate, and warm communication allows the employees to fully express their views and receive satisfactory responses, which yields the same effect as training. Employees feel respected, so they are more willing to commit to the organization.

The first contribution of this study is that it once again verified the effect of human resources management practices on employee organizational commitment. In the context of management, if an organization has good human resource management practices and the employees are aware of the practices, better employee attitude will be developed. Thus, if an organization wishes to have employees with a positive attitude, it can be achieved by providing commitment type human resources management practices; especially, a comprehensive system of education and training, satisfactory salary and bonus, flexible benefits, open and fair career development opportunities and, effective, moderate, and warm communication are effective in the improvement employee attitude.

And in the relationship of the moderator variables of the effect of the HR Manager's transformational leadership, as an individual human resource management practice, on employee organizational commitment, we found that the interactive items of performance management and the HR Manager's transformational leadership have positive and highly significant effect, and the interactive items of salary and bonus, as well as benefits, and HR Manager's transformational leadership have a positive and moderately significant effect. The interactive items of communication and the HR Manager's transformational leadership have a negative and highly significant effect, and no significant correlation is found in the interactive items of education and training, as well as career development, and HR Manager's transformational leadership.

HR Manager's transformational leadership is positively moderating to the performance management, salary and bonus, and benefits on employee organizational commitment. When HR Manager and his/her employees work together to make the performance goal, the former is responsible for performance evaluations. Salary and bonus and benefits, that is, flexible welfare, are similarly HR Manager's responsibility. Therefore, when HR Manager's transformational leadership is higher, it helps to enhance the

effect of human resource management practices on employee organizational commitment. The moderating effect of HR Manager's transformational leadership, education and training, and career development on employee organizational commitment was not significant. The main reason should be that these systems are usually set openly by the organization, so even if the HR Manager has high transformational leadership style, it would still be out of his power to enhance the more personal factors of the employees, such as education and training and career development.

The greatest contribution of this study is that it achieved further understanding in the moderating effect of HR Manager's transformational leadership, as a human resource management practice, on employee organizational commitment. The results of this study offer the organizations the insight that a HR Manager's transformational leadership must be fully manifested, and these leadership behaviors include guidance and employee training, conveyance of the organization's strategic goals and vision at the key meetings, and linking employees' work goals the organization's goals. A HR Manager demonstrates transformational leadership behaviors and the interaction between communication and a HR Manager's transformational leadership appears to flow in a negative direction. This also represents that communication and the HR Manager's transformational leadership are mutually replaceable. HR manager leadership is also a kind of communication channel, so when an organization is unable to design an effective communication system; a HR Manager's transformational leadership behaviors can be used to replace the formal channels of communication for proper conveyance of the organization's goal and vision.

LIMITATIONS OF THE RESEARCH AND RECOMMENDATIONS FOR FUTURE STUDIES

For the limitations of this study, the independent variables, moderator variables, and the dependent variables of this research are all done through the employees' assessment; therefore, problems of the homologous variation may occur [52]. Significant correlations among the independent variables, moderator variables, and the dependent variables could be detected because the two share the same source. This is the first limitation of this study. Even so, the main objective of this study is to verify the existence of the moderating effects. And the chances for the moderating effects to be affected by the common method variance (CMV) are relatively low. Therefore, the problem of CMV may be less significant in this study. However, we still suggest the future studies to incorporate the variables of social expectations as control factors or use different sources for data collection when designing a research targeting on this issue.

Furthermore, in the study of human resource management practices and organizational performance, there have been disputes on the issue of whether good human resources management practices result in good organizational performance, or good organizational performance results in good human resources management practices [63]. This study validates the viewpoint that good human resources management practices achieve good organization, but it is also possible that good organization enables good human resource management practices. This poses the second limitation of this research. Although human resource management practices and organizational performance may have reciprocal cause-and-effect relationship, implementation of human resource management practices improves employee attitude. This cause-and-effect relationship is more determined: there should be human resource management practices first, which make the employees feel that the company considers for them before their attitude can be changed. This study collected cross-sectional data, which is less capable of verifying the cause-and-effect

relationship between human resource management and employee organizational commitment; therefore, we recommended that future studies collect longitudinal data, which will offer more accurately means for verification on the cause-and-effect relationship.

This study used variables at the individual level to measure human resource management practices (organizational level), HR Manager's leadership style (group level), and employee organizational commitment (individual level). In the recent studies on organization, cross-level research methods are advanced research methods. If the cause-and-effect relationship between different levels is analyzed with cross-level methods, the results will be closer to reality. Therefore, using only variables of the individual level to measure variables at the organizational and group levels still poses limitation on this study. Nevertheless, this study emphasizes the importance of perception. In the confrontation with one universal reality, the factor that truly affects employee's attitude and behavioral change is the employees' perception. Therefore, even though this study measured only variables at the individual level, it still has contributions to the study on organization. We suggest that future researches employ cross-level approaches for further study on the related issues.

Another limitation of this study emerges in the relatively low increase volume in the R2 value as shown in Model 3 (0.008). This indicates that after the moderating effect is input into the models, the increase in the interpretative variance is significant. This result foretells that because only two of the six interactive variances are found to have significant effect, two other are found to have partly significant effect, and the rest of the two are found to have no significant effect, ΔR 2 will be on the low side. And according to [17] on the subject of statistical analysis methods for handling variance interaction, if variables are standardized before multiplication and the results are then subjected under analysis for the interaction of variables, it will under-estimate the presence of the moderating effect. Therefore, although the ΔR 2 of this study is low, the interactive effect is significant, which indicates that the moderating effect of HR Manager's transformational leadership indeed exists.

This research, studying the moderating effect of HR Manager's transformational leadership, has found that moderating effect does not exist in the effect of education and training and career development on employees' organizational commitment. We suggest that future research may try to find other contingency factors for the effect of human resource management practices on employee organizational commitment. This research studied mainly on the HR Manager's transformational leadership. The transformational leadership of other departmental managers, however, may also affect the employee organizational commitment. Therefore, we recommend that future researches should collect data on the transformational leadership of the department heads for the further exploration of the moderating effect of transformational leadership on the relationship between human resource management practices and employees' organizational commitment.

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