

Paper 1

ESSENTIAL INFRASTRUCTURES FOR WORLD-CLASS UNIVERSITIES

P. S. Aithal¹ & Shubhrajyotsna Aithal^{2*}

¹Srinivas Institute of Management Studies, Srinivas University, Mangalore – 575 001, India

²Faculty, College of Engineering & Technology, Srinivas University, Mangalore, India

E-mail : shubhraaithal@gmail.com

Abstract:

Higher education institutions including universities finding more challenges due to enhanced competitions worldwide. Innovations in higher education model are finding importance than ever before due to enhanced higher education institutions and the advancement in technology adopted mass education opportunities. After privatization of higher education, there is an enhanced competition between universities to attract students globally. Universities are competing with each other in terms of their physical and intellectual assets. In this paper, it is postulated that the six essential infrastructures to be developed by a university for accelerated growth as world-class university are (1) Physical infrastructure, (2) Digital infrastructure, (3) Innovative academic & training Infrastructure for confidence building, (4) Intellectual property infrastructure, (5) Emotional infrastructure, and (6) Networked infrastructure. We have determined the primary focus of these infrastructures along with their essential objectives, components, and the procedure of developing them to the optimum level.

Keywords : World-class universities, Essential assets, Physical infrastructure, Digital infrastructure, Academic & training Infrastructure, Intellectual property infrastructure, Emotional infrastructure, Networked infrastructure.

1. INTRODUCTION :

Higher Education, being one of the important service industries, plays a major role in the development of the economy of the country. Accordingly, innovations in the higher education model are finding importance than ever before due to enhanced higher education institutions and the advancement in technology adopted mass education opportunities. After privatization of higher education, there is an enhanced competition between universities to attract students globally. Universities are competing with each other in terms of their physical and intellectual assets. In many developed countries, private universities could establish a huge amount of physical infrastructures due to their autonomy and existence since a long time usually more than a hundred years. Compared to public universities which are depending on limited public funding, private universities could invest more funds on developing better infrastructure due to their autonomy in using funds on their accelerated development. World class universities are those universities from both public and private sectors focus both teaching and research which have made name and fame to attract global students for their multidisciplinary degree programmes through their quality & capability to provide world class education in varied areas. Times Higher Education (THE) Magazine, a university ranking agency has identified various parameters as metric to rank universities.

Based on such common parameters called performance indicators and comparison of scores under such parameters, it is announcing world ranking of universities every year. Times Higher Education World University Rankings evaluates more than 1000 world universities based on 13 performance indicators related to teaching, research, citations, international outlook, and industry income to provide the most comprehensive and balanced comparisons and hence is by far the most reliable and the most respected. One of the important parameters which play an effective role in the world ranking of universities and hence World-class universities is time duration of its existence i.e., length of its service to the society and hence its reliability. Many of the world top universities have a common factor of more than 100 years of their existence. Such a long existence and service to society is giving them a special reputation and advantage in the world ranking. The new universities born in the 21st century have a disadvantage of achieving this time based reputation and hence face a greater challenge to enter such university ranking list. However, by means of innovative and differentiated service, new universities can also compete with old universities using re-defining their quality of service, intellectual abilities, research contributions, industry networking, and physical assets to earn special recognition in world higher education scenario. In this paper, we made an attempt in a systematic way to identify such resources both tangible and intangible to accumulate in growing universities to be a world-class university.

2. RELATED WORKS :

There are many scholarly research publications on building and analysing world-class universities. These papers are either resource based analysis or geographic based analysis. This also includes policies, strategies, or contributions of universities globally to higher education and research. Table 1 summarizes the area and focus of various scholarly papers published during last few years in the 21st century.

Table 1 : Review on various scholarly papers published related to world-class universities

S. No.	Area	Focus	Reference
1	World class Universities	Cost and benefits	Altbach, P. (2015) [1]
2	Building world-class universities	Different approaches to a shared goal	Wang, Q., et al. (2013). [2]
3	Quest for building world-class universities in South Korea	Outcomes and consequences	Byun, K.et al. (2013) [3]
4	Building the world-class research universities	A case study of China	Huang, F. (2015). [4]
5	How world-class universities affect global higher education.		Cheng, Y., (2014) [5]
6	Corporate universities	Lessons in building a world-class work force	Kottke, J. L. (1999). [6]
7	Building World Class Universities		Krishnan, R. T. (2005). [7]
8	Third mission ranking for world class universities	Beyond teaching and research	Montesinos, P., et al. (2008). [8]
9	National initiatives for building world-class universities	Comparison between Asian and European experiences	Deng, Q., et al. (2010). [9]

10	An analysis of mobility in global rankings	Making institutional strategic plans and positioning for building world-class universities	Hou, A. Y. C., (2012). [10]
11	Creating world-class universities in Japan	Policy and initiatives	Oba, J. (2008). [11]
12	Creating world-class universities	Implications for developing countries	Lee, J. (2013). [12]
13	India	World-Class Universities	Altbach, P. (2015). [13]
14	World-Class universities	Can Young Universities Achieve World-Class Status?	Salmi, J. (2013). [14]
15	World-Class universities	Successful strategies to be learnt from world-class universities	Bejinaru, R. Et al (2017). [15]

3. OBJECTIVES :

Innovations in higher education model are finding importance than ever before due to enhanced higher education institutions and the advancement in technology adopted mass education opportunities. The objectives this paper are :

- (1) To identify the essential infrastructures for autonomous institutions/ universities to attain Excellency in imparting higher education globally.
- (2) To determine the primary focus of these infrastructures along with their essentials in detail.
- (3) To study each infrastructure in detail and strategies to be followed to develop such infrastructures.
- (4) To discuss how the above Infrastructures help to develop strategies for Survival, Sustainability, Differentiation, and Growth & prosperity.
- (5) To classify necessary and sufficient conditions of developing such infrastructures for all the above strategies towards building World class universities.

4. METHODOLOGY :

The methodology used in this study is called Focus group based Predictive analysis which deals with collection of information related to identified problem from a group of experts in the field and related fields and analysing such information in the context of predicting the future consequences of the identified present problem [16-18].

A simple method called predictive analysis is recently developed to address decision making problems related to predicting the future. Predictive analysis is an analytical method consisting of several techniques to predict future possibilities using present trends. It can be qualitative or quantitative. It is different from predictive analytics in such a way that it will support to predict future. On the other hand, predictive analytics is a method of generating information from historically available dataset to determine and predict future trends and outcomes [19].

Predictive analysis is a method consisting of several techniques to predict future possibilities using present trends. It is different from predictive analytics in such a way that it will support to predict future. On the other hand, predictive analytics is a method of generating

information from historically available dataset to determine and predict future trends and outcomes. A qualitative predictive analysis is used to predict the future possibilities by studying present trends using self-developed predictive analysis model shown in figure 1 [20]. The procedure of predictive analysis of a system or an activity encompasses 4 steps : Collect information on present trends, Develop postulates based on present trends, Generate argument based description, and Predict the future.

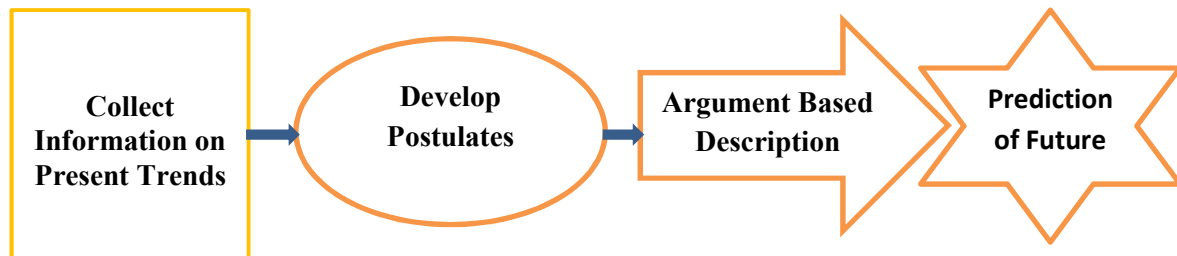


Fig. 1 : Predictive Analysis Model to predict future [19]

5. ESSENTIALS FOR WORLD CLASS UNIVERSITIES :

The six infrastructures identified based on our predictive analysis for world class universities are listed in table 2 with their preliminary focus. The block diagram shown in figure 2 depicts the essential components for world class universities.

It is known that ideal systems are hypothetical systems with ideal characteristics. There are many varieties of ideal systems are predicted, analysed, and discussed on possibility of realization of such ideal systems by different authors in their scholarly publications [21- 37]. Table 3 depicts the ideal expected level of essential infrastructure required for attaining global excellence.

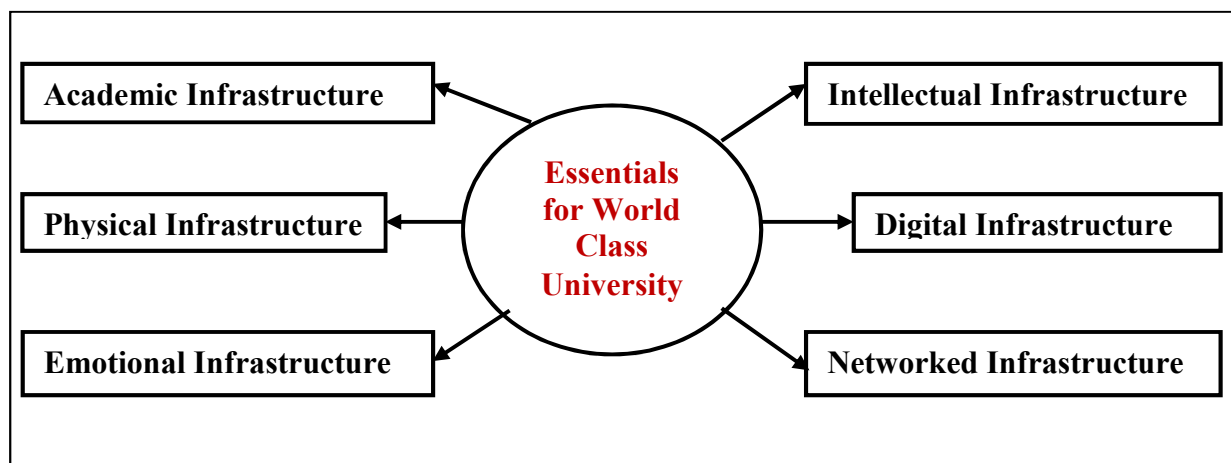


Fig. 2 : Block diagram of essential components for world class universities

Table 2 : List of Infrastructures required for attaining excellence and their focus

S. No	Essentials for attaining Excellence	Primary Focus
1	Physical Infrastructure	Comfortability
2	Digital Infrastructure	Openness & Ubiquitous accessibility
3	Innovative academic Infrastructure	Confidence building
4	Intellectual Property Infrastructure	Creating new knowledge & Innovation
5	Emotional Infrastructure	Belongingness & Connectedness of all stakeholders
6	Industry Networked Infrastructure	Industry Interactions for Training, Placement, & entrepreneurship

Table 3 : Ideal Infrastructures required for attaining global excellence

S. No	Essentials for attaining Excellence	Ideal Level of Expectation
1	Physical Infrastructure	Open outdoor natural place without any disturbance
2	Digital Infrastructure	Free access to any & every information in any form
3	Innovative academic Infrastructure	Models and pedagogies to make ideal graduate with unlimited knowledge, skills, experience and hence confidence
4	Intellectual Property Infrastructure	Infinite ability to Creating new knowledge & new innovation (IP) by students & faculties.
5	Emotional Infrastructure	Every stakeholder feels that the organization is of his own and every other stakeholder is his family member.
6	Networked Infrastructure	Perfectly networked with all kind of industries in entire globe for open Placement & entrepreneurship

(1) Physical infrastructure :

Physical infrastructure is required to provide comfortability and safety for the stakeholders for the teaching-learning process. Though a good and safety physical infrastructure at a comfortable location is desired, the ideal education system promotes an Open outdoor place without any disturbance. In reality the Country, Location, Land, Land connectivity, Landscaping, Students feeding area, Supporting industries, Attractive & green buildings, Structure & design of each buildings, Parking facilities, Roads with walking & bicycle path, Admission & Counselling Area, Classrooms, counselling rooms, faculty chambers, Meeting rooms, Laboratories, Studios, Gymnastics, Theatres, Cafeteria, Games & Sports facility, Auditorium, Library/Digital resource centre, Xerox & Printing centre, Hostels, Residents, Shops, Hospital, Student recreation facilities, International student centres, Research Park, etc. are considered essential components. Physical infrastructure provides comfort facilities to the stakeholders. It can be built for (1) minimum requirement with basic facilities to fulfil the objectives of higher education, or (2) for a fair level to satisfy the stakeholders and differentiate to gain competitive advantage, or (3) for a luxurious level to establish monopoly and high impact on stakeholders as mentioned in table 4.

Table 4 : List of Physical infrastructure Requirements for a University

S. No.	Facility	Details of physical infrastructure
Minimum Requirements		
1	Green building	The buildings of the university should be constructed with principle of open environment by using optimum models of water & energy consumption. Use of green energy, harvested water, renewable and recycled resources to produce and provide clean air, water, & food, light, electricity indecently internally in the Campus.
2	Roads with walking, Motoring & bicycle path	Entre Campus buildings should be surrounded by high quality motoring roads and bicycle paths to allow both students and staff to use bicycles or battery based vehicles for commuting inside the campus.
3	Admission & Counselling Area	Adequate amount of Admission & Counselling Area is required to conduct admission tests/ personal interviews.
4	Classrooms	Classrooms of different size with comfortable seating arrangements and teaching-learning facilities should be available to accommodate 120, 80, 60, 40, & 12 students.
5	Counselling rooms	Student counselling rooms of different size with comfortable seating arrangements and teaching-learning facilities should be available to accommodate 20, 12, & 5 students.
6	Strong Room	Strong Room of adequate size to accommodate confidential documents & question papers for examination sections.
10	Faculty chambers	Adequate number of well equipped faculty chambers to accommodate all permanent faculty members, visiting faculty members, part-time faculty members, Research scholars, etc.
11	Meeting rooms	Meeting rooms of sufficient size for 10 to 20 Participants with furniture and Electronic communication/presentation facilities.
12	Laboratories	State-of-the art laboratories along with advanced super specialty research centres in selected scientific and technological areas.
13	Computer Centre	1: 4 :: Computer: Student Ratio
14	Cafeteria	Clean, neat, and adequate in size
15	Dining Room	For 10 People, 30 people, and 90 people size.
18	Games & Sports facility	Indoor Stadium of sufficient size to accommodate variety of games.
19	Auditorium	One auditorium of sufficient size.
20	Library/Digital resource centre	Adequate in size with reading rooms, stock areas for books & Journals with online information access facility.

21	Xerox & Printing centre	Student amenity (40 Sq. M.)
22	Hostels	For at least 60 % students
23	Parking	Adequate to fulfil the requirements of all stakeholders
24	Office Rooms	Adequate to fulfil the requirement of all staff members
25	Exhibition Hall	Adequate in number to fulfil the requirement of all co-curricular activities
26	Guest House	Adequate for university requirement
Fair Requirements		
27	Faculty Residents	2 – 3 Bedrooms
28	Shops	For students and staff to purchase essential items
29	Hospital	A modern round the clock functioning hospital with inpatient and outpatient facility
30	Student recreation facilities	Adequate with modern touch
31	Yoga & Meditation Centre	Adequate with traditional touch
32	Faculty Cubicals	Adequate in number to fulfil the demand
33	Departmental Libraries	Adequate in size with reference books & online digital information resources
34	Students Waiting Room (Male)	Adequate in size
35	Student Waiting Room (Female)	Adequate in size
36	Faculty & Staff Quarters	Adequate in number (1-2 Bedrooms)
37	Guest Hostels	Star hotel type with accommodation, food, and recreation facility
38	Research Scholars Hostels	Adequate in numbers with contemporary facilities
Luxury Requirements		
39	Central Air Conditioned High Tech Buildings	With modern clean-green environmental concept
40	Faculty Chamber with attached washroom for each faculty	Ambient & adequate in number
41	Studios	Modern studio with optimum sound control & recording facilities
42	Gymnastics	With sufficient size & modern facilities
43	International student centres	With contemporary student amenities
44	Research park	With in-house industry R & D units & collaboration
45	International Student Hostels	Adequate in size & number with aesthetically built modern facilities
46	High Tech Playgrounds	Adequate
47	Swimming Pool	Modern type with multiple user facilities
48	Shopping Complex	Adequate
49	Stadium	Modern type
50	Indoor Stadium	Modern type
51	Botanical Park	Natural type

Even though, an appropriate physical infrastructure with adequate facilities is essential to attract admissions of students, it cannot offer a competitive advantage to the university continuously over a long time because competitors can also develop better infrastructure with more luxurious facilities to attract students and teachers to the system quickly by finding an appropriate investor. Physical infrastructure

(2) Digital Infrastructure :

The digital infrastructure helps all stakeholders to simplify their job and to make their contribution effective. All information related to the HEI including about the organization, about academic programmes, about admissions, about academics, examinations & evaluations, about faculty & research, about industry collaborations & placements, about student activities, etc. are ubiquitously available globally through digital infrastructure. The various supporting facilities to enhance the effectiveness of the services and to minimize the time spent to avail such services by different stakeholders. The following table 5 lists various types of digital infrastructure required for a university to be considered as world-class university.

Table 5 : Lists various types of digital infrastructure required for a university

S. No.	Types of digital infrastructure	Details of digital infrastructure & its usage
1	Internet usage	Connecting external world to the stakeholders through an electronic device.
2	Website	For providing institutional information to the publics
3	WhatsApp groups of stakeholders	For vertical and horizontal communication between Stakeholders
4	Google Blogs & Google sites for every course	To provide course information and day to day progress of the students who enrolled to the course to stakeholders and publics.
5	Wi-Fi Campus	To access online ubiquitous information in the campus and classes.
6	Online Study material	Development of study materials both in audio, video, and text form as per the curriculum and providing them to concerned students online as additional support to classroom teaching – learning process. The study material in the form of PDF book to be stored in smart phone, tablet, or laptop computer will help ubiquitous reference for the covered portion of the course subjects.
7	Digital Library	Developing and updating digital library and providing digital library membership to every stakeholder of the university for ubiquitous access of books, periodicals, study materials, magazines, annual/year books of organizations, journals in digital form is the responsibility of University digital library. For this purpose, the University digital library can collaborate national digital library and Global digital libraries.
8	Digital Publication	The university should have its own publication for books, newsletters, magazines, journals,

		proceedings, and printing question papers for examinations. Online digital publication as open access publication globally is the best practice.
9	Paperless office	By developing academic administrative software the university should provide online office environment to cater the services of stakeholders.
10	Paperless exams	Adopting digital examination system eliminates the wastage of papers in examination process.
11	Online Evaluation	Automated & digitized online evaluation system eliminates the wastage of time of evaluators & speed up the evaluation process.
12	Website based result announcement	Ubiquitous reachability.
13	NAD markscards Facility	A convenient and completely secure <i>digital academic depository</i> solution.
14	Online admission test	A ubiquitous facility for global admission
15	Education ERP	To integrate various departments of the university for timely exchange & access of information.
16	Plagiarism software facility	A software facility available to every stakeholder to check plagiarism content in the documents.
17	Online digital magazine & Student publication	In online digital format through University publication.
18	Online placement (Project, internship, & final)	Online ubiquitous support.
19	Video documentation of each course & each College	For open information access from globally
20	Video documentation in U-Tube	For open information access from globally
21	Facebook and Twitter based promotions	Information access & Brand building promotions
22	Use of ICCT underlying technologies like AI, BA, CC, DS, MB, OC, VR & AR	Adopting present technologies in automating the services
23	Studio for video online classes	Studio for digitization of sound and scene
24	Video conference facility	For global information exchange in digital format
25	Online open Publication system	For exchange of new knowledge generated to everybody through open excess system

(3) Innovative academic Infrastructure :

Academic infrastructure is the most important infrastructure among all. It is the main purpose of the education system and decides the quality of teaching-learning process. An innovative academic infrastructure also decides the quality of the output students of the university. Table 6 lists various components of innovative academic infrastructure required for a university for growth and prosper.

Table 6 : Lists various components of innovative academic infrastructure required for a university

S. No.	Types of Innovative academic infrastructure	Details of innovative academic infrastructure & its usage
1	Industry oriented curriculum	To meet the present and future demands of the industry
2	Employability skill focussed curriculum	For increasing employability of the graduates
3	Speciality & super speciality professional courses	Students can go deep in a specified subjects based on their interest and hence further growth in such areas are possible.
4	Experienced committed faculty	Experienced and committed faculty is the asset of the organization and are the motivators of students to involve in research to create new knowledge or to do innovations.
5	Session wise teaching plan	Systematic planning in teaching and learning process is required which includes session wise teaching plan and following such teaching plan.
6	Study books prepared as per the syllabus,	To provide equal amount of essential information to all the students in a class it is essential to provide study books prepared as per the syllabus of the subject.
7	Question bank	Question bank is a book containing all possible questions prepared as per the examination pattern. Such question bank eliminates the chance of asking questions out of the syllabus.
8	QB answers as assignments	The students are encouraged to work more by answering all question bank questions in the form of assignments. Periodic assignment submission with due date and offering internal marks systematically will enhances the responsibility of doing their work in right time.
9	Make-up exams	Students should be given enough opportunities to show their talents. Similarly, due to different reasons, if a student fail to take an exam or fail to perform well in the exam he should be given another opportunity without loss a year and so.
10	Value added employability skills enhancement Papers	Apart from core and elective papers in each semester, the university should identify some general skills required based on professional requirement and enhancing employability of the students. These skill development based value added papers should be offered as separate papers and taught by industry or professional people in the field.
11	Experimental learning pedagogy	The teaching – learning pedagogy should contain substantial amount of experimental learning part related to their specialization trough either real

		environment or virtual environment.
12	Co-curricular & extracurricular activities	These activities supports all-round development of students and enhances their competency and confidence in facing any challenges.
13	Earn while learn facility & flexibility	Earn while learn model has dual objectives : it gives working skills for a student with responsibility and it also supports financial needs of a student so that he need not depend on his parents for his pocket money.
14	Multi-skill development & certification opportunities	The university, by using its academic autonomy, should design the UG & PG courses in such a way that students should be offered many opportunities in all areas of STEAM for multi-skill development. Additional certificate programmes across the field may be offered.
15	Provision of optimum utilization of time to develop liberal arts skills	The regular class times should be planned optimally in order to provide sufficient time for liberal arts skills training so that students develop additional skills with them by involving in inculcating cultural and traditional skills which enhances their design thinking ability.
16	Provision of opportunities to develop & utilize Research & innovative thinking skills.	The UG & PG curriculum should be designed in such a way that there must be enough research components which allows students to work for their projects independently under the guidance of their research guide either individually or in a team. Such effort enhances the innovative ability of students and increases their competency and confidence.
17	Academic activity to build confidence	Academic support to raise knowledge, skills, attitude, and experience based competency to improve confidence in doing innovation.
18	Co-curricular activities to mould good character for social benefit	Co-curricular actives in teams or groups related to social work and social contribution also moulds good character and team working skills of the students and incorporates collective responsibility in them.
19	Special training in Event management & disaster management training	Irrespective of specialization and type of Course, every student at UG level get special training on event management & disaster management training as a part of their curriculum to prepare them in public program execution and to face natural calamities.
20	Compulsory Environmental Science Education	To create awareness to carry the clean, green, and peace environment to the next generation.

(4) Intellectual property infrastructure :

The university can prosper for longer time and establish name and fame at international level only if it focuses on enhancing intellectual property infrastructure. A research university by

objective has opportunity to contribute intellectual property of the country by focussing research and innovation leading to new knowledge creation. A list of various components of intellectual property infrastructure required for a university is shown in table 7.

Table 7: Lists various components of intellectual property infrastructure required for a university

S. No.	Types of intellectual property infrastructure	Details of intellectual property infrastructure & its generation
1	Research oriented experienced faculty members	Research oriented faculty members are usually research inclined. They motivate students and other faculty members to involve in research and innovation which adds intellectual property infrastructure of the university.
2	API based faculty compensation	Developing and implementing an Academic Performance Indicator (API) score based faculty compensation system stimulates faculty interest in participating research & publication activities. API based compensation creates healthy competition among the faculty members for accelerated IP contribution.
3	Targeted research	The university identifies some emerging areas in different subjects and supports the expert faculties in those areas to do research and to publish papers as well as patents. This is called targeted research and the university can create IPR as well as international brand through such efforts.
4	Atomic Research centres for each faculty	This is an innovative idea and best practice to be followed by Universities. Here, each faculty member identifies one or more area of research interest and develop an atomic research centre in his/her coordinate-ship. The centre develops the objective of the proposed research centre, methodology, and Expected outcome along with list of working papers, list of published papers in journals & proceedings. The centre may contain a list of researchers including coordinator, internal collaborators, and student members.
5	More Ph.D. & post doctoral research scholars	The university must admit more research scholars within its capacity of support. The university should use its autonomy to appoint more research professors (might be retired from regular services) only for guiding research scholars. University should also develop post doctoral research programmes to keep the doctoral graduates in sustained research contribution.
6	More Faculty members with Ph.D.	The university should implement a policy of increasing number of Ph.D. degree holders in its faculty group. In addition to serving as teaching faculty, the Ph.D. degree holders also available for guiding the research scholars for Ph.D. programmes.
7	Faculty encouragement for Book Publications, Research Publications,	In order to improve the Intellectual Property Rights (IPR) of the university, the university should have the policy to encourage IPR contributors who are none other than UG

	and Patents	& PG Students, Research scholars, and Faculty members. Based on implementing conducive policies to encourage research and publications at all above levels university can enhance its IPR infrastructure. Varieties incentives and supporting schemes will help such a mission.
8	More conferences (At least two conferences per year per College)	Organizing research paper presentation conferences periodically keeps students, research scholars and faculty members create an opportunity to keep up targets and to compare them with other colleagues through networking.
9	Student involvement in Research	Students are the most important resources in the university system and if guided properly can do innovations by developing patentable inventions. Similarly, through systematic research, they can also come out with scholarly publishable results. By involving students at the graduate and postgraduate level, the university can boost its IPR infrastructure.
10	Industry collaboration & Consultation	Supports collaboration based research so that the university can create IPR along with industry personnel. This also gives the opportunity to use industry research facilities by university personnel. Further collaborative research leads to more patents & publications.
11	University Incubation centres	University Incubation centres supports students to plan to start their own business after graduation. Any ideas developed during project work or internship period can be nurtured and supported as a business proposal to initiate self employment.
12	University Publication through its own press	Many universities start own publication press to speed up their scholarly publications. This also simplifies or decreases the cost of publications and encourages the faculty members to make use of their press for publication of new knowledge created. Presently, digital and online publications are prevailing and considered as one of the most important strategies of world-class universities.
13	University publications & Citation service	As a facility to researchers, universities have started citation services to their faculty members and the stakeholders including public. This will further help researchers to enhance quality publications.
14	Compulsory patent claim for UG & PG projects in Professional subject areas	By fixing the target for UG & PG students for internship and continuously guiding & monitoring them for planning and applying for patents for their invention certainly improves the result.
15	Faculty Ranking (Annual) system	Announcement of annual faculty ranking based on API and grading them under different levels develops competitive spirit among them and faculty members continuously strive for excellence. In such cases, faculty monitoring at every stage can be reduced.

(5) Emotional infrastructure :

Creating a sense of belongingness with the organization essential for all stakeholders is essential. The major elements of emotional infrastructure are listed in table 8.

Table 8 : Lists various types of emotional infrastructure required for a university

S. No.	Types of emotional infrastructure	Details of emotional infrastructure & its generation
1	Acceptable leader as role-model	University must develop leaders who have shared vision of developing the university in a planned manner. The leader himself must be all-rounder and role-model in terms of motivating & target setting to others.
2	Trust among stakeholders and outsiders	University system should develop trust (self & mutual) among all stakeholders based on their commitment and contribution to the system.
3	Institutional values (Core values)	For example, (1) Team Work, (2) Respect, (3) Responsibility, (4) Ethics, (5) Etiquette, (6) Social service, (7) Character, Commitment, Competency, & Confidence, (8) Tech-savviness & Scientific thinking, (9) Quest for excellence, (10) Continuous improvement, and (11) Promotion of Open systems.
4	Institutional Rituals & Tradition	The objectives, values, rituals, and the tradition cultivated by the seniors of the institution from several years should be carried to further as an institutional culture to involve every stakeholder in strong emotional bondage. This improves the commitment of stakeholders to fulfill their responsibility towards organizational development.
5	Create rich communication channels	Information related to day-to-day activities, subject, and course based information, Information related to the evaluation of students & teachers should be openly available to respective stakeholders. Through the open system model, the university should try to provide the right information at the right time to its stakeholders. This enables the stakeholders to make an optimum decision towards the growth of the university. By using various features of Information Communication and Computation Technology (ICCT), through a properly designed website and internal communication system, University can achieve this.
6	Alternative strategy & Support network	Stakeholder service is very important in gaining emotional support to the university. Thus to provide continuous services which are promised in the beginning must be provided in any situation. Accordingly, the university should think of an alternative strategy to fulfill promises. College facilities, Hostel facilities, food & drinking water

		facilities, transportation facilities, quality faculty members to cover the syllabus, conducting exams and announcement of results in time are very essential in an academic environment and require alternative strategy [38] and support network.
7	Set vision in every student	Goal setting in every student by creating awareness about opportunities is a major responsibility among students. The university system should motivate every student and identify the best among them and support to set a vision to prosper.
8	Safety & Security	The university should give priority in providing the hassle free ambience to every student. The safety and security are prime factors in the university campus for every stakeholder.
9	Search for proximity (Local friends. Local food, local culture)	Students usually search for proximity during the first year of their study. Seeking local friends, local food, local cultures are the common expectations among the students. University has the responsibility in creating such an environment to keep students not to feel loneliness.
10	Comfortability but need not luxury	The university should establish all facilities towards students basic needs and focus on providing students wants to ensure a certain level of comfortability in their campus life.
11	Legacy of the system	The university should carry further the traditions, cultures, and hence the legacy of the system by arranging the required number of such programmes, festivals, and other descent entertainment programs. The university also maintains organizational hierarchy in a dignified way.
12	Respect & perception about organization	The legacy of the system should be maintained in such a way that every individual stakeholder of a system should show positive perception about the university and respect heartily as their alma-matter.
13	Openness in terms of information	As a part of the emotional infrastructure of the university, it has to maintain openness and transparency in doing business. Openness & transparency in the admission process, academic teaching-learning processes, examination and evaluation system, research & publications, and investments & profitability are important.
14	Ability of the institution to fulfil the promises	One of the major challenges of higher education institutions is their inability to fulfil their own promises. Using autonomy of the university if it can solve its failures it can establish a good name in a short span of time.
15	Accountability measures	The university should adopt a system to check the accountability of every stakeholder and both

		positive incentives and negative punishments should be incorporated in the annual evaluation process.
--	--	---

(6) Networked infrastructure :

Connecting with the industry, with the alumni, with other higher education & research institutions creates synergy for collective development. By means of properly planned collaborations and implementing the objective of collaboration leads to positive-sum game. Organizations which focus on effective networking can encash more opportunities for self and mutual developments along with their brand image. Collaboration and partnership with local, national, and global agencies can be used to support other infrastructures like innovative academic infrastructure, intellectual property infrastructure, and emotional infrastructure. Table 9 lists various components of networked infrastructure required for a university.

Table 9 : Lists various types of networked infrastructure required for a university

S. No.	Types of Networked infrastructure	Details of networked infrastructure & its creation
1	Collaborations – Horizontal, Vertical & Diversified	Student progress should be planned and implemented to support industries, further education institutions, and for the social upliftment based on collaborating and involving with these institutions. University should create a situation where the industries, other educational-research institutions, and the whole society feel emotionally the importance and contribution of the university to society.
2	Alumni association & Networks	Keeping the alumni with their alma-matter, involving them in university progress, involving them in resource mobilization, and using their services as mentors to existing students is an effective strategy to enhance the emotional infrastructure of the university.
3	Industry integrated collaborations	Industry integrated collaboration by updating syllabus of study as per industry requirement, providing industry skills by involving industry experts, supporting industry projects through industry internship, etc.
4	Academic Integrated Collaborations	Collaborating with other academic institutions which have developed their core competency in related academic areas by creating synergy so that students can opt their subject in different universities / institutions to get dual degrees or to complete research internships etc.
5	Research Collaborations	Research collaborations between neighbouring organizations strengthen networking among the stakeholders.
6	Consultancy Collaborations	The faculty members, based on their professional specialization, should be encouraged to work as

		consultants in industries. This will improve industry-institute relationship and networking leading to enhanced synergy.
7	Placement Collaborations	The university should develop networking with local, national, and international companies of many industry sectors both for training the students during the internship and to provide campus job placement services to ensure that the graduates of the university are employable.
8	Collaborations for student - Earn While Learn model	As a new trend in higher education, the university should encourage the students to work during their free time to get working experience and at least to earn their pocket money through earn while learn model.
9	Collaborations with NGOs & Social service Organizations	The university should also work in close with various NGOs & social service organizations using its students and staff members. Such collaboration and networking with NGOs provide social service and fieldwork opportunities to the students of the university.
10	Membership with National & International Accreditation bodies for Quality & Credibility	The university should also improve its quality service by means of educational innovations and best practices. The quality and credibility of the organization can be verified by its recognition by national and international accreditation bodies.

6. INFRASTRUCTURE DEVELOPMENT STRATEGIES :

6.1 How to develop Physical Infrastructure :

Physical infrastructure can be developed to any extent by investing in huge financial investment. By identifying investors as partners, a university in the private sector can create large and essential infrastructure. But due to preset heavy competition in the higher education service business, huge investment by means of borrowing money from lenders/banks with high annual interest is not viable. Many organizations in HEIs/universities have identified political leaders/Bureaucrats as partners for the investment of unaccounted money. Creating huge attractive infrastructure can support brand building initially, but the competitors can also follow such investment model and compete for the institution so that in larger scale this infrastructure may not give any differentiation advantage. Physical infrastructure should support both academic and research activities of various schools and departments of the universities. In public universities, the physical infrastructure investment is done by the government through various independent authorities whereas, in private universities, the decision is taken by sponsoring organization. Since the physical infrastructure can add value but in long term, it may not create differentiation due to the fact that any competitor university can also develop huge infrastructure during a small interval of time as a counter strategy. The list of physical infrastructure given in table 4 can be developed by any university within one or two years if they get suitable investment partner.

6.2. How to develop Digital Infrastructure :

Digital infrastructure includes a paperless office system using automatic learning management system which includes digital information processing of all teaching, learning, examination, and evaluation activities. All the stakeholders get online information from both push and pull format. The university website centered admission process, payment of all fees by the students and faculty compensation are in digital payment format. Digital infrastructure of a university can be improved by implementing educational ERP/LMS, Having a dynamic website, Online teaching systems, paperless environment, computerized examination and evaluation system, Digitized marks cards/credit score cards, online e-placement supporting systems, online alumni networking, etc. The university needs one to two years to digitize its infrastructure either by its own efforts or by outsourcing digitization work for an internationally experiences information technology enabled services organization.

6.3. How to develop Innovative academic Infrastructure :

Innovative academic infrastructure can be developed by means of various innovative academic activities for creating innovators by means of Planning, Implementation, Evaluation, Feedback, & Self-study report. The following steps may be helpful for developing innovative academic infrastructure :

- (1) Institutional SWOC analysis.
- (2) Developing best practices by doing ABCD analysis.
- (3) Developing future strategy through predictive analysis.
- (4) Creating & retaining a strong faculty base through faculty performance analysis.
- (5) Using appropriate industry experts in curriculum design & implementation.
- (6) Developing leaders as role models through commitment & multi-tasking analysis.
- (7) Developing students by offering confidence building education model through student integrated development model.
- (8) Growth & expansion of the university through environmental analysis.

To optimize the academic infrastructure, the university needs 3 to 5 years time once it decides to invest in innovative academic structure. The academic infrastructure should provide unique teaching-learning model developed by the university as student integrated development model [39] to enhance their employability and innovability.

6.4 How to develop Intellectual property Infrastructure :

Development of intellectual property infrastructure is one of the biggest challenges for a university. A university can enhance its intellectual property infrastructure by implementing many strategies which include :

- (1) Involving all stakeholders in research, innovation, & documentation in the form of scholarly publication.
- (2) Developing a culture of innovative thinking through research & contribution to society.
- (3) Promoting institutional research in a systematic manner with high performance and output but low cost.
- (4) Having collaboration with many universities and research centres locally and globally to enhance joint research and publications.
- (5) Inviting industry as a partner to support their research & development activities and intern gaining in IR infrastructure.
- (6) Focusing equally on Research programmes leading M.Phil., M.Sc./M.Tech./M.S.(By research), Ph.D., Postdoctoral certificates, Postdoctoral degrees like D.Sc., D.Litt., etc. with compulsory Journal publication & patents/ copyrights.

(7) Encouraging faculty members through incentives to bid for government & industry funded research projects.

(8) Through university policy, motivating faculty members through faculty ranking based on research based API scores and subsequent additional incentives.

Since developing intellectual property infrastructure is long term activity and depends on many factors, universities take a long time to establish in this area, usually 10 to 15 years to reach substantial amount even if they are fully focused on such activities. The most appropriate way of calculating the IPR infrastructure for a given time duration is proposed in ABC Model of Organizational Performance [40-41].

6.5 How to develop Emotional Infrastructure :

Creation of emotional surplus with respect to employees and customers is a big challenge for every organization. Universities also should strive for emotional surplus as their essential infrastructure in order to accelerate their growth. Providing a good working environment for all stakeholders with ethical policies and transparent academic and administrative system and giving extra care in all service area of both higher education and research activities are the necessary and sufficient conditions for developing emotional infrastructure in the HEI organizations. Creating a substantial amount of emotional infrastructure for a university takes long time since it has to prove its long time credibility & identity through its dedicated and committed service to the society. Some of the strategies which support to develop emotional surplus as emotional infrastructure in universities are listed below :

- (1) All regulations related to various services should be framed from learner centric.
- (2) Honest effort of providing transparency in administration with democratic touch.
- (3) Leaders should be visionary and have inherent intention to treat every stakeholder as the family member.
- (4) Atmosphere to be created to build mutual trust and respect between stakeholders.
- (5) Develop an institutional tradition and culture from local tradition and culture.
- (6) Develop core values of commitment, dedication, and service among all stakeholders.
- (7) Create a system where everybody should know their responsibility and struggle to achieve it.
- (8) Create a system where every stakeholder gets security and justice.
- (9) Openness & transparency in all administrative decisions.
- (10) Accountability based on job description at all levels of the university.
- (11) University social responsibility for economically weaker sections.

To create emotional infrastructure in substantial amount and use it as a resource for brand creation, the university has to make sustainable efforts for long time period. Most of the existing universities all along the world with more than 100 years existence have advantage in accumulating emotional infrastructure compared to recently started universities. However, using innovative strategies, it should be possible for the present generation universities to create substantial emotional infrastructure for a time period of 10 to 30 years.

6.6 How to develop Networked Infrastructure :

Through effective networking with industries, other HEIs and various research organizations, universities can prosper and develop as one among world leader. The network collaborative model should have a systematic plan of involving industry experts in teaching-learning process. Starting from planning the courses and the subjects, developing the curriculum, collaborative training, collective evaluation, and offering employment, industry-institute interaction has the opportunity to add value to their services. Connecting with the industry,

with the alumni, with other higher education & research institutions creates synergy for collective development.

The following steps may be helpful for developing networking infrastructure for universities and HEIs:

- (1) Universities should realize that they are by the society and for the society so that by working with more organizations in a team, they can fulfil their objectives and contribute substantially for the society.
- (2) Involving alumni in close confidence in many processes, universities can get huge benefit for their brand building exercise.
- (3) Identifying and involving various industries which provide internship and employment opportunities in curriculum design.
- (4) Networking with student feeding institutions by means of involving/admitting faculty members of such institutions in university research programmes.
- (5) Collaborating with national and international universities for joint research & publications, Credit transfer Courses, Dual degree programmes, etc.

By means of properly planned collaborations and implementing the objective of collaboration leads to a positive-sum game. Organizations which focus on effective networking can encash more opportunities for self and mutual developments along with their brand image. Collaboration and partnership with local, national, and global agencies can be used to support other infrastructures like innovative academic infrastructure, intellectual property infrastructure, and emotional infrastructure.

The estimated time period required for development of the essential infrastructures for a university in a private sector where the board of directors have autonomy to make investment decision is shown in Table 10.

Table 10 : Time period required to develop various infrastructure optimally

S. No	Essentials infrastructures for attaining Excellence	Time period required for reaching optimum level
1	Physical Infrastructure	02 - 03 years
2	Digital Infrastructure	01 - 02 years
3	Innovative academic Infrastructure	03 - 05 years
4	Intellectual Property Infrastructure	10 - 15 years
5	Emotional Infrastructure	10 - 30 years
6	Networked Infrastructure	05 - 10 years

7. CONCLUSION :

The important essential infrastructures required for a growing university to emerge itself as a world-class university are discussed. It is postulated that the six essential assets to be developed by a university based on predictive analysis for the accelerated growth and prosper as world-class university are (1) Physical infrastructure, (2) Digital infrastructure, (3) Innovative academic & training Infrastructure for confidence building, (4) Intellectual property infrastructure, (5) Emotional infrastructure, and (6) Networked infrastructure. The study focuses on various components of these infrastructures and how to develop these infrastructures for growing universities along with the essential objectives in detail. The various generic strategies to be followed to develop such infrastructures along the lifecycle of the university including Survival, Sustainability, Differentiation, and Growth & prosperity

are analysed. The necessary and sufficient conditions of developing such infrastructures using all the above strategies towards building World-class universities are identified.

REFERENCES :

- [1] Altbach, P. (2015). The costs and benefits of world-class universities. *International Higher Education*, (33), 5-8.
- [2] Wang, Q., Cheng, Y., & Liu, N. C. (Eds.). (2013). *Building world-class universities: Different approaches to a shared goal* (Vol. 25). Springer Science & Business Media.
- [3] Byun, K., Jon, J. E., & Kim, D. (2013). Quest for building world-class universities in South Korea: Outcomes and consequences. *Higher Education*, 65(5), 645-659.
- [4] Huang, F. (2015). Building the world-class research universities: A case study of China. *Higher Education*, 70(2), 203-215.
- [5] Cheng, Y., Wang, Q., & Liu, N. C. (2014). How world-class universities affect global higher education. In *How World-Class Universities Affect Global Higher Education* (pp. 1-10). Sense Publishers, Rotterdam.
- [6] Kottke, J. L. (1999). Corporate universities: Lessons in building a world-class work force (revised). *Personnel Psychology*, 52(2), 530.
- [7] Krishnan, R. T. (2005). Building World Class Universities. *Economic and Political Weekly*, 1681-1683.
- [8] Montesinos, P., Carot, J. M., Martinez, J. M., & Mora, F. (2008). Third mission ranking for world class universities: Beyond teaching and research. *Higher education in Europe*, 33(2-3), 259-271.
- [9] Deng, Q., Wang, Q., & Liu, N. C. (2010). National initiatives for building world-class universities: comparison between Asian and European experiences. *Research Institute for Higher Education Hiroshima University*, 7, 735.
- [10] Hou, A. Y. C., Morse, R., & Chiang, C. L. (2012). An analysis of mobility in global rankings: making institutional strategic plans and positioning for building world-class universities. *Higher Education Research & Development*, 31(6), 841-857.
- [11] Oba, J. (2008). Creating world-class universities in Japan: Policy and initiatives. *Policy Futures in Education*, 6(5), 629-640.
- [12] Lee, J. (2013). Creating world-class universities: Implications for developing countries. *Prospects*, 43(2), 233-249.
- [13] Altbach, P. (2015). India: World-Class Universities?. *International Higher Education*, (40).
- [14] Salmi, J. (2013). Can Young Universities Achieve World-Class Status?. *International Higher Education*, (70), 2-3.
- [15] Bejinaru, R., & Prelipcean, G. (2017, July). Successful strategies to be learnt from world-class universities. In *Proceedings of the International Conference on Business Excellence* (Vol. 11, No. 1, pp. 350-358). De Gruyter Open.
- [16] Kitzinger, J. (1995). Qualitative research: introducing focus groups. *Bmj*, 311(7000), 299-302.

- [17] Rabiee, F. (2004). Focus-group interview and data analysis. *Proceedings of the nutrition society*, 63(4), 655-660.
- [18] Narula, A. V. & Aithal, P. S. (2018). Employability Skill traits Management Quotient [ESMQ] – A Conceptual Model Proposal. *International Journal of Applied Engineering and Management Letters (IJAEML)*, 2(1), 1-30. DOI: <http://dx.doi.org/10.5281/zenodo.1156138>.
- [19] Shubhrajyotsna Aithal & Aithal, P. S. (2018). The Realization Opportunity of Ideal Energy System using Nanotechnology Based Research and Innovations. *International Journal of Advanced Trends in Engineering and Technology*, 3(2), 1-15. DOI : <http://doi.org/10.5281/zenodo.2531876>.
- [20] Aithal, P. S. & Shubhrajyotsna Aithal (2019). New Directions in Scholarly Research- Some Fearless Innovations & Predictions for 21st Century Research. *International Journal of Management, Technology, and Social Sciences (IJMTS)*, 4(1), 1-19. DOI: <http://doi.org/10.5281/zenodo.2557222>.
- [21] Casey, V., & Richardson, I., (2004). A practical application of the IDEAL model. *Software Process: Improvement and Practice*, 9(3), 123-132.
- [23] Aithal, P. S. (2016). Review on Various Ideal System Models Used to Improve the Characteristics of Practical Systems. *International Journal of Applied and Advanced Scientific Research*, 1(1), 47-56. DOI : <http://doi.org/10.5281/zenodo.159749>.
- [24] Aithal, P. S., & Shubhrajyotsna Aithal, (2015). Ideal Technology Concept & its Realization Opportunity using Nanotechnology, *International Journal of Application or Innovation in Engineering & Management (IJAEM)*, 4(2), 153 – 164. DOI: <http://doi.org/10.5281/zenodo.61591>.
- [25] Shubrajyotsna Aithal & Aithal, P. S. (2018). Concept of Ideal Water Purifier System to Produce Potable Water and its Realization Opportunities using Nanotechnology. *International Journal of Applied Engineering and Management Letters (IJAEML)*, 2(2), 8-26. DOI: <http://doi.org/10.5281/zenodo.1323714>.
- [26] Aithal, P. S. & Shubhrajyotsna Aithal (2018). The Concept & Characteristics of Ideal Energy System and its Realization Constraints. *International Journal of Applied Engineering and Management Letters (IJAEML)*, 2(2), 127-137. DOI: <https://doi.org/10.5281/zenodo.1487702>.
- [27] Shubhrajyotsna Aithal & Aithal, P. S. (2018). The Realization Opportunity of Ideal Energy System using Nanotechnology Based Research and Innovations. *International Journal of Advanced Trends in Engineering and Technology*, 3(2), 1-15., DOI : <http://doi.org/10.5281/zenodo.2531876>.
- [28] Architha Aithal & Aithal, P. S. (2018). The concept of Ideal Drug & Its Realization Opportunity using present Pharmaceutical Sciences Scenario. *International Journal of Health Sciences and Pharmacy (IJHSP)*, 2(2), 11-26. DOI : <http://doi.org/10.5281/zenodo.1469963>.
- [29] Aithal, P. S. (2015). Concept of Ideal Business & Its Realization Using E-Business Model. *International Journal of Science and Research (IJSR)*, 4(3), 1267 – 1274. DOI : <http://doi.org/10.5281/zenodo.61648>.

- [30] Aithal, P. S. (2015). Mobile Business as an Optimum Model for Ideal Business. *International Journal of Management, IT and Engineering (IJMIE)*, 5(7), 146-159, DOI : <http://doi.org/10.5281/zenodo.163880>.
- [31] Aithal P. S. and Shubhrajyotsna Aithal (2014). Ideal education system and its realization through online education model using mobile devices, *Proceedings of IISRO Multi Conference 2014*, Bangkok, 7/01/2014, 140 - 146, ISBN No. 978-81-927104-33-13. DOI: <http://doi.org/10.5281/zenodo.62059>.
- [32] Aithal, P. S. and Shubhrajyotsna Aithal (2015). An Innovative Education Model to realize Ideal Education System. *International Journal of Scientific Research and Management (IJSRM)*, 3(3), 2464 - 2469. DOI: <http://doi.org/10.5281/zenodo.61654>.
- [33] Aithal, P. S. (2016). Ideal Banking Concept and Characteristics. *International Research Journal of Management, IT and Social Sciences (IRJMIS)*, 3(11), 46-55. DOI : <http://dx.doi.org/10.21744/irjmis.v3i11.311>.
- [34] Aithal, P. S. (2016). Realization of Ideal Banking Concept using Ubiquitous Banking. *International Journal of Scientific Research and Modern Education (IJSRME)*, 1(2), 119-135. DOI: <http://dx.doi.org/10.5281/zenodo.164703>.
- [35] Aithal, P. S. (2016). A Comparison of Ideal Banking Model with Mobile Banking System. *International Journal of Current Research and Modern Education (IJCRME)*, 1(2), 206-224. DOI: <http://dx.doi.org/10.5281/zenodo.198708>.
- [36] Aithal, P. S., & Vaikuth Pai, T. (2016). Concept of Ideal Software and its Realization Scenarios. *International Journal of Scientific Research and Modern Education (IJSRME)*, 1(1), 826-837. DOI: <http://doi.org/10.5281/zenodo.160908>.
- [37] Aithal, P. S. & Priyesh Pai, T. (2017). Opportunity for Realizing Ideal Computing System using Cloud Computing Model. *International Journal of Case Studies in Business, IT and Education (IJCSBE)*, 1(2), 60-71. DOI: <http://dx.doi.org/10.5281/zenodo.1094995>.
- [38] Aithal, P. S. & Architha Aithal (2018). The Concept and Importance of Alternative Strategy as Parallel Strategy to be followed in Organizational Decisions to Ensure Success. *International Journal of Management, Technology, and Social Sciences (IJMTS)*, 3(2), 1-15. DOI :<http://doi.org/10.5281/zenodo.1302779>.
- [39] Aithal, P. S. & Aithal Shubhrajyotsna (2019). Innovation in B.Tech. Curriculum as B.Tech. (Hons) by integrating STEAM, ESEP & IPR features. *International Journal of Case Studies in Business, IT, and Education (IJCSBE)*, 3(1), 56-71. DOI: <http://doi.org/10.5281/zenodo.3248630>.
- [40] Aithal, P. S. & Suresh Kumar, P.M. (2016). ABC Model of Research Productivity and Higher Educational Institutional Ranking. *International Journal of Education and Management Engineering (IJEME)*, 6(6), 74-84. DOI: <http://doi.org/10.5815/ijeme.2016.06.08>.
- [41] Aithal, P. S. & Suresh Kumar P. M. (2017). Interconnecting Theory A and ABC Model of Organizational Performance. *International Journal of Management, Technology and Social Sciences (IJMTS)*, Srinivas Publishers, 1(1), 1-13. DOI: <http://dx.doi.org/10.5281/zenodo.268598>.