

2. ROLE OF TECHNICAL UNIVERSITY IN NURTURING ACADEMIC EXCELLENCE: OPPORTUNITIES AND CHALLENGES

Prof. Prem Vrat*

Abstract

This paper identifies the need for and role of a technical university in a state to nurture quality and academic excellence in technical education as a result of privatization of technical education system and resultant proliferation of institutions. It identifies the advantages of having a technical university in a state and briefly traces the history of technical university system in India. To ensure success of this system, it outlines a strategic roadmap with TQM based approaches with focus on "employability enhancement, student orientation, faculty – driven and enlightened visionary led institutions". It advocates strong focus on 'quality' and 'academic' excellence, transparency in functioning; agility to quickly respond to requirements in industry and balance teaching, applied research and consulting or outreach activities. It pleads for a case for greater financial, administrative autonomy, commensurate with accountability for performance on well defined parameters and metrics perceived by stake – holders: the university members, institutions affiliated, students, employers, state govt. and the academic regulators at the national level. It addresses on the issue of recent trends in bifurcating/ trifurcating technical universities in the states and cautions about the dysfunctional aspects of such a strategy and proposes an alternative to take care of efficient handling of increased numbers.

Introduction

There has been an exponential growth in quantitative terms in the technical education system in the country over the past twenty years, primarily due to privatization of technical education. Technical education is defined as an umbrella term to include engineering and technology, architecture, pharmacy, computer applications, hotel management, business administration, fashion technology etc. as per the mandate of the All India Council for Technical Education (AICTE). While from the view point of access and inclusive growth and

participation of private equity, in what was earlier thought to be a social sector; it is a welcome development. However, due to sudden expansion of the capacity to meet tremendous demand for good quality education in the country, the quality might not have kept pace with the quantity. Perhaps, that is the reason, why quality of technical education has been a topic of debate in almost all academic fora in recent times, particularly accentuated by the NASSCOM report of low immediate employability of IT graduates (25% - 30%).

The primary mandate to regulate quality has

*Professor of Eminence; MDI, Gurgaon & Former Vice Chancellor, UP Technical University & Founder Director, IIT, Roorkee

been statutorily given to AICTE in the country for approval of establishing technical institutions; grant of seats, branches, increase of intake and accreditation of programmes through NBA under AICTE. At the state level, the affiliation to a technical university where it exists or to the nearby general university, where a technical university does not exist, is the second tier regulation for quality of academic programmes offered by an institution. The technical university is responsible from admission to graduation level processes and can be an effective instrument for quality assurance. It helps in setting benchmarks of quality of graduates.

Quality Aspects of Technical Education

Quality is conformance to (Customer) requirements. Therefore, quality of technical education system has to be seen in the context of meeting the aspirations of the internal customers (students) and the ultimate customers – the employers and the society at large. Traditionally, quality and quantity have been taken to be antithetic to each other; although, if seen in the right perspective, it need not be so. An acceptable proposition given here is “Number is not a constraint; if these are quality numbers; and numbers (quantity) has no meaning if these are not quality numbers”. Hence, growth without sacrificing quality, should be a vision of a technical education system.

Even from the system dynamics point of view, the exponential growth of a system is not a sustainable proposition and perhaps points out to a fact that the control mechanisms have not fully delivered. Some of the negative side effects of this near exponential growth are the ‘imbalances’ of various kinds, it has created in the technical education system. From a systems point of view, an imbalance is a symptom of an ailment in the system adversely affecting its health and well being. Hence, this ‘imbalance’ in the technical education system needs to be addressed seriously. Following kinds of imbalances can be seen in the technical education systems that have crept

during past 20 years of expansion: -

(a) Geographical imbalance

Most of the expansion in the capacity has remained confined to a few regions/ zones in the country. More than 50-60% of capacity expansion has been confined to 4-5 states while many other states do not have adequate capacity to train their students in technical education. Even, within a given state, there could be imbalances, where 20-30% of the districts account for 70-80% of the total enrolments. Thus, a Pareto's Law of maldistribution seems to be in evidence. While this needs to be corrected, this can have a positive fallout as well – to identify clusters of these colleges and leveraging their locational advantage and develop them as ‘Special Knowledge Zones (SKZ)’ similar to SEZ'S and also like ‘Export Promotion Zones’ to cater to the international students.

(b) Branchwise imbalance

Since private equity gets attracted to ‘low investment’, ‘high return’ options; majority of new institutions have added only few popular branches, which essentially hover around ‘computer science and information technology’ in various, almost synonymous, permutations and combinations. As a result nearly 70% enrolments are confined to these 20% of the branches and core engineering disciplines- Civil, Mechanical, Electrical, Textile, Agricultural, Chemical Engineering., Metallurgy, Mining etc. have not found enthusiastic investors. Such an imbalanced technical education system will eventually adversely affect the balanced development of the country. The regulatory authorities and the state governments must play an effective and proactive role to ensure such a balanced growth, through a set of incentives and disincentives.

(c) Imbalance between Degree and Diploma Institutions

A degree is considered inherently more

prestigious in the country as compared to a diploma due to social mind set. As a result, the degree level institutions and their enrolments have expanded much more; whereas diploma technicians and vocational courses were ignored by private equity holders. This has led to a very serious lop-sided inverted pyramid with more engineering graduates than those who provide technical support. Fortunately, in recent times, there is some realization with 'National Skill Development Missions'; but a holistic approach is needed to rectify this imbalance between degree and diploma and perhaps there is a need for a vertically integrated technical education from 'ITI' to 'IIT'. A credible forecasting of skill sets needed for balanced growth is an operating necessity.

(d) Imbalance in Faculty Profile

Due to fast expansion, faculty shortage has become an endemic problem and not only in quality terms but also in terms of 'cadre-mix', a tremendous imbalance has resulted. If one peruses through the faculty profile of affiliated colleges in terms of their qualifications, age, experience and compensation package offered - a large variability is to be seen. Roughly speaking - about 75-80% faculty members are young, fresh B.Tech./ MCA/ MBA and in the age group between 20-30 years and another 10% could be in the age group of 60 plus - superannuated professors from leading engineering institutions and from industry. A stable middle cadre is almost missing. There are serious anomalies in emoluments of director/ principal and other faculty members. Variability across institutions is also seen where some institutions pay handsomely while others do not.

(e) Pedagogic Imbalance

Most of the teaching - learning process is based on 'rote learning' primarily aimed at clearing the university examinations - at times from simple 'made easy' like reference materials. Lack of practical orientation, industry interaction, summer placements and lack of

focus on a good final year project work, are perhaps the cause for serious concerns.

Role of a Technical University in a State

The concept of a technical university, essentially affiliating in character, is a relatively new concept in India and it perhaps started with JNTU in Andhra Pradesh. Currently, around 18 state levels technical universities are functioning in the country. Still, all states do not have a technical university. A very recent trend of bifurcation or trifurcation of state technical universities is also seen. If not implemented in the right spirit, such a division of state universities might 'undo' the rationale of having a technical university. These issues are addressed in this paper.

A technical university is created by an Act of the legislative assembly of the concerned state and all degree level institutions in engineering and technology, pharmacy and architecture and MBA/ MCA, M.Tech, M.Arch; etc. located in any part of the state within its geographical territorial jurisdiction come under the affiliation of the state technical university. The technical university comes into picture after AICTE grants approval to establish the institution and grants the branches and sanctioned intake. Thus, it has a very limited role, if any, in controlling the quality of colleges being established. However, it can have a very effective role in nurturing the quality into the programmes approved by the AICTE. This is possible through admission process, curricula design, monitoring delivery processes, attendance, faculty selection process, examination process, result analysis, encouraging better performing institutions and educating the public and parents about the academic performance of the institutions by posting the result analysis on the university website. Thus, the quality assurance roles of AICTE and the technical university are in tandem.

In the absence of a single technical university at the state level, various engineering

and management institutions get affiliated to a nearly or a preferred state level university of a general nature. Since the admission, curricula revision, fee structure, examination process of technical subjects and academic calendar for the teaching – learning process in these colleges require a special attention, these may get overlooked if these technical institutions are affiliated to a general university. There may not be common admission criteria; course curricula, academic calendar etc. for various institutions affiliated to different state general universities. Hence, brand equity attributed to institution at a state level does not get created which may in turn impact adversely on placements and employability of graduates. Engineering/ Management education being holistic with curricular and co-curricular mix of skill sets and generally residential in nature; their affiliation to a general state university may possibly suffer. Hence, there is a strong rationale of setting up a technical university in each state.

Should a Technical University be only affiliating in Character?

One of the key policy issues that needs to be addressed is – ‘should a technical university offer its own academic programmes in addition to providing affiliation or should it be strictly an affiliating body’? There is no standard pattern emerging to such an issue in the country as there are both kinds of models, in evidence. However, in order to offer a benchmark and to be a playing captain, it sounds more logical for a university to have its own academic and research programmes as well and affiliate others. In the absence of this, the entity will merely be an admission and examination board and academic spirit will be missing from such an entity. However; it is possible to confine the academic component of a technical university to Master’s and Doctoral level only, and faculty development programmes, while undergraduate programmes may be offered through its constituent colleges which are directly managed by the university. By this

arrangement, the technical university still will have on its roll a dedicated full time faculty belonging to it and can offer ‘benchmarks’ in academic and administrative performance to its affiliated colleges. Such a structure might perform better than purely affiliating function. However, the caution to be exercised in this structure is to ensure that in its over-indulgence with affiliating role, the academic role of the teaching – learning processes within its own premises do not take a back seat.

Some Core Advantages of having a Technical University

Since technical education mandated through AICTE requires special attention, a technical university, working in conjunction with AICTE and deriving its autonomy through UGC and the Act of the legislative assembly of the concerned state, can become very useful in nurturing quality among its member institutions and foster academic discipline and a standard academic calendar. The advantages of having a technical university affiliating all the colleges imparting degrees that coming under the definition of technical education by AICTE located all over the state are as follows:-

1. There will be a common basis of admissions across the state with common criteria for eligibility and common basis for entrance test. This will bring in greater consistency and transparency in the admission process and therefore ensure quality input to the affiliated colleges. This will also reduce multiplicity of admission related efforts and centralized counseling will reduce strain on time, efforts and finances of the admission seekers.
2. There will be a common standard of examination; curricula, for all colleges and therefore graduates from the state will not be subjected to variable standards of achievements. Thus, a common quality brand of the state colleges is possible and the role of the college of a graduate will have a secondary role essentially influencing the overall result of that college. This is by far the most powerful argument in favour of a

- technical university. Brand equity of all colleges will be created through this.
3. A common academic calendar will ensure that student graduate in time irrespective of the college they get admitted to. Academic schedule slippages can be more effectively controlled, due to common centralized examination conducted by the technical university.
 4. A comparative evaluation of the academic performance of various colleges is possible by placing their academic results on the university website. While this will bring required transparency, it will foster inter-college competitive spirit and will exert indirect pressure on the institutions to improve their academic performance. Thus, a university becomes a powerful enabler of quality at the state level.
 5. The quality enhancement initiatives of the university will have a multiplier effect and even a small incremental improvement replicated at all the affiliated institutions will have a major accumulated effect on the quality of technical education in the state. A common standard will reduce variability in the quality of graduates.
 6. An accomplished, visionary, university leadership can motivate the entire technical education system and therefore setting up such a university offers an opportunity of availing the talent of such a leader. The acute shortage of such an intellectual capital in the country can be salvaged to some extent by this 'economy of scale'. A visionary vice chancellor, can transform institutions across the entire state.
 7. Faculty development institute, virtualization of technical education through e-learning and leveraging NPTEL resources are feasible in a cost – effective manner through state technical university. Being a single source of academic authority, coordination and cooperation among affiliated colleges is more easily facilitated.
 8. A common index of evaluating the academic performance such as Gross average intellectual attainment per student 'GAIA' being used by UPTU can be implemented as a simple, yet, holistic quality measurement parameter.
 9. Foreign institutional and industrial collaboration is more easily possible because of the brand value so developed. It may be relatively difficult for colleges to do so in a standalone mode. MOU's with the industry, foreign and national institutions of repute can be more easily established to get networking advantage and synergy.
 10. A major quality enhancement strategy, which has successfully been implemented through UP Technical University Academic Excellence Award can be instituted to let colleges know the expected profile of an excellent institution on a multiple criteria framework of a quality award model. This will create a healthy spirit of competition to be an award winner – and more importantly will tell what an institution needs to do to be an award winner. A graded motivational road map can be strategized to identify excellence award winners; star performers and the certificate of appreciation. This becomes an 'Exclusive as well as Inclusive' road map as there can be an increasing number of star performers and recipients of the certificate of appreciation; while the award winners are limited.
- This initiative of UPTU, in practice for past three years, has definitely enthused institutions to develop along quality lines and is perceived by the institutions as a grand success story worth emulating in the other state technical universities.
- ### **Some Features to make Technical Universities Function Efficiently**
- #### **1. Governance structure:**
- The University, being a statutory and autonomous authority, must have an

organization structure that empowers the University to achieve academic and professional excellence, yet holding itself accountable to deliver performance and be free from any undesirable interference of any kind. It must be transparent in its functioning and e-governance, must be mandatory and a pre-requisite for its efficient functioning. Given the large size due to its affiliating nature and quick response time expected by all stake holders, e-governance, e-learning virtual knowledge network with all colleges and e-library with e-journals must be a part of initial blue print, before it is approved. In times to come, on-line admission test, on-line attendance, fee deposits, document submission and video conferencing facility with university and its constituent, affiliated and autonomous colleges must be a rule rather than exception.

The Executive Council, Academic Council, Finance committee and Boards of Studies must comprise of outstanding educationists, technologists, scientists, industrialists and representatives of those affiliating colleges who are themselves role models of academic excellence. These decision making bodies must be free from any political, religious or regional or caste based considerations and an inspirational, excellence driven outstanding academician with unimpeachable integrity should be persuaded to be the Vice Chancellor.

2. Organization structure:

To empower Vice Chancellor (once he is chosen on outstanding credentials and unimpeachable integrity), the organization structure at the top level must be a team chosen by the Vice chancellor, through a transparent process and eligibility criteria. Pro – Vice Chancellor(s), Deans, Registrar and Finance Officer must have the confidence of the Vice Chancellor and continue in their position during his/ her pleasure as the Vice Chancellor continues only during the pleasure of the Chancellor. Team work and accountability for delivering performance must be the operating work culture. In the current scenario; there is a

kind of power – balance between the Governor – Chancellor and the government of the day by having registrars, controller of examinations and finance officers as the appointees of the government and Vice Chancellor as the appointee of the Chancellor. Such a structure is not designed for outstanding performance although on the personalities of individuals and based on good will; at times it may deliver performance. By design; the organization structure must enable team work; shared vision and perception among its team members. No functionary at the top level – V.C/ P.V.C./ Dean/ Registrar/ Controller of Examinations/ Finance officer must be a permanent employee. All of these must have up to 5-years tenure which upon objective, impartial, performance driven basis could be renewed after getting stake holder's collective feedback on their style of functioning and efficiency as well as effectiveness. If topmost single positions below Vice Chancellor are made permanent; there, is no guarantee that even the well meaning VC could deliver.

3. Resources:

The technical university should have adequate physical (land, building etc.) financial and human resources to enable it to meet its objectives efficiently and it must be empowered to create positions through approval of its executive council; frame finance rules and should not have to wait for approvals from the concerned state governments which at times can take years to get positions sanctioned and to fill them up. Due to constraining procedures to create positions, even if it has adequate financial resources, it may not be able to utilize them. The university should be able to create its own financial rules and procedures being self – funded entities instead of blindly adopting state government rules and processes. Of course; these have to be approved by the Executive/ Finance committee with the chancellor's concurrence.

4. Regional centres:

Keeping in mind the geographical dispersion of the affiliated colleges and to serve the zonal clusters of affiliated colleges better, the technical university should create regional centres to be located optimally in the heart of the cluster and create adequate decentralization and empowerment to the head/dean of the regional centre so that for most routine decisions and services, the students and other stake holders do not need to visit the university premises. This model, in the author's perception is better than dividing the university into 2-4 universities; which goes counter to the spirit of having a single unifying authority.

TQM Approach to Technical Education

The technical university must adopt the total quality management (TQM) approach in nurturing the technical education in its domain. The TQM approach is centred around the processes to ensure that the university and its constituent colleges create an environment of adopting a concept of Total Continuous Improvement (TCI).

Here, T Total = Involving every one

C Continuous = For ever

I Improvement = Elimination of waste; reduction of variations and innovation to enhance productivity and quality.

The TQM approach is not inspection and compliance driven but relies on the foundation of – people involvement, transparency, scientific management approach and visionary and enlightened leadership.

The five pillars of TQM education are build on the base of values; vision, universalism, systems and standards. These pillars are:

1. Intellectual capital
2. Infrastructure
3. Ownership

4. Strategic intent

5. Kaizen – continual sustained incremental improvement.

Intellectual capital

The faculty and students are the most important intellectual resources required for excellence in an educational system. While the students seeking admission are of high relative intellectual calibre; the faculty resources of high calibre are in real short supply.

The faculty is the soul of an academic institution and is perceived as a role model by the students. Hence one of the most important and pious duty of a Vice Chancellor to attract, motivate and retain, outstanding scholars with brilliant academic credentials, inspiring communication skills and a role model value system to the faculty. The job description of a faculty member is contained in the acronym IIT (Inspire – Involve – Transform). If the university and affiliated colleges have excellent faculty – the rest will follow, but if they do not have it, then the physical infrastructure even if outstanding will not lead to excellence. The analogy that the author used to give as Vice Chancellor of UPTU to impress upon the college management chairmen to invest in good faculty was that of a faculty as the SIM, without it or without adequately re-charging it, the handset (the buildings etc.) is a costly paper weight and is not the value for money as a paper weight. It is the SIM in it that makes it functional. Hence buildings without great faculty will not deliver performance.

In the current social – economic milieu of the country, the best and the brightest from engineering colleges are not opting for teaching and research as a preferred career option. Hence faculty development has to be an important function of the technical university to pro-actively help the institutions to develop its faculty resources. In the selection of faculty in colleges; the Vice Chancellor's nominee should be an outstanding academician known for his

fairness in evaluation to inspire confidence in the selection process. The faculty profile along with qualifications and photographs must be placed on the college web-site and hyper-linked with the technical university web-site.

Application of Statistical Techniques for Quality Assurance

The technical university and all its affiliated, constituent and autonomous colleges must have a "Quality Assurance Cell" directly reporting to the Vice Chancellor. This cell should make use of the TQM tools – Histograms, Flowcharts, Run charts, Pareto diagram, Cause-effect diagram, Scatter diagram and the Control charts for analysing a huge amount of admission; instruction and examination related data base that gets generated in the university. These tools are simple to use; but are very penetrating and provide useful insights in measuring and assuring quality of academic processes and products. This analysis must be shared with the colleges and the society at large through university web-site.

Some key quality characteristic must be evolved for assessing the academic performance of colleges – this should use maximum possible use of data generated by the (say) examination process of the university. The author evolved a simple yet most comprehensive measure of such a performance for ranking of colleges based on only theory examination conducted by the university. This quality characteristic has been named as 'Gross Average Intellectual Attainment' (GAIA) per student and is measured as:

$$\text{GAIA} = \frac{\text{Sum of marks of all the students in all the subjects in all the years}}{\text{Total number of answer books examined}}$$

This uses 100% of the examination related data generated by the Controller of Examinations office and can lead to subtle strategic intervention that can influence for quality admission and holistic coverage of students

and subjects. Since this data is available on university computer system, computation of this holistic academic performance index is fairly easy.

Some applications of SQC techniques in technical university attempted in UP Technical University, Lucknow

The author, while serving as Vice Chancellor of UPTU, Lucknow attempted the following SQC techniques:

- (a) Pie chart indicating the % share of enrolments in various branches of engineering and technology to demonstrate the 'imbalance' in the enrolment with 20:80 rules manifested (20% of total branches account for 80% of enrolments). 80% branches of engineering account for just about 20% enrolments.
- (b) Pareto diagram to identify 'Vital few' subjects contributing to 80% failures. Such 20% subjects should get priority attention of the college management to see that best teachers are deployed to teach these subjects and attendance etc. is strictly monitored. By focusing on these few subjects the university pass percentage can be very substantially improved.
- (c) A fishbone (cause - effect) diagram will lead to identify the root cause of poor academic performance of a college; in a subject or for a student. Thus instead of addressing the symptoms of a problem, we can attempt to remove the root cause.
- (d) Performance Spectrum Control Chart - Using X - chart principles; based on GAIA for the university and its standard deviations; a colour code based VIBGYOR (Rainbow) model the groups colleges into 7 categories from 'Excellent' to 'Poor'; and in each colour band the college codes are inserted on the basis of rank ordering. Colour code facilitates comprehension even to those who may not know statistics.

- (e) **Value Addition Grid:-** This is innovative, data driven approach to identify the colleges on the extent of value addition (degradation) contributed by the college. This is a good indicator of special efforts put in by a college which gets relatively less calibre students but through dedication, sincerity and commitment trains them so effectively that they give better quality of output performance compared to the input quality. This is particularly relevant to first year's intake. Input quality can be indexed either by the ratio of 'Number admitted through university counseling divided by the total number admitted' and the output quality can be indexed on the basis of first year examination results. A regression line - ideally should be at 45° of the X and Y axes. For each grade of quality index a cluster of colleges is identified according to the following three categories:
- i. **Value addition** - those institutions which have higher quality of output compared to the quality of input they received. This can be one or more grade higher. For example - the input quality was 'good' but output quality was 'very good' and if 'excellent' then it means two grades value addition. Such institutions reflect dedication, hard work and sincerity of purpose and hence university must honour/ recognize such colleges/ institutes.
 - ii. **Value maintenance** - these colleges 'maintain' the same grade of output quality as the input quality. Good for good; very good for very good and excellent for excellent. Even this should get noticed and appreciated, even if mildly.
 - iii. **Value degradation** - colleges which take 'very good' input but lead to 'good' or 'satisfactory' quality of output results contribute negatively. In such institutions, there may not be right learning environment or discipline or adequate and motivating faculty or academic resources. This is a cause for concern and university must convey its concern to the concerned college and request for a corrective action.
- (f) **Tenure Histogram:-** A tenure histogram is a simple but effective measure of the quality of a technical institutions in which a histogram is prepared to depict the % students graduating (say) for B.Tech. Programme in 4 years; 5 years, 6 years and 7 years. The university average (say) 75% will indicate that at the university level about 75% of total student enrolled will complete their B.Tech in minimum stipulated period of 4 years. If a college has only 22 % students enrolled in that college complete their B.Tech in 4 years; it shows a very poor quality of college. If 95% students complete in 4 years; then it is a 'very good' college and so on. This histogram is easy to comprehend by even a lay parent to judge the quality of a particular college.
- (g) **Six-Sigma Process Quality in Examination System:-** Percentage error is a poor measure of quality in TQM. In a Six-sigma process, on an average 3.4 errors per million opportunities are acceptable. The examination process which is technology driven should be aimed to be a Six-Sigma Process. Teams leading the university examination system must be trained in Six - sigma.
- (h) **Technical University Academic Excellence Award Model:** - To generate healthy sense of competition and focus on total quality; an academic adaptation of national quality award models was initiated by the author known as "UP Technical University Academic Excellence Award" in the year 2007 which has since been implemented with tremendous enthusiasm and success by the UPTU for past three years.
- The UPTU Academic Excellence Award Model is a 10 - factor model in which a total of 1000 points are allocated to 'Enablers' and 'Results' as follows: -
- Leadership - 100, Faculty Resources Development and Management - 50, Quality Policy & Strategy - 50, Academic resources-

100, and Academic Processes - 100. The enablers are allocated 400 points. The results are allocated 600 points as follows:-

Faculty & Staff Satisfaction -100, Student Satisfaction - 100, Impact on Society -50, Academic Results - 250 and Placement Results - 100.

The implementation of this model has generated a tremendous enthusiasm among colleges and the awards are conferred by the Chancellor; HE the Governor of UP which adds to grace. It is strongly advised that other technical universities should benchmark this success story of UPTU. Fig.1 shows the structure of the Award Model.

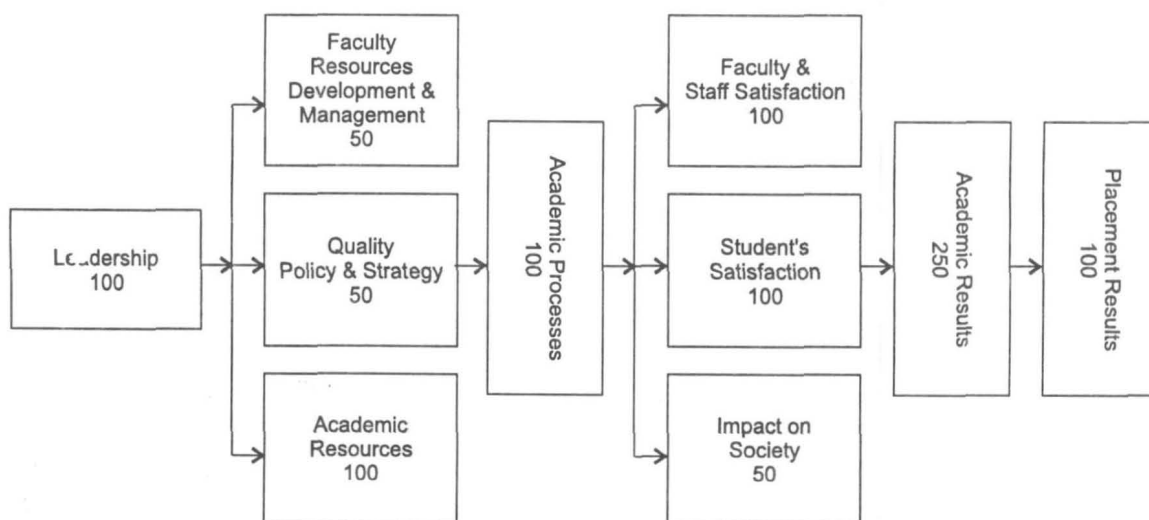


Fig. 1 UPTU Academic Excellence Award Model

Concluding Remarks

This paper supports the concept of establishing a technical university as an opportunity to nurture quality of technical education at the state level affiliated all – government and privately funded technical institutions located within the geographical boundaries of the state. It outlines success pre-requisites and suggests enabling structure, processes and leadership with a particular focus on developing inspiring faculty resources. It suggests TQM based management approach and lists a number of techniques successfully implemented during author's tenure as the Vice Chancellor of UPTU, Lucknow.

References

1. Vrat, Prem: Academic Excellence through Quality Award Model Framework: A Case Study of UPTU; Proceedings of GLOGIFT 08 Conference; Stevens Inst. of Tech., New Jearsey, USA, 14 – 15 June 2008.
2. Vrat, Prem: Role of Technical Education in Emerging Indian Society: Opportunities and Challenges: *RITES Journal*, July 2009, pp. 9.1 – 9.10.

