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BITS PRACTICE SCHOOL
A CASE STUDY IN
INDUSTRY–UNIVERSITY COLLABORATION

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...It is not uncommon for men and organisations to indulge in little luxury walks down their memory lanes re-living the past. But then sometimes it happens that such past-time indulgences leave a lingering sense of inadequacy which, it soon becomes clear, can best be removed only by projecting individual experiences on a larger canvas. Perhaps such are the occasions when it becomes obvious to all those involved in experiences that a large audience of people from many walks of life would also find this introspection of theirs important. It is in this context that the following pages describe the trauma and subsequent sense of fulfilment experienced by BITS in starting and establishing the Practice School Programme.

PILANI
March 1979

VIJAY V. MANDKE

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Words are inadequate to describe my deep sense of gratitude and intense respect for Dr. C. R. Mitra, Director, BITS, Pilani, to whom belongs the very concept of Practice School education, around the implementation of which the entire case study has been built. Indeed, every detail at the planning, design and implementation stage developed and described in the case study owes its origin to the constant guidance given by him.

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I am highly obliged and deeply grateful to all the host organisations which have collaborated with the Institute in this joint educational endeavour.

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Finally, I want to express my appreciation to all those who have helped me in the preparation of this case study.

VIJAY V. MANDKE

BITS Practice School : A Case Study in Industry-University Collaboration

VIJAY V. MANDKE

Dean, Practice School Division and

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ABSTRACT

In the context of the national educational scene the subject of "university collaboration with the world outside the campus" needs no introduction. Right since independence, the Ministry of Education, through its AICTE and through the reports and recommendations of various national level committees and commissions, has been time and again reiterating its firm decision to have closer interaction between the professional world and the university world in terms of the organisation of activities such as practical training, apprenticeship scheme, practice schools and sandwich programmes.

It is within this frame of reference that this paper presents in the form of a case study the innovation of the practice school (PS) system of education evolved by the Birla Institute of Technology & Science (BITS), Pilani during the last decade. To begin with, the study describes, in the national context, the historical background of efforts towards industry-university collaboration and, then, proceeds to discuss its impact on the Institute in terms of the implementation of a scheme such as practical training during the early years between 1964–69.

This is followed by an analysis of the critical appraisal of the entire theme of "collaboration" that the Institute undertook during the years 1969–70, wherethrough it was realised that any meaningful collaboration with the professional world could never be a mere add-on to the time spent in classrooms but rather it must create circumstances whereby teaching and research in the universities are integrated with the tasks of production, design and development, implemented outside the university campuses.

Towards the achieving of this, then, the study describes the model of practice method of education that BITS had conceived. In a nut-shell, just as a medico undergoes internship

in a teaching hospital before graduation, similarly the practice school requires students of engineering, science and humanities to practice their profession during the educational years. In specific terms, this is achieved by establishing, in the professional world, classrooms, designated as practice stations where, in consultation with the professional experts, the entire responsibility for supervision of the student education and evaluation consistent with the principles of the semester system of internal continuous evaluation rests with the university faculty fully resident at the station.

It was in the year 1973 that the Institute started its first round-the-year practice station, accommodating a controlled student input of 12, accompanied by 4 faculty members. Today, during any academic year, as many as 300 students from different subjects and classes and 60 faculty members from different disciplines are participating in this joint educational endeavour at 60 different host organisations spread across the length and breadth of the country. The description of the PS model is followed by details from the field, comprehensively presenting various facets of the above educational organisation in terms of planning process, educational contents, semester-wise calendar, evaluation techniques, growth statistics, man - power development, physical facilities, man - management system, financial costs, educational administration, etc.

As an obvious outcome of the evolution of such a vast infrastructure where academic community and professional experts can come together through the integration of their respective professional commitments, the paper discusses the emerging directions for the future in terms of details at practice centres such as organisation of collaborative post-graduate and doctoral programmes, initiation of sponsored research at the campus, inception of the theme of consultancy based on the needs of practice stations and defining for a university a role in the task of rural development.

Finally, the study concludes that the task of turning the face of a university to the environment is essentially a task of evolving cognitive methods of teaching and learning backed up by an integrated approach to education characterised by flexible degree structure. Thus, the theme of industry university collaboration, which itself is a beneficiary and product of the process of innovation, is bound to become a source for further innovations. The case study thus abstracts this entire experience to suggest an approach to the challenges of educational innovation and development.

1. INTRODUCTION

The Practice School (PS) system of education is essentially an effort to institutionalise the process of building the much needed bridge between the professional world and the academic world. Just as a medico undergoes internship in a teaching hospital before his graduation, the practice method of education requires students of engineering, science and humanities to practice their respective professions in the real world during their educational years.

In concrete terms, the Practice School establishes classrooms designated as Practice Stations, in the professional world, defined in terms of production and manufacturing units, engineering design, development and consultancy agencies, national research laboratories, social science planning cells, banks, centres for science communication, science and technology museum. publishing houses, the rural backdrop as represented through a village, etc. along with the immediate locale in and around the academic campus. At practice stations, students and teachers drawn from different disciplines, involve themselves in interdisciplinary and mission and goal oriented real - life problem -solving efforts, pre-eminently concerned with solving practical problems, making improvements and serving immediate needs pertaining to production, design and development, planning and ultimately, social action.

In the process, with the help of instruments like quizzes, viva voce, group discussions, seminar, project reports, etc., teachers resident at practice stations continuosly evaluate, in consultation with professional experts, student performance in terms of personality traits like professional judgement, decision - making ability, skills for data handling, ability for written and oral presentation, initiation, ability for team work, leadership quality, industry, sense of responsibility, ability to meet deadlines, etc. Letter grades so obtained by students constitute an integral part of their respective degree transcripts. Further, the PS system of education also issues a rating sheet qualitatively describing the degree for which a student had demonstrated the above mentioned personality traits during his training. Thus it is important to note that Practice School is very much a formal system of education.

After the successful completion of the PS requirement, the student is awarded in his discipline a degree which carries the words 'with Practice School'. It is axiomatic that the student who completes the PS programme carries greater total academic load and spends more time than the student who attends the respective traditional degree programme. In view

of this, the PS programme judiciously utilises the in-between summer vacation (s), so as to make both the programmes duration almost comparable.

From the above it follows, indeed, as a natural corollary, that the PS system of education aims at a well-defined model of university system, through which teaching and research activities of the academic community can be meaningfully linked with the production and development based activities of the environment that go to define the entire gamut of the economic growth as well as national construction. It may be mentioned that the concept of the Practice School as a workable method for collaborating with industry was first initiated and perfected, as early as 1914, by the Chemical Engineering Department of MIT, USA. In the Indian context, right since independence, the Ministry of Education, through AICTE as well as through the reports and recommendations of various national level committees and commissions appointed from time to time, has been reiterating the need for closer interaction between the academic institutions and the professional world in terms of organisation of apprenticeship training, the Practice School and Sandwich programmes. Indeed, the first decision to establish practice schools was taken by AICTE as early as 1958.

Around 1967, HBTI, Kanpur became the first institution in the country to start the PS programme for the Chemical Engineering discipline at the post-graduate level. BITS, Pilani was introduced, in the year 1964, to this concept of education, across the university level, through a Ford Foundation sponsored project of collaboration with MIT, USA. However, it was not until 1973 that BITS launched this programme at the undergraduate as well as postgraduate levels scanning the entire spectrum of university disciplines, ranging from Engineering to Science to Pharmacy to Management to Economics to English. Later BITS also extended this programme to disciplines of Computer Science, Instrumentation, Museum Studies, and Science and Technology Development (STD).

Indeed, since its inception in the the year 1973, thanks to the all-round enthusiastic and mature support of the students, the teachers and the professional world alike, the BITS Practice School has grown immensely. Today, during any academic year, nearly 800 students, 400 during the summer sessions for the Practice School -I (PS-I) course and 200 during each of the two regular sessions for the Practice School–II (PS II) course, attend Practice School and towards their supervision about 60 teachers, 40 in the summer and 20 round-the-year, are away from the campus. Further, approximately 60 professional organi-

sations of various types, representing Government, Private, Public as well as Semi-Government sectors, are involved with the Institute in this joint educational endeavour.

By any known norms, within a short span of only five years, BITS has evolved through its PS programme a vast infrastructure which can act as an effective meeting ground between the university world and the real world. In the process, the Institute has gained a rich experience and felt a sense of fulfilment that are obvious. An attempt has been made in the following sections to capture the flavour of this entire experience in the form of a case study.

2. THE HISTORICAL BACKGROUND

So far as the subject matter of education is concerned, it will not be an overstatement to say that no national level decision has been able to command, at all times, as much unanimity of views (from policy makers, planners, experts, financers and public at large all alike) as happens to be the case with regard to the need for establishing closer linkages, particularly between the system of higher education and the industry. An expression of this need is abundantly found in the time to time recommendations of various councils, committees and commissions, notable amongst them being the Scientific Manpower Committee (1973), Engineering Personnel Committee (1956), AICTE, the Committee for Post-graduate Engineering Education and Research (1961), Education Commission (1966) and the High Power Committee of AICTE on studying collaboration between Technical Institutions and Industry (1970).

Indeed, be it the problem of effective training of the scientific and technical man-power or of strengthening the R & D effort or of accelerating the pace of industrialisation, in all such cases, the committees and commissions have invariably and unequivocally arrived at the conclusion that one facet of the correct strategy lies in ensuring opportuniny for teachers and students to have field experiences in the industrial enterprises, with a view to helping them keep in touch with the progrees taking place in the contemporary engineering practices.

Thus, if the Scientific Manpower Committee (1947) recommended the 'practical training stipend scheme', the Engineerig Personnel Committee (1956) argued for consultancy opportunities for the university staff.

One of the earliest expressions at the AICTE on the need for closer interaction between the academic institutions and the professional world is to be found in the minutes of its 11th meeting held in March, 1958. In

this meeting, which considered the recommendation of the Board of Chemical Engineering and Chemical Technology to initiate the Practice School Programmes, the address from the chair went on to observe that "there is no doubt that the employer today is as greatly concerned with the calibre of technical personnel trained by our technical institutions, as he is interested in participating in the training programmes". Understandably, consistent with its theme of industry-university collaboration, this council meeting accepted in principle the theme of the establishment of practice schools and suggested that Lala Shri Ram be included as a member of the expert committee appointed by the Board for this purpose.

On similar lines, the Thacker Committee for Post graduate Engineering Education and Research (1961), while emphasising the need for closer industry-university linkages, recommended widening of the base of post-graduate education, so that the master's and doctoral thesis efforts aim at some of the industrial problems, so that technical education fulfils its appointed role of supplying manpower to tackle effectively many of the problems that beset our industrial growth, viz. improving manufacturing processes, designing improvements in the existing machinery, cutting down the production costs, development of indigenous know - how, etc. In the same vein, the Education Commission (1966) recommended the starting of sandwich courses, with the difference that this scheme covered the undergraduate programmes.

The same year, but a little earlier, the All India Board of Technical Studies in Chemical Engineering and Chemical Technology, in its 20th meeting held in February, 1966, observed that, in spite of a firm decision by the AICTE as early as 1958, it had not been possible to formulate a detailed scheme for the implementation of the Practice School as the Chemical Engineering institutions and industries had shown a poor response. The Board went further to note that it was decided that an opportunity might be given to the institutions to explore possibilities of organizing such schools and if they were able to make satisfactory arrangements with the industry in this context, they might formulate their own schemes for setting up the Practice School and necessary help be extended to them for this purpose. Accordingly, the meeting observed that all the chemical engineering institutions in the country be addressed in the matter. But in this case too the response was very poor.

However, in the same year, immediately following the release of the Education Commission report, AICTE, in its meeting held in July,

1966, once again reiterated its decision in terms of the need for closer linkages between the academic institutions and industries and, towards the same end, recommended various measures such as the establishment of a two-way traffic wherethrough senior academic staff could go to the industry to learn the latest techniques in manufacturing, financing and marketing, while the personnel from industrial set-ups could teach university students practical aspects of problem – solving; opportunity for teachers to spend one or two years in industry; opportunity for the postgraduate and undergraduate level students to work on problems assigned by the industry; seeking by university faculty of research problems from the industry; holding of get-togethers and seminars between industries and technical institutions, etc.

Keeping in view the spirit of the above measures, the AICTE appointed a sub-group of Directors on Technical Education to study the recommendations of the Education Commission. It may be mentioned that in its discussions (December, 1966), particularly in terms of the sandwich programme, the sub-group observed that it is certainly a good scheme, having proved its worth in foreign countries and then went on to note that the question of how to implement the same in our country was still unresolved.

It is in the midst of all the above type of developments that the untiring efforts of AICTE attained, so to say the first success when around the year 1967 HBTI, Kanpur started its Practice School programme in the Chemical Engineering discipline at the post-graduate level. However, in the context of the national scene, it was obvious that this was only a beginning and the main body of the job was still to be initiated.

The achievement in the year that followed is not much different from that of the years covered so far. Indeed, in spite of frequent reiteration of the firm policy decisions to organize practical training, practice schools and sandwich programmes towards establishing closer interaction between the university world and the professional world and in spite of all the promise of necessary help, the attainment of the objective was all the time eluding the nation, except in the case of the practical training scheme. Starting from 1947, thanks to the untiring efforts of the of the AICTE, by 1966 the number of fresh engineering graduates and diploma holders receiving the inplant practical training in the established industrial enterprises had already risen as high as 3000 approximately as during the training period the Government undertook the reponsibility of payment of stipend at the rate of Rs. 250/— per month to engineering graduates and Rs. 150/— per month to

diploma holders, and this commitment on the part of the Government, understandably, led to a massive expansion of training centres in established industries. If, on the one hand, in the industrial sector this gave birth to the practice of hiring and maintaining the training personnel, on the other hand, in the universities and particularly in technical institutions, this gave spurt to the introduction of practice training in the degree and diploma programmes, basically as an add-on and subsequently leading to the practice of appointing training and placement officers.

However, as the years passed it was becoming increasingly clear mainly as a result of its add-on character that the practical training scheme could not be the basis for achieving the much desired organic linkage between the industry and the university and at the same time no definite model was emerging for the implementation of schemes like the Practice School and the sandwich programme. It is against this background that, in March 1969, the Board of Post-graduate Engineering Studies and Research of AICTE decided that concrete steps should be taken to promote collaboration between technical institutions and industry and then went on to appoint a High Power Committee to examine the matter and make recommendations. The Standing Committee of UGC on Engineering and Technical Education strongly supported this decision of the Board.

The High Power Committee in its recommendations submitted in 1970, once again reiterated the decision to establish Practice Schools. Similarly in May 1970 the Ministry of Education approached universities to start sandwich programmes.

Needless to say, during the subsequent years too the pattern of effort, similar to the one described above, was being repeated and thus, again at its meeting held in May 1974 the AICTE considered the question of interlinking technical education and research with industry and recommended the establishment of Practice Schools. In the meanwhile, as described earlier, in the year 1973 BITS launched the PS programme on a massive scale embracing the entire range of discipline taught at the Institute. The echo of all these developments is to be found, as recently as 1978, in the ninth report on Higher Technical Education of the Estimates Committee of the Sixth Parliament. This report, while summarising ways and means in terms of industry - university collaboration, reiterates the need for organising Practice Schools.

The above is a brief historical background, at the national level, of the theme of the industry - university

collaboration. As one reflects over these details, the picture that emerges makes one thing crystal clear, namely, that in spite of the firm policy decisions made right in the beginning at the highest level, and repeated reiteration of the same, somehow the concrete action plans towards achieving the objective had generally been eluding the national scene, thus depicting an impression of some sort of a drift. Where and how to begin seem to have been the questions asked. Another important observation emerging is that somehow, when the above pattern of industary–university collaboration was being evolved, all the attention was focussed only on the system of technical education, thus giving an impression that there was no need for and nothing could be gained from providing training facilities in the professional world to the students of science and humanities disciplines.

It is within the above described co–ordinates of the national scene that in 1964 as a result of the whole - hearted commitment of its Chairman, Shri G. D. Birla, what had started in 1901 as a 'Pathshala' at then an isolated desert village of Pilani, graduated to become a deemed university, entrusted by the nation with the task of imparting education for tomorrow.

3. THE EARLY YEARS : 1964-1968

From the very beginning, it was obvious that as a privately endowed 'deemed' university, directly receiving financial support for its existence from a large industrial comlex, BITS had a special obligation to pioneer development in the field of industry - university collaboration aimed at increasing the pace of industrialisation. And towards this goal it could not have asked for more favourable conditions than it began with. Firstly, and most importantly, it had the fullest commitment of its Chairman, and thus, as one of the many fall-outs of this, an easy access to the large complex of industrial enterprises evolved by him. Secondly, at the time of its inception itself, through the untiring efforts of its Chairman, BITS was fortunate to enter into collaboration with MIT, USA, under a Ford Foundation supported project, thus making it possible for BITS to draw upon MIT's rich experience in evolving programmes with similar objectives, though in its own context. Thirdly, as a 'deemed' university, BITS had all the autonomy to go ahead with such educational innovations. And finally, as described earlier, at its highest levels the nation had been from time to time and all occasions reiterating its firm policy decisions supporting the organisation of Practice Schools and sandwich programmes towards achieving the above goal.

But before the Institute could plunge into action along the above

lines, certain other details in terms of curriculum development and examination reforms needed attention. Thus the years from 1965 to 1968 saw the Institute diverting its major energy in implementing reforms like consolidating the transition to a 'deemed' university status from an affiliated college structure, adoption of semester system, introduction of features like credit and unit system of education, coursewise promotion and reduction in contact hours, introduction of continuous and internal evaluation systems, establishment of the book bank, etc.

Perhaps partly as a result of its aforesaid preoccupation and partly as a result of an impression of a 'drift', as was evident during this period at the national level mainly due to the lack of any concretc plans for action, when the Institute wanted around this time to introduce industry-university collaboration, instead of boldly opting to draw upon the favourable surrounding conditions, it (the Institute) merely chose, like its sister institutions in the country, to respond in a passive manner by introducing the theme of practical training in the engineering degree programmes.

The Institute Senate took the above decision in October, 1965. The decisions and actions of the Institute Senate from now onwards, for a few years to come, were merely an exercise in solving this puzzle of practical training. Thus in February, 1966 it was resolved that "if a candidate does not complete his practical training satisfactorily, he may be permitted to appear in the final B.E. Examination, but his result be withheld till he completes the requirement of the practical training." In April, 1967 it was resolved that 'Practical training for a month each at the end of 3rd and 4th year courses for B.E (New Schemes*) be introduced from the session 1967 — 68.' It was further resolved that "in view of the difficulties experienced in arranging practical training for 80 days at the end of 4th year B.E. (Old Scheme**) examination, the distribution of 140 working days' practical training may accommodate a practice of completing the residual training after the final B E. examination, covering a period of not less than 50 days". And then in April, 1968, the Senate went on to resolve that "the training of 30 days at the end of 3rd year be abolished". Indeed,

* New Scheme was meant for students admitted under the newly acquired "deemed university" status of the Institute.

** Old Scheme was for the pipeline students who were with the Institute during the above period of transition and had joined it under the Rajasthan University rules.

this exercise, reflecting a kind of a state of confusion, went on till 1969, when the Institute decided to go back to its starting premises and objectives.

It is also worth noting that, during the entire period of the above effort, the maximum extent to which the academic community could go so as to meet its task of strengthening the industry-university collaboration, was in terms of its recommendations for creating opportunities for in-plant summer training for faculty, inviting industrial personnel for giving lecture and creating facilities for faculty to seek research problems from industry. It is strange that neither the visiting professors from MIT, who had the honour of being a party to the conceiving of the Institute's Master Plan (1967), nor the BITS faculty, who had the privilege of training under exchange programme at MIT, could introduce ideas like co-operative education (operative in electrical and mechanical engineering departments of MIT) or the Practice School (operative in the chemical engineering department of MIT), etc., in the above context.

Understandably, the above period also witnessed a linear expansion along the Institute growth-curve, particularly in terms of the development-oriented investments on library and equipment facilities as well as on faculty exchange programme, between MIT and BITS. Needless to say, in the process the financial commitments of the Institute underwent a sharp increase. An expression to these and such other similar spiralling aspirations, arising out of this growth model, was to be found in the Master Plan of 1967, describing the programme for development of the Institute.

However, during this intervening period as described in the previous section, the AICTE at the national level was making every possible effort towards achieving a breakthrough in industry-university collaboration. The effort was indeed strengthened by the recommendations of the Education Commission (1966).

It is against the above background that in November, 1968 the Board of Governors of BITS considered the problem of industry-university linkages and resolved that the question of introducing a course like sandwich scheme be examined by the Senate of the Institute.

4. THE YEARS OF INTROSPECTION : 1969–70

Need for Self-reliance — A Peculiar Crisis

As an echo of the ambitions described in the Master Plan (1967), the year 1969, in some sense began with

the recognition of a peculiar crisis of higher education. In specific terms, the crisis seemed to be one of matching the demands of the spiralling aspiration of a growing university with the need for evolving the strategy for securing the much needed funds to meet the same (demands). Indeed, to an extent, recognition of the above crisis was a kind of a reflection, in the local context, of the national scene prevalent then.

Change of Leadership

At the Institute level the change of leadership was the single most important event of 1969, when Dr. C. R. Mitra took over as the Director of the Institute. Along with this decision the Chairman reiterated the Institute's mission to revolt against all out-of-date ideas, so as to acquire new knowledge, to realize new dreams, and to think of a method for being prepared to face the problems of 1985.

The Call for Instrospection

Naturally this was the time for introspection. The need of the hour was in terms of understanding the nature of the issue behind the uncompleted tasks carried over from the past and also in terms of evolving a strategy for the total growth of the Institute consistent with the newly emerging realities of the process of development.

Thus in August, 1969 the Director addressed a memo to the Institute faculty requesting them to think about the forward plan for the Institute. Amongst many items that were to be considered, one related to the choice of a model for building the bridge with industry.

Issues

During the months that followed, a critical assessment of the past efforts was undertaken with respect to the theme of industry - university collaboration. Many issues were raised, studied, and answered in the process. The important ones amongst them are listed below :

(a) Practical Training : An Assessment

What was the experience of the industries and the Institute with regard to the practical training scheme as implemented since 1965 ? Was it educationally appropriate to leave the entire responsibility for practical training with the industry ? By doing so, had not the academic community in some sense abandoned its responsibilities towards student education ? Could the content and quality of the practical training be ever improved merely by manipulating the number of training days and recommending that as a further incentive the industry and/or the government should consider payment of stipend to students during the training period even before

graduation ? Could the practical training be made something more than a mere add-on to the time spent in classrooms ? Why was it that there were no proposals for some kind of practical training for students from science and humanities streams ? Would such opportunities for them not improve their employment opportunities ?

(b) Linking Research with Industrial Problems

What was really preventing the academic community from orienting its research efforts to solve the problems that beset our industrial growth ? Why was it that, in spite of the fullest blessings from its Chairman, the BITS academic community was not able to exploit the easy access that it had to a large industrial complex ?

(c) Need for Interdisciplinary Training

Could the industrial problems of the type described above be ever tackled in isolation by a student of one discipline without regard to an integrated overview of details like design, development, fabrication, financing, management, marketing and so on ? If not, then was the traditional approach to research pursued at the university sufficient, given that the academic community was serious about its efforts to establish research-based collaboration with industry ? What kind of professional skills and attitudes of mind were needed if students and faculty were to tackle industrial problems of interdisciplinary nature, thus demanding a team effort ? In such a case then was it not implicit that no meaningful collaboration with industry was feasible unless the structure of collaboration visualised, afforded an unusual opportunity for students of engineering, sciences, management, economics and languages to work in multidisciplinary groups ?

(d) Education for Interdisciplinary Training

For the above to be feasible, what kind of an educational base was needed ? Could this base afford to see education merely in terms of codified orthodoxies of knowledge ? If not, then what reforms in curriculum were necessary to give an interdisciplinary character to the education across the Institute ? Just as engineering curriculum demands student exposure to sciences and humanities, similarly should not the humanities curricula, in this systems age, demand student exposure to engineering and sciences ? Should not a similar thing be valid in the case of sciences too ? If the industrial (professional) training component was considered a must to train a student as a better professional, was it not obvious that such a component should constitute an integral part of the

educational structure in terms of details in the transcript as well as duration requirements ?

(e) Structural Flexibilities

Could an interdisciplinary educational structure, when evolved, be sustained unless it also provided students with unusual flexibilities, so as to help them fully exploit the benefits of such education ? In this context, would it also not be necessary to look into the possible reforms in the admission policy so as to ensure that the same was in tune with the flexible educational structure visualised ?

(f) Need for Examination Reform

As the culture of the internal system of continuous evaluation matched very well with the industrial practices of periodic assessment of the tasks at hand as well as the performance of the manpower, was it not obvious that the same be adopted towards evaluating the student performance during the industrial training component ? As a real life problem solving activity demands personality traits such as decision-making ability, skills for data handling, ability for written and oral presentation, initiative, ability for team-work, leadership quality, ability for meeting deadlines, etc., would it not be meaningful to ensure that the evaluation method visualized for the industrial training scheme, focussed its attention on many of the latent attributes of the above type, which normally a campus-based classroom is not called upon to keep track of ? If this be so, then would it not mean that the introduction of an industrial training scheme must be accompanied by an examination reform, through which the system of internal continuous evaluation, as perfected in campus-based classrooms was further suitably strengthened so as to be able to evaluate the professional personality of the student in the sense mentioned above ?

(g) Existing Models–A Comparison

How well did the models of co-operative education operated by many of the universities in USA sandwich programmes evolved in the UK and practice schools implemented by MIT in USA and HBTI in India, compare with each other in terms of the objective of integrating the process of education with the tasks of industrial development ? Consistent with the demands of the industrial problem solving situations in choosing the model, would it not be helpful to go for the one where it would be possible to ensure the entire rigour of the semester system of education characterised by the internal system of continuous evaluation ?

(h) BITS-MIT Faculty Exchange

Once the choice of the model

was made, in what capacity would the participation of foreign visiting professors be most helpful ? Consissent with the emerging answers, what then should be the exact qualifications of the visiting faculty ? Also, what was the cost benefit factor if one were to think of training some faculty abroad with a view to accelerating the pace of events on the home front ?

(i) Financial Issues

Last but not the least, what should be the attitude of the academic community towards the problem of securing the much-needed funds for implementing the model it conceives of ?

Emerging Directions

From what has been described above, it follows as a natural corollary that when the issues were studied threadbare, it became obvious that the reasons for inadequacy of efforts in terms of closer relationship between industry and university were too deep to be taken care of through a non-committal approach on the part of the academic community and by merely saying that everything rested with industry and government. The major issues behind the inadequacy seemed, in fact, to concern the very fabric of isolated existence of the university system evolved since independence. If higher education had been aware of the need to integrate educational processes with those of local and national development, then it became further clear that it (higher education) had at least not given enough evidence of this awareness. Unlike the mail service, power supply, or public transport, higher education did not seem to have been able to integrate its teaching and research activities with the process of self-generation and acceleration of industrial development so that breakdown in its activities could result in a calamity. This lack of involvement and following blindly the examples of advanced countries had, it seemed, made it easy to overlook the fact that over the years universities were falling into the dishonourable role of training centres to help advanced countries, baby-sitters for the society and job-filters for employers who have to face hordes of applicants chasing the non-existent jobs. In short, it became obvious that if the academic community was serious about resolving issues before it, it must create circumstances whereby educational institutions are linked with their environment and in such a case then the curriculum must find a formal method and time for bringing the reality of the environment into the educational process.

This then was the crisis—the crisis of securing the much-needed finances for sustaining and strengthening the uni-

versity, of developing relevant educational activities where course work and research programmes were organically linked with the needs of contemporary life and problems, of seeking cultural transformation, of training students to participate in interdisciplinary efforts, of ensuring 'retrainability' of future citizens, of introducing flexibility in the structure and of introducing examination reforms consistent with the demands of industrial problem solving situations. Indeed, the decisions and actions of the Institute to follow from here onwards, at all levels and on all fronts, must be seen as its answer to the challenges coming its way as a result of this crisis of higher education as a whole.

In November, 1969 in continuation of his previous memo and with reference to the subsequent discussions across the Institute, the Director addressed another memo initiating thoughts on new academic regulations to meet the demands of the educational structure that seemed to be emerging as a result of the Institute-wide deliberations. Around this time the Institute also issued a world-wide advertisement for faculty recruitment in terms of the tasks of interdisciplinary education, of building the bridge with industry and of future research directions.

Forward Plan for the Institute

A natural culmination of this Institute-wide debate, stirred up with the conscious objective of evolving a strategy for tomorrow, was the formulation, in the year 1970, of a Forward Plan for the Institute. This document viewed education as a single entity and accordingly, towards meeting the newly emerging demands of higher education, went on to define its thoughts in terms of a wide range of subject matters such as educational flexibility and innovation, interdisciplinary programmes, direction of research involvement, co-operative education - a bridge with industry, public service, faculty development, academic administration, central library, information processing centre, equipment and interdepartmental laboratories, central service facilities, language laboratory, museum and museology, student amenities, campus facilities, operating expenses, collaborations, etc. Indeed, this Forward Plan for the Institute, comprising some 30 pages, to this date remains the single most comprehensive statement of the thoughts of the Institute on its concept and approach to the task of Institutional Development.

Choice of the Model

In its section on *Co-operative Education – A Bridge with Industry*, while abstracting the details of the Institute-wide deliberations in terms of the earlier described issues pertaining to the theme of industry-university interaction, the Forward Plan enunciated the choice of the practice school system of education across all its disciplines from engineering and science to the humanities; thus firstly, incorporating science and humanities disciplines in the gamut of industry-university interaction, and secondly, rejecting the concept of unsupervised practical training which had no direct involvement of the faculty. Elaborating further in this context, the document went on to add that 'the cardinal requirement of the PS programme consists of teacher – student teams in residence at a (Practice) station, where facilities for measurement, testing, drafting boards, reference library and lecture (seminar) hall will be provided.' Describing its vision for the future, the Forward Plan observed that "once permanent stations of the Institute are located in selected industries (professional organisations), a permanent link will be created between these industries and the Institute... This will result in an interflow of men and ideas...(and) out of this relationship will grow consulting activities which in turn would have a source of ideas for industrial research". And thus the die was cast.

Reiterating the Decisions

In May, 1970 the Institute appointed a Co-ordinator for Practice School and entrusted him with the responsibility to accelerate the planning process for the implementation of the programme. The same month, the Institute Senate approved new academic regulations which were also evolved over the previous few months and by July 1970 Guidelines to Teachers were formulated towards the successful implementation of these regulations, thus setting the tone for the introduction of the interdisciplinary and flexible educational structure so necessary for the Practice School Programme.

In the meawhile in August, 1969 the Standing Committee of UGC on Engineering and Technological Education strongly recommended sandwich programmes, and in September, 1969 AICTE once again endorsed the the general principle of the PS education. Further, as mentioned earlier, in May, 1970 the Ministry of Education addressed communications to universities asking them to start sandwich schemes.

However, to cap all this, the Chairman in his address to the faculty during his visit to Pilani in May, 1970 again reiterated his commitment to the theme of collaboration with industry by inviting faculty to come forward and evolve a meaningful scheme for interaction and in the process, if faculty chose any of his industries to explore research problems to work on, offered all financial help in terms of travel, accommodation, funds for

research, etc. In short, from all the quarters the pressure was continuously on the increase that the first plunge be taken at the earliest.

The Plunge

It is against this background that in November, 1970 a team of senior faculty members under the convenership of the Co-ordinator settled down to plan the operational details of the BITS Practice School Programme. This was also the time when the Institute was deeply involved in the task of recruitment effort with reference to its world-wide advertisement issued earlier.

5. BITS PRACTICE SCHOOL : THE MODEL

Education at BITS

The 5-year (4-year) integrated programmes evolved at BITS, since 1973 onwards, in the areas of engineering, science and the humanities indeed constitute the concretisation of the ideas and thoughts conceived and presented in the *Forward Plan*. The central theme of the integrated programmes can be expressed in a two-fold manner, namely, (i) the need for broad-based education during foundation years so necessary to appreciate and to react to the interdisciplinary nature of real-life problems followed by (ii) the need for specialization along with an opportunity for student - teacher teams to go into the professional world with a view to working on real-life problems through the Practice School. The important features of these programmes are as follows :

(i) Semester system of course - wise promotion with continuous internal evaluation;

(ii) Admission policy to the integrated programmes characterised by multi-entry input points as also facility like admission with marginal deficiency. Till the end of the year 1977 - 78, the Institute also had been making unassigned admissions to these integrated programmes. Indeed, this admission policy while, on the one hand, helped the Institute attract a very high quality input as never before, on the other hand, it helped students have greater time at their disposal and that too closer to their professional years to take decision on the choice of their degree. Further, this admission policy also maintained a high degree of competition among students, as the desire to get the profession of their choice always succeeded in keeping them on an all-time alert from the point of view of studies, thus bringing out the best among them. In short, educationally it proved a valid admission policy, superior to the system of assigned admissions that is normally followed in the Indian university system. However, somehow this admission reform tended to create a lot of social tension, particularly among parents and thus,

as a result of the public pressure, in 1978-79 the Institute switched back to the assigned admission policy after having operated the unassigned admission policy successfully for seven years since 1971 - 72;

(iii) Broad based but integrated core education during foundation years. The entire first year is common across the Institute. Irrespective of disciplines they desire to pursue, all the students study courses such as Concepts in Science, Engineering Graphics, Chemistry, Mathematics, Physics, Workshop Practice, Report Writing & Comprehension, Computation Techniques, Probability & Statistics, Principles of Management, etc. Due to integrated approach to education, redundancy in courses is rejected. (Refer to Appendix 9 giving the structural chart of the 5-year and 4-year integrated programmes);

(iv) There is a great deal of flexibility by which a student can seek transfer from the middle of one degree to another without having to go back to the starting point;

(v) Structural flexibility in the programme to ensure lateral and vertical movement of students, provision to pursue dual degrees for students, new horizons for late starters; and

(vi) Bold innovation of Practice School across the three faculties aimed at institutionalizing the efforts to build the long needed bridge between the professional world and academic world by establishing PS stations (analogue of classrooms in the universities) in the professional world with a view to providing student-faculty an opportunity to participate in multidisciplinary, mission-oriented and time-bound problem solving efforts of direct interest to the professional world.

The Model

As described in the introductory section, the PS theory of higher education and research is based on the central theme of the teacher-student participation in the environment. It can be described as a controlled simulation of professional life during the educational years. Through this method, the university student learns how to practise in his profession even before his graduation, through his direct involvement at practice stations in problem solving efforts, pre-eminently concerned with solving practical problems, making improvements, and serving the immediate needs of the environment. Practice stations are established in the professional world, defined in terms of production and manufacturing units; engineering design; development and consultancy organisations; national research laboratories; social science planning cells; banks; centres for science communication; science and technology

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museum; publishing houses; the rural backdrop as represented through villages, etc. along with the immediate locale in and around the university campus.

As a process of education, the practice method substitutes the narrative approach followed within the four walls of a classroom and the two covers of the textbook by experience-based cognitive process of learning and teaching, operative in the very way of life, thus making education student centred and environment as well as circumstance oriented. In view of this the attempt in the Practice School is not merely to further student's knowledge in given codified orthodoxy (as this facet of education is well achieved in the classrooms), but to train him in the art of effectively contributing to real-life problem-solving efforts of production, of design, and ultimately of social action. Therefore, basically practice method aims at cultivating amongst students appropriate attitudes and analytical skills towards decision making and team spirit, responsibility of leadership, importance of time schedule and regularity, skills of written and oral presentations, organisational ability, etc. so necessary to respond to open-ended professional situations, more often than not characterized by insufficient data, uncertainties of events and unfamiliarity with the environment. Seen from this angle, it follows that though Practice School pursues project method of education, the attempt here is not to rediscover the past, but to use the contemporary day to day developmental activities of direct interest to the professional world as a vehicle to prepare students to participate in interdisciplinary, goal and mission oriented, and time-bound problem solving tasks.

Further, the PS differs in a major and the most fundamental sense from the engineering practical training and sandwich schemes in terms of its requirement of a full-time faculty presence at practice stations. While on the one hand, the PS faculty along with professional expert (s) directly interested in practice assignments, plays the role of a consultant to teams of PS students working on assignments, on the other hand, it (PS faculty) in consultation with professional experts shoulders the entire responsibility for supervising the day to day student performance during their PS involvement.

Student evaluation, as would be described in detail later, is done in terms of personality traits demonstrated by him during his problem solving effort. The letter grades, thus received by the student during his PS courses go into his degree transcript. On successful completion of this requirement for the PS stream, the student receives

a degree in his discipline which carries the words "with Practice School". As can be visualised, the PS degree constitutes an optional stream. It is understood that the student who opts for PS stream carries greater academic load and spends more time than the one who attends the respective conventional stream. However, through reduction in information-crammed subjects, proper integration of courses and judicious use of summer vacations, the time - slot requirements of PS courses are so accommodated as to make the total time duration of PS degree almost comparable to that of the conventional degree. Thus in every sense of the word, the PS programme constitutes an integral part of the model of higher education.

Finally, it can be seen that in the long run the programme can act as an effective catalyst for the participation of the professional experts in the educational activities of universities such as course development, textbook writing, development of project-oriented laboratory, joint research schemes, etc.; thus providing a total set up for integrating educational and developmental processes. On a more immediate basis, the Practice School provides the professional world with an opportunity to use the motivated and talented student world to give impetus to the developmental activities without making large long-term financial commitments.

A conceptual and very simplified representation of the model is shown below :

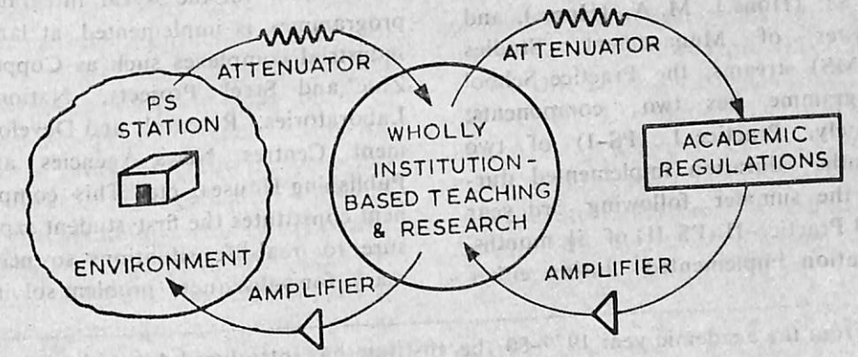

Fig. I Simplified Model of Higher Education Based on Practice School.

The above model is adaptive and self-explanatory. While amplifiers indicate that the essence of the academic regulations and the details of education and research at the university will have to be amplified in the classrooms and at the practice stations respectively, the attenuators suggest that the experiences gained at the practice stations and in the university classrooms and laboratories must be abstracted to improve upon the methods of university education and also the nature of university academic regulations respectively. Further, understandably the boundary of the environment is ill-defined.

Structure of the Practice School Programme

For 5-year* integrated programmes (Ref. to the integrated programme flow chart) leading to B. E. (Hons.), M. Sc. (Hons.), M. A. (Hons.), and Master of Management Studies (MMS) streams, the Practice School programme has two components; namely, Practice-I (PS-I) of two months' duration implemented during the summer following 3rd year and Practice-II (PS-II) of 5½ months' duration implemented during either of the semesters of the final year. As against this B. Pharm. (Hons.) has only PS-II which is also normally implemented in either of the semesters of the final year. For two year Master's programmes leading to M. E., M. Pharm., and M.Sc. (Tech.), the Practice School has only one component of 5½ months, i.e. PS-II. For these programmes the Practice School is implemented during the second semester of the final year. It may be noted that the two year Master's degree students undergo their PS-II component at the same stations as 5-year integrated students. Finally, while PS-I is operative for two months every summer, PS-II is implemented round the year.

PS-I Course

This first component of the practice school for the 5-year integrated programmes is implemented at large industrial complexes such as Copper, Zinc and Steel Projects, National Laboratories, Research and Development Centres, News Agencies and Publishing Houses, etc. This component constitutes the first student exposure to real-life situations so necessary for subsequent problem solving

* From the academic year 1979-80 the Institute has introduced 4-year integrated programmes which are structured on a normal input of 10+2 system. The programmes consist of a perparatory year and a 4-year superstructure. The preparatory year takes care of a student who might need one or two semesters for preparation for crossing over to the first year of superstructure.

experience at PS-II. During PS-I students are first initiated and oriented towards professional activity. For engineering students this means detailed undertanding of vast engineering operation as well as introduction to the theme of industrial infrastructure and development defined in terms of problems such as inventory, productivity, management, industrial relations, information system, wage administration, etc. As to 3rd year science students, PS-I aims at exposing them to the integrated theme of science in terms of how science aids man, and at the same time provides them with an excellent opportunity to study science in action. Further, it creates an awareness amongst students of the method of scientific experimentation and enables them to see in operation, and study, and handle some of the costliest scientific equipment which a university cannot possess. Management students are initiated into their profession by ensuring that PS-I requires them to study the technological operations, and during the process, exposes them to the problems of industrial management. Economics students get an opportunity to observe groups of experts in management, economics, operations research, statistics, and engineering, working on economic problems at micro as well as macro levels. Finally, PS I provides 3rd year language students an opportunity to study various facets of modern journalism consisting of sub-editing, writing news, writing editorials and features, etc. In other words, the emphasis is on the application of language. The very choice of stations for this course tells us that they provide a variety of experiences and hence are attended by students drawn from various streams. Indeed, the broad - based core education, strong in fundamentals and rich in analytical tools, that the students receive during their first three years provides them with the necessary foundation to understand properly the nature of real-life situations. The students are accompanied at the practice stations by Institute faculty who have the overall responsibility for day to day educational as well as evaluation details concerning PS-I. Some of the typical places where this component has been implemented are Hindustan Copper Complex, Khetri; Hindustan Zinc Ltd., Udaipur; Fertilizer Corporation of India Ltd., Durgapur; Sikkim Mining Corporation, Rangpo (Sikkim), Assam Oil Company, Digboi; National Physical Laboratory, Delhi; Bhabha Atomic Research Centre, Bombay; Central Food Technological Research Institute, Mysore; Century Spg. & Wvg. Mfg. Co. Ltd., Bombay; PTI and UNI, Delhi, etc.

PS II Course

As indicated earlier, this component operates round the year and is attended by students of final year

of 5-year and 4-year integrated programmes along with two year Master's programmes in batches coming every six months. To achieve this, normally all students across the Institute in the final year programmes are broken up into two groups—roughly about half the number going in the first semester and the other half in the second semester. Consistent with the educational philosophy of the Practice School, this component is implemented at various production and manufacturing units; design, development and consulting agencies; national laboratories; R & D centres; banks; social and planning cells; museums; villages, etc. (Refer to the PS station classification reported in Appendix 1.6). The student education in PS-II is in terms of his involvement in the problem solving efforts of direct interest to the host organisations. The necessary assignments are identified by practice faculty apriori in consultation with professional experts from the host organisations before students arrive on the scene. Problems so chosen are normally assigned to different groups, each consisting of 3 to 4 students generally drawn from different disciplines. Each group has its own leader who has the total responsibility of planning, scheduling and implementing various stages of the task on his hands. The professional expert interested in a given problem and the BITS practice faculty resident at the practice station play the roles of consultant and supervisor respectively, The groups are encouraged to take independent decisions and are required to defend the technical credibility of the work from time to time through written as well as oral presentations. All along the programme an attempt is made to emphasize the importance of team work, the need for leadership qualities and the need to fulfil a time-schedule. Some of the typical assignments that in the past students have undertaken in PS-II course are Design and Fabrication of Pneumatic Crust Breaker; Treatment of Effluents from NaOH plant; Reorganisation of Electrical Distribution System; Design of Chopped - Ramp Generators; Construction Monitoring through PERT/CPM; Improvement in the Yield of Lysergic Acid Derivatives through the Submerged Culture Method; Development of Software for Traffic Signal Control System based on INTEL-8080 Micro Processors; Production and Market Survey for Small Scale Industry in Punjab; Design of Ground Water Reservoir; Study of Coal and Ash Handling Systems; Optimal Cropping Pattern-a Linear Programming Approach; Resource Development in Colaba District; Credit Plan for Sitarmahi District of Bihar; Organisational Restructuring; Evaluation of Indo-German Fertilizer Educational Project; Documentation of Temporary Exhibition on Transportation in Calcutta; Choice of Rural Technology—a Novel Approach, etc.

Further, some of the PS-II assignments come under the broad areas of contemporary interest like Alternate Sources of Energy; Waste Treatment; Effluent Treatment and Pollution; Industrial Management; Process Technology, Engineering and Instrumentation; Catalysis; Rural Development; etc. which also happen to be Institute research areas.

Typical Practice Station : A Model

An analogue of the university classroom and laboratory set up in the professional world is the practice station. Each practice station is usually manned by a team of teachers with one of them acting as the Instructor-in-charge. It is quite possible that a given city may have more than one practice station. In such cases a conglomeration of practice stations at a given location is designated as 'practice centre'. Consistent with the educational requirements, every effort is made to ensure at each station/centre facilities such as office space, blackboard, sitting place for students, a small library and if necessary, instrumentation and computational facility, etc. In this connection it is worth mentioning that the host organisations have always come forward with all the possible help they can give.

Practice School (PS) Assignments

The issue here is in terms of intrducing students to the real-life culture which can not be simulated in the classrooms. The practice assignment is a vehicle for this. Thus the challenge of education at Practice School is in terms of abstracting pedagogy of teaching and evaluation when students are engrossed in the real life problem solving efforts. This very intention of capturing the flavour of the real life culture makes it axiomatic that PS assignments must necessarily be those of direct interest to the host organisations. Further, the nature of practice assignments is multivaried. Firstly, when faced with the culture of 'detect the problem and get it solved', it seems to be next to impossible for one to classify tasks on one's hand in terms of codified orthodoxies of knowledge. 'Multidisciplinary' is the word used normally to describe this situation A natural corollary is that a real life problem invariably seems to need a team effort from students drawn from different disciplines so as to ensure that all the points of view have been taken into account before arriving at the answer. Secondly, such problems are mission and goal oriented, and hence understandably are time bound. Thirdly, a strategy for solutions to real life problems is often found to be a peculiar mix of attitudes of the scientific mind, respect for every day routine and element of adventure. Finally, to make things complex, they are also open-ended in the sense that one can rarely be sure that one knows all the answers; thus intro-

ducing an element of decision-taking in the face of insufficient data and uncertain parameters. This in turn then provides the frame-work within which practice assignments are selected and implemented. Further, it may be noted that while some of these practice assignments may be of 'improvement' or 'design' and/or 'development' type, some others could be of continual type, forming part of long-term research and/or development projects.

Student Allotment

Consistent with the educational requirements of PS–I, the student allotment is done on the basis of professional experiences available at any given PS–I station and the student preferences along with the information concerning his CGPA, as well as physical facilities, etc. However, this task of student allotment acquires a new dimension and assumes highly challenging nature when it comes to making allotment for PS-II. This is so because from the past experience it is observed that the very nature of PS–II assignments is such that more often than not it is extremely difficult to specify necessary student input in terms of details such as CGPA or discipline alone. Therefore the following approach is adopted. With the help of host organisation and practice faculty, information is collected in terms of the type of total integrated personality of the student who could do the task on hand. Simultaneously, profiles of practice students are prepared incorporating details available in terms of CGPA, performance in unconventional courses credited, assignments worked on at PS I, languages known, committee work, achievements in terms of sports, debates, organisational challenges, personal aspirations etc. so as to summarise student capabilities in a comprehensive manner. Information so collected is then matched, keeping in mind details such as student preferences, constraints of physical facilities, etc. to arrive at the final student allotment. In short, the entire method is based on the theme emerging from the experience that it is not possible and also not necessary to order students linearly so as to say who is better than whom. Challenges of the real life, and hence choices, are too complex and too varied to allow one merely to say who in his opinion is best suited for what, while providing a rationale for it.

Evaluation in PS Courses

The practice method of education is a vehicle through which one can meaningfully innovate in methods of student education and evaluation to bring them closer to the real life situations. In all practice school courses the concept of continuous evaluation is followed. At the end of

each practice course students are awarded letter grades based on their total performance and these grades are incorporated in their degree transcripts. It is in this sense that practice school constitutes an integral part of education at BITS. The educational process in the practice courses seeks out and focuses attention on many latent attributes which do not surface in the normal classroom situations, such as intellectual ability, professional judgement and decision-making ability, interdisciplinary approach, skills for data handling, ability for written and oral presentation, initiative, ability for team work, leadership qualities, industry, sense of responsibility, ability to meet deadlines, etc. (Refer to clause 22 of the Academic Regulations reported in Appendix 4.6). These attributes are judged by the faculty through various instruments of evaluation, namely, quiz, viva, seminars, group discussions, project reports, daily observation of student's performance, and diary.

At the end of every PS–II course, students are also given in the form of a rating sheet a statement describing qualitatively the degree to which the above mentioned personality traits have been demonstrated by them in the course (Appendix 4.5).

Finally, at the end of successful completion of Institute–based courses as well as practice courses, a student is awarded the PS degree in his discipline.

Role of Professional Experts

In the PS programme, the concepts of identification of assignments, allotment of students, guidance, student evaluation, selection of teachers and participation by professional experts are closely inspired by what is authentic and worthy in the professional world. In the process at the practice stations, the student plays a dual role both as a learner as well as an understudy, while the PS faculty and the professional expert, in the roles of consultants to the student, constitute the much–needed link between the theory and practice. In this context, it will be worth mentioning at this stage the demands that the PS programme makes on the time and energy of various officers of the host organisations.

Indeed, as is being repeatedly emphasised all through this case study the entire responsibility for the day to day details of the PS education and evaluation lies with the Institute faculty who are resident at the Practice Station. Speaking in terms of the details of PS–I it may be mentioned that the preparation of its educational schedule is initiated at the Institute itself. On reaching the practice station the faculty discusses the same with the

officers from the host organisation particulary, with a view to seeking their guidance and concurrence. After this the faculty engages the students in various assignments and keeps the officers informed of the overall student progress. In the process, the faculty may arrange group discussion between officers, students and himself. The officers are also invited from time to time to participate in the seminars given by students. At the end of the PS–I session the practice faculty seeks officers' critical comments on reports submitted by students with a view to receiving the much-needed feedback on the student work.

As regards PS–II operation, officers from the host organisation come into picture mainly on two occasions in the span of about 5½ months; firstly, when the practice faculty is preparing the problem bank for the next batch of students and secondly, when the students defend the technical credibility of the reports prepared by them. In the first case, the officers or the professional experts from the host organisations need to supply the practice faculty with details of the various problems that the officers have in mind and on which they desire practice students to work. Simultaneously, they are also required to give their visualisation of the type of student input needed to work on each assignment suggested by them. Once this information is supplied, the PS faculty and Pilani-based Practice School Division work out all the other details, including those concerning student allotment. After students' arrival at the practice station the practice faculty remains at the helm of the activities involving details like information about student groups, assigning of projects, holding of seminars, group-discussions, etc. Whenever seminars and group discussions are held, the practice faculty certainly tries to secure the presence of the officers, but their participation, though desirable, is optional. Further, when the assignments are in progress, the role sought from the officers or professional experts is equivalent to that of a consultant and normally students are encouraged to approach professional experts through practice faculty, thus ensuring that students go well prepared and do not take the experts' time for granted. The second major phase of the officers' involvement in the PS–II activity comes towards the end of the course. At this stage an attempt is made to require students to defend the technical credibility of their work before as large a gathering of experts as possible. This indeed is a kind of brain-storming session which normally forces detailed discussions on various aspects of the problem, invariably resulting in resolving critical issues involved. From here on once again students and faculty carry on their activities as per their practice school schedule and the entire process is repeated

Thus every effort is made to ensure that professional experts are not required to worry about routine details concerning the educational as well as administrative organisation of the PS programme.

Some Historical Aspects

The model described above reflects the present situation. It differs slightly from the one that was initially conceived and implemented between 1973 and 1975. The difference was that then the PS programme for the 5-year integrated engineering student, leading to B. E. (Hons.) degree with Practice School had in all three components instead of two as explained above. The third component, designated as 'Design Practice', followed the PS–II and was implemented for two months in the summer immediately following the fifth year. When the feedback from students, teachers as well as host organisations was sought after operating Design Practice for consecutive summers during 1974 and 1975, it was gathered that the two month duration for the design type PS involvement was rather inadequate. Further, this component was also felt to be operationally inconvenient as the student's mind by this time was invariably found set on a search for employment. It was against this background that in January, 1976 the Institute Senate proposed that some of the stations under PS–II itself would be a conglomerate of engineering design, development and consultancy firms, and thus it was decided to do away with the separate two-month requirment of the design practice. (Ref. to Item 37.11 of the 37th meeting of the Senate held on 20.1.1976).

The PS model described above is the result of planning that the Coordinator, Practice School with his colleagues initiated in November, 1970.

6. THE PLANNING PROCESS : 1971–72

The most important and also the immediate issue, to which this planning group addressed itself right at the outset, was concerned with the choice, to begin with, of the round-the-year PS–II stations. At this stage it was noted that the phasing of the introduction of the 5–year (4–year) integrated programmes was so emerging that the students from engineering disciplines were becoming available first to undergo the PS programme, while students from sciences and humanities were getting ready for the same at a later point of time. Therefore, perhaps as a natural extrapolation of past practices in terms of the choice of industrial training centres for engineering students, this initial search for the PS-II stations revolved around large production and manufacturing units which, consistent with the philosophy of the PS system of

education, were characterised by the interdisciplinary base of the problem solving activities.

Around the same time, as a follow-up of the Chairman's May, 1970 offer (during his Pilani visit) to the Institute students and faculty that PS could collaborate with any of his industry, the management of the Hindustan Aluminium Corporation Ltd. (Hindalco), situated at Renukoot in the district Mirzapur of U.P. State, came forward with a proposal to start with it the round–the–year practice school station and offered all the necessary facilities. As an aluminium complex, Hindalco has a unique position in the sense that all the stages of the aluminium production and manufacture, namely, the alumina plant, the reduction plant and the fabrication plant are located at one place. Further, the power generation units at Rihand and Renusagar are also located in close proximity from the plant which is easily approachable, thus making Hindalco an ideal locale for implementing the practice school type of education.

It is against this background that in January, 1971 the planning group converged on the choice of Hindalco as the first round - the - year PS–II station.

Once this decision was taken it looked clear that the next step was to start operating the PS programme at Hindalco without any further delay of any sort, particularly in view of the fullest backing of the Chairman and the total agreement between the managements of the Institute and Hindalco. However, being conscious of the fact that this entire effort towards collaboration was essentially the task of bridging the gap between two cultures, the Institute opted to move cautiously by first attempting to reach, before students arrived on the scene, fullest professional rapport between the senior as well as junior colleagues from both the organisations. Thus in February, 1971 the planning group identified a team of six faculty members, drawn from different disciplines of chemical, electrical and electronics and mechanical engineering, for the summer stay at Hindalco during 1971. In concrete terms, the planning group proposed that during their summer stay the above mentioned pilot team would undertake the following four tasks, namely, (i) to understand the nature of the real-life industrial problems, (ii) to establish the much needed rapport with the industrial experts, (iii) to prepare the problem bank of PS–II assignments for the Hindalco practice station and (iv) to identify schemes for campus-based research.

This was followed by a visit to Hindalco in March, 1971 by the Director, the Co-ordinator, Practice School and their senior colleagues, during which extensive managerial, technical and educational discussions were held with the entire cross-section of the Hindalco officers, seeking their views, suggestion, and concurrence on the planning as well as operational details visualised. It is with this preparation that the team of six faculty members spent two months of the summer of 1971 between May and July, applying themselves to the above mentioned well-defined tasks. It may be noted that as a symbol of its commitment to the educational theme, the management of Hindalco viewed this team as its consultant and accordingly offered the team appropriate professional honorarium.

Simultaneously, at the other end, in response to the Ministry of Education's request of May, 1970 and consistent with the directions enumerated in the Institute's Forward Plan, the Co-ordinator, Practice School in May, 1971 made a proposal to the Ministry of Education on the subject of Co-operative Education. The proposal visualised the PS programme, on an optional basis, for the first integrated degrees as also for the two-year master's degrees across the entire cross-section of the engineering, sciences and humanities disciplines at the Institute. Understandably the PS at B.E. level was proposed in lieu of the sandwich scheme which some of the other institutions in the country were contemplating. To begin with, at the B.E. level, the proposal suggested a maximum controlled student intake of 50 from all the engineering disciplines.

Simultaneously, the work was also in progress at the Institute in terms of the designing of the overall flexible structure for the 5-year (4-year) integrated programmes with the Practice School. It was in July, 1971 that the Senate approved the emerging new academic structure that moved towards the broad-based foundation education which included in it the PS component. During the same month, as desired by the Ministry of Education, the Institute sent a copy of the proposal on the Co-operative Education to the Assistant Educational Adviser at the Northern Regional Office (N.R.O.) in Kanpur for his favourable consideration.

And it was around this time that the planning group got reinforced by the arrival at the Institute of Dr. Sam Fleming, the then Director of the Chemical Engineering Practice School, MIT, USA, in the capacity of a Visiting Professor.

In October, 1971 the six faculty members who visited Hindalco in the summer were entrusted with the task of preparing a comprehensive version of the PS-II problem bank at Hindalco so as to cover a period of at least 2 to 3 years of problem solving efforts, once the Hindalco PS station began

to function. In this context, for each PS-II assignment it was expected that the team would provide the following details :

(i) Title of the practice school assignment along with the name and discipline of the principal faculty investigator;

(ii) Abstract (one brief paragraph);

(iii) Objective of the proposed work;

(iv) Practical implications (Description of the practical need for a broad research problem);

(v) Method of attack:

(a) Brief summary of pertinent literature,

(b) Principal theoretical and experimental methods to be used,

(c) Manpower and equipment required,

(d) Time required,

(e) Budget,

(f) Schedule for interim reports to be submitted during the semester; and

(vi) Name of the professional expert interested in the PS assignment.

Further, the planning group entrusted the team also with following additional tasks :

(i) Detailed PS planning at first integrated as also two-year master's degree levels,

(ii) Identification of PS faculty,

(iii) Designing PS syllabus in terms of goals, methods of problem solving, nature of student assignments, breakdown of timing in terms of the number of weeks to be devoted to each activity, etc. with the objective of being specific in terms of details like plant familiarization activity, report writing, oral presentation and so on,

(iv) Identification of any special preparation that students may need at the Institute end so as to be able to successfully participate in PS assignments,

(v) Identification of infrastructural needs at PS-II station such as office space, equipment, services, hostel accommodation for students and faculty housing,

(vi) Considering the entire programme of courses to be taken by PS students (this was also to cover suggestions on the distribution of basic, advanced and professional courses), and

(vii) Planning for the dovetailing of the PS schedules for various programmes.

While the pilot team was busy working out the above details, in

November, 1971 the visiting PS expert, the Co-ordinator, BITS Practice School and a senior member of the planning group held discussions with the Hindalco officers seeking feedback on their interaction with the six BITS faculty members.

In the meanwhile there had been a continuous interaction between the Ministry of Education and the Institute with regard to certain clarifications on the proposal in terms of the programme structure, examination details, items of expenditure pertaining to laboratory equipment, books and journals, drawing equipment, manpower requirements, etc. The necessary explanations were promptly given.

In some sense the details such as the above might seem to be a minor query but when abstracted, it seems that much of such communication gaps could primarly have been due to the following four reasons:

(i) Firstly, while the AICTE, as a custodian of the technical education, had seen the need for professional traning in engineering disciplines, appatrently no such thought was given by any responsible body in terms of the needs of the science and humanities education, and thus the proposal had constituted a bold departure from the traditional meaning of the word 'profession' by also bringing under this umbrella, in addition to egineering, the disciplines of sciences, magement, economics and languages.

(ii) Secondly, unlike the sandwich scheme operative in U. K., which the Ministry of Education had uppermost in mind, the PS system of education demanded a full time presence of the university faculty at the station, thereby meaning an extension of the entire rigour of the university culture into the professional world, and thus requiring infrastructural facilities in terms of books and journals, equipment, furniture, personnel expenses, etc. for which the Ministry had not planned.

(iii) Thirdly, it basically being an attempt to provide the much needed educational opportunity to students to acquire the necessary attitudes of mind and methods, techniques and skills to participate as contributors in the interdisciplinary, goal and mission oriented and time-bound real life problem solving efforts, the PS model qualitatively differed from that of the sandwich scheme, which essentially in terms of its educational organisation itself only aimed at training students further in the monochromatic skills from the codified orthodoxy of their discipline pursued by them in the university classroom.

(iv) Finally, by cutting across the entire cross-section of the universiiy disciplines, the PS system of education conceived by BITS was emerging into something deeper and wider

academically, and bigger, dimensionally, than even the PS model perfected since World War I by the chemical engineeing department of MIT, USA, to which, it so happened, that the AICTE had referred right since 1958, whenever it reiterated its decision to start practice schools.

It was in December, 1971 that the N. R. O., Kanpur of the Ministry of Education sent its approval to the Institute to start the PS at B. E. level, sanctioning money for the same from the IV Plan for the maximum intake of 5o students; while in February, 1972 Prof. D. S. Kothari, the then Chairman of UGC, conveyed to the Institute the Commission's acceptance of the PS programme at the postgraduate level. In April, 1972 this was followed by a communication from the Ministry of Education intimating to the Institute the acceptance by the Board of Postgraduate Engineering Studies and the UGC of the PS at the postgraduate level across the engineering, science and humanities disciplines. Later in May, 1972 the UGC also communicated allocation of funds for PS from the IV Plan resources meant for the Institute.

As the above details were getting sorted out, in February, 1972 the pilot team completed the tasks entrusted to it by the planning group, and thus the problem bank for the Hindalco PS station saw the light of the day. With this data base ready, in March, 1972 Prof. Edward Vivian, the then Visiting PS expert from the Chemical Engineering Department, MIT, USA, the Director and the Co-ordinator, Practice School, visited Hindalco to have detailed discussions with the management and the engineers in terms of the overall, but now more structured educational and operational requirements of the programme. In June, 1972 a decision was taken to appoint the Co-ordinator for the Hindalco PS station. Further, in the same month a meeting was arranged at Renukoot between the Co-ordinator, Practice School, the faculty designate Co-ordinator, Hindalco practice station and the management of Hindalco to work out the day-to-day programme details in terms of the number of students, faculty and office staff to be accommodated, student and staff staying arrangements, office space and furniture requirements, and space needs for library, laboratory and conference, etc. It was decided that keeping in view the operational conveniences, it would be helpful to begin with a small number of students, namely 12.

In July, 1972 the Senate approved the transitory provisions for the then existing pipeline B. E. and M. E. students to be accommodated into the the PS stream. With this, the Institute was now more or less ready to start the PS programme from the next semester, beginning with a batch from the M. E. stream to be followed by a group of pipeline B. E. students in June, 1973.

Following the Senate decision the Co-ordinator, Practice School invited the then pipeline M. E. students to apply for the P S programme to be implemented between December, 1972 and June, 1973. The selection interviews were held in the third week of July itself. In August, 1972 the Co-ordinator, Practice School, initiated discussions with the management of the Hindustan Copper Limited (HCL), Khetri in connection with the arragements for the PS–I training of the regular batches of students that were to follow from the summer of 1973 onwards. This was followed by the initiation of the task of identifying the PS-II faculty for Hindalco. In November, 1972 the Co-ordinator, Hindalco PS station was appointed and, inclusive of him, at this stage a team of four faculty members was finalised to man the Hindalco PS station. This team consisted of one faculty member each from the disciplines of Chemical and Electrical and Electronics Engineering and two from the discipline of Mechanical Engineering. Two out of these four faculty members were drawn from the pilot team. In the same month, decisions were also taken with regard to :

(a) operation of PS-II station accounts,

(b) PS-II student registration,

(c) PS guidelines to students and staff,

(d) recreational facilities to students and staff,

(e) student board arrangements and the manpower assistance required for same.

Finally, in December, 1972, details were worked out in terms of the utensils and crockery needs of the students and staff as also decisions were taken with regard to the disbursement of scholarships at the PS–II station and with this the entire educational apparatus got set to launch the Hindalco PS–II station from the coming semester, which was to begin on 26th December, 1972. Characteristic of the above planning methodology, it was around this time only that the Institute at the Pilani end got simultaneously busy with the task of filling in the course details for the 5–year (4–year) integrated programmes with Practice School.

This was the planning process then stretching over almost $2\frac{1}{2}$ years since the appointment of the Co-ordinator, Practice School and 2 years since the appointment of the planning group. As is obvious from the above description, this planning process, true to the approach to the innovation indicated in the Forward Plan of 1970, pervaded all the aspects of the

educational administration and, at every stage of decision making, involved the teachers and the professional experts who were to implement the programme. Guided by the desire to succeed and even more perhaps being conscious of the fact that the task of bringing together the 'two cultures' is rather a fundamental one, the process was meticulously planned, leaving nothing to chance. Very often these efforts got transformed into the drudgery of day-to-day life. To a casual onlooker as also to an impatient mind it even sometimes gave the impression of a deliberate delay. It needed precision, intelligence, patience, perspective and motivation. Indeed all these were the different facets of the same totality.

7. THE ZERO HOUR : 1973

Practice School II (PS-II)

BITS implemented its first practice school course, stretching a little beyond 5½ month at the Hindalco PS station from 26 December, 1972 to 21 June, 1973. A group of 10 ME students consisting of 4 chemical, 3 electrical and electronics and 3 mechanical engineers attended this PS-II course. The assignments on which these 10 students worked during the PS training were identified by the PS planning team as early as February, 1972. Each of the assignments selected was such that, apart from fulfilling the educational needs, it also had at least one, if not more, professional expert from Hindalco who had a direct interest in the success of the problem solving effort. The selection of these 10 students was finalised as early as the beginning of August, 1972. Between 26 and 30 October, 1972 these students were given at Pilani a sort of pre-orientation by way of four lectures in the areas of process metallurgy of aluminium and fabrication of aluminium. A team of four faculty members, who also had an opportunity for the fullest involvement in the planning process, supervised the student education. These faculty members were drawn from different disciplines of chemical, electrical and electronics and mechanical engineering. One of the members of this team of teachers had the responsibility of acting as the Co-ordinator of the Hindalco PS station. Understandably, he was also the instructor-in-charge of this PS-II course.

During the course of the above PS training, the students underwent a week-long orientation programme and then worked in groups of 2 to 3 on 7 different PS-II assignments of durations ranging from 2½ to 5 months. These assignments were : (i) Recovery of cryolite from pot linings, (ii) Study of ventilation system in fabrication MCC room, (iii) Modelling the Alumina Plant of Hindalco, (iv) Feasibility study of using hot flue gases from re-melt and holding furnace to heat billets in a homogenizing furnace, (v) Study of the rotary kiln, (vi) Study of the heat transfer on properzi and (vii) Study of soaking pits.

The registration for the above course was done at the Institute* on 26 December, 1972. The students reported at Hindalco PS station on 29 December, 1972. Meanwhile at the station a meeting was held on 27 December, 1972 between the PS faculty team and the Hindalco Co-ordinator for the PS programme and his colleagues. During this meeting last minute touches, wherever necessary, were given to the problem statements and it was also decided as to what would be the team of students, PS faculty and professional expert(s) for each of the assignments.

Shri S. S. Kothari, the President of Hindalco, formally inaugurated the Hindalco PS station on 1 January, 1973. This PS-II station has now its own office space which covers the floor-area of 54ft × 51ft. The 12 study tables accounting for the maximum proposed student intake are accommodated in a spacious 36ft × 51ft hall which forms an integral part of this office building. For the maximum number of 4 faculty members, this office building has 2 staff rooms, each of dimension 18ft. × 12½ ft. In addition to the staff room there is a library-cum-seminar room covering an area of 18ft × 25½ft. This room is equipped with a large size blackboard as also enough cupboard space for keeping books. Right on its starting date this PS-II station was equipped with about 120 books loaned by the Central Library of the Institute and a modest set of 6 instruments, namely, honeywell potentiometer, pitet tube, thermocouple wire, velometer, inclined tube manometer and orset apparatus. Such library and test equipment facilities are to be taken merely as an add-on to what facilities the plant already has and to which the students and faculty have full access. Further, this office is fully furnished with adequate furniture for the students and faculty.

It may be mentioned here that the very theme of the PS system of education demands that while fulfilling their individual educational commitments, students and faculty adhere to the discipline of the host organisation. Normal working hours at Hindalco PS station correspond to the general shift timings, but depending on the requirements in a specific problem solving situation, students must put in additional hours, if necessary. As regards residential facilities, students and faculty are accommodated in furnished houses located in the plant township.

* However, this practice has since been abandoned and today all students, about 200 at a time, directly register at the respective PS-II stations. There are as many as 25 PS stations across the length and breadth of the country.

The office and the accommodation facilities have been given by the host-organisation (Hindalco) free of charge. Students and faculty also have either free or subsidised access to various other infrastructural facilities such as children's education, recreation, sports, medicine, etc. that are enjoyed by the staff of the industrial unit. Indeed, it will be worth mentioning at this stage that for all practical purposes the management of Hindalco gives the PS faculty the full status – professionally as well as socially – that is due to its senior officers.

And this entire educational infrastructure was ready even before the first batch of PS students arrived at Hindalco on 29 December, 1972.

As indicated earlier, the first assignment on which the students worked was aimed at familiarizing them with the Plant. This was carried out in the first week in two parts: (i) the first part concerned the general study of the plant and (ii) the second part dealt with intensive study in assigned areas. Towards this the students worked in groups. The students were encouraged to exchange ideas during their studies of the specific areas. Specifically, this orientation was done so as to achieve the following:

(a) to give the students an understanding of the functions of various subsystems and the processes carried out in them,

(b) to impart to them skill in terms of the tracing of various flow lines pertaining to material, steam, water, gas and fuel circuits and so on,

(c) to enable them to identify the control equipment used and also the quantities they were intended to control, and

(d) to help the students locate various measurement points for determining material flow rate, power consumption, heat losses, etc. At the end of this orientation assignment, students submitted reports and also gave seminars which were conducted on 8 January, 1973.

Immediately after this, as planned before, students in teams were assigned their PS–II problems. Each team had a leader who had the total responsibility for planning, scheduling, implementing and defending his team's steps to the solution. The teams were to complete their respective final project reports on this first phase of assignments by 26 March, 1973 and were to defend this work of theirs in the seminar scheduled for 28 March, 1973. After that they were to be given the next phase of assignments for which they were to complete their reports by the first week of May, 1973 and defend them around the middle of June, 1973. In addition to this, it was also expected that during both these phases of the problem solving efforts students would be periodically

giving seminars and reporting their interim progress. Such was the emphasis on the educational discipline.

The faculty team continuously evaluated students through components such as group discussions, seminars and interim and final project reports. The format of the evaluation scheme used then is given in the Appendix 4. 3. After each round of the assessment the students were given feedback on their performance with suggestions as to how the same could be improved. On the average such an interaction took place almost twice every month. In the end the students were awarded letter grades based on the details of the above described interim evaluations.

It will, however, be wrong to suggest that right in the first attempt itself all the above educational operations were getting implemented in an ideal manner. In concrete terms, firstly, more often than not and in spite of the best efforts of the faculty, there was in many a problem solving and evaluation situation a visible lack of proper scheduling. Secondly, though there was a continuous professional dialogue between students, PS faculty and professional experts, it took quite some time to establish the practice of formal presentation by students where all these three groups came together for free and frank professional discussions. Thirdly, at the early stages of the problem solving efforts, it was also a little difficult for all concerned to fully appreciate the educational advantage of more frequent oral presentations by students. Fourthly, in spite of the total agreement concerning its need, the student–faculty team, when it came to implementation, suddenly found itself wanting in terms of planning and scheduling steps leading to the final project report preparation. Fifthly, in many a situation faculty seemed to display a tendency to define narrow boundaries of educational and organisational responsibilities for themselves. However, during the entire period of this PS–II course, the maximum difficulty that the PS faculty team seemed to have faced concerned the area of student evaluation. To be specific, for quite some time, whenever the team sat down to evaluate the student personality traits such as professional ability, initiative, leadership, sense of responsibility, etc., the team found it extremely difficult to agree upon the norms for the same and thus in the process it presented before an interested outsider such as students an image of non-homogeneity and conceptual drift.

Seen against the educational totality, the type of issues as the ones listed above essentially relate to the new professional challenges that the PS system of education puts before the teachers. While at PS stations, the

student plays a dual role, both as a learner and an understudy or some kind of a junior manager, the teacher acts as the most important link between theory and practice. In the process the PS faculty has the task of evolving teaching and evaluation techniques which are 'performance' based in the sense they facilitate, against the concept of the delivery schedule, the periodic assessment of the problem-solving tasks at hand as well as of the multi-objective contribution towards the same by the individual members of the student team. This 'project' oriented approach to the teaching and learning processes is certainly a major departure from the usual university classroom norms.

With the passage of time, backed up by the continuous guidance and help from the Pilani-based planning group (this even meant the group's participation in the activities like seminar, etc.), the Hindalco team did resolve all such issues bringing the ship, so to say, on an even keel. Once these teething problems were over, the course was set free. Here it must be mentioned that during this period the PS programme was once again very fortunate to have the able and timely services of Dr. Sam Fleming who was then with the Institute on his second assignment.

In May, 1973 the Hindalco team initiated the task of standardisation of the formats for data recording and calculation sheets to be used by the students. Around this time, keeping in mind the needs for the future, effort was also undertaken to further strengthen the equipment facilities at the station. A little earlier, i. e. in April, 1973 preparations were initiated at the Institute for the second PS-II batch that was to follow from 26 June, 1973 to 15 December, 1973. As indicated earlier, this group was to consist of the pipeline B.E. students seeking PS stream. The selection of the 12 students was made with the help of interviews which aimed at testing them in terms of the following abilities; (i) leadership and initiative, (ii) engineering aptitude and common sense, (iii) capacity for independent thinking, (iv) unusual drive and desire to achieve results, and (v) spirit of co-operation along with the personality for group work.

The Hindalco PS station held the closing function for this first PS-II course on 21 June, 1973. It was a largely attended get-together to mark the successful beginning of this joint educational endeavour. Out of the ten students, four were offered jobs by the host organization itself while others got employed at other places. The host organisation found it feasible to reduce the students' inplant training programme aiming at their cultural induction by the period of PS training.

The next batch consisting of 12 B.E. students drawn from disciplines of chemical, electrical & electronics, mechanical and civil engineering, started their PS-II training from 26 June, 1973 onwards. During their PS-II course these students worked on four different phases of problem-solving exercises. The first phase was devoted to the familiarization task and each of the remaining three phases consisted of a number of PS-II assignments consisted with the student background. Once again a team of 4 PS faculty supervised and graded their work. The format of the evaluation scheme then adapted was the same as the one followed during the previous session. However, with experience gained over the years the scheme has undergone changes. This format is shown in Appendix-4. Coming to the Institute end, the selection of the next batch of 12 students was finalised towards the end of July, 1973. This batch consisted of all M. E.* students and underwent its PS-II course from 26 December, 1973 to 15 June, 1974. Keeping in mind the expanding horizon of the PS education following the adoption of the 5-year (4-year) integrated structure, during this session, the PS programme stretched its physical facilities to make room for as many as 8 faculty members so as to meet the need for a larger faculty number trained in the methods and techniques of the PS system of education. With the passing of time it was becoming clear that all this meant new challenges and it was therefore necessary to define and assign specific responsibilities. In other words, this was the time when the preliminary planning steps were more or less complete and the educational project had entered into the production stage. It is against this scenario that around April, 1974 the Institute designated one of its faculty members, who was a member of the PS planning group, a member of the Hindalco pilot team and also a member of the Hindalco PS faculty team between January, 1973 and July, 1973 as an Incharge, Practice School Programme with the total responsibility for implementation and development of the Practice School system of education across its disciplines.

And, thus, the ball was set rolling.

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* At this stage it is worth mentioning that this rigid classification of BE students in one semester and ME students in the other was purely circumstantial so as to take care of transitory as also operational needs. In reality the PS structure, that the Institute has perfected over the years has, consistent with its interdisciplinary educational theme, the much needed flexibility to accommodate students of all disciplines and of the first integrated as also of the two year master's degree levels in either of the regular semesters during any academic year.

Practice School I (PS–I)

The first PS–I course was implemented between 18 May, 1973 and 2 July, 1973 at Hindustan Copper Limited, Khetri situated over 32 miles south of Pilani. In all 15 third year engineering students attended this course which was supervised by 4 faculty members with one of them acting as the Instructor-in-charge. The student education was broadly conducted through (i) study-oriented assignments, (ii) design-oriented assignments, (iii) opportunities for in-plant exposure and (iv) visits to various departments backed up by gap lectures by experts, wherever necessary. Each student in all worked on 10 PS–I assignments.

The student performance was graded through evaluation of project reports, diary, oral presentations, participation in discussions, personality characteristics, quizzes and short reports. Study - oriented assignments were assessed on group basis, while design and in-plant exposure type assignments were evaluated on individual basis. Further, every student was required to keep a diary which consisted of day - to - day professional observations and during discussion the effectiveness of the diary was judged. The students undertook the above assignments in groups and each group had a leader. During oral presentations the work of the entire group was evaluated. Further, each student's participation in his own group's work as also in the activities of the other groups was also assessed. The personality characteristics graded were leadership, sense of responsibility, co-operation, initiative, and regularity. Finally, during the length of the above course 2 quizzes were given and students were required to write short reports based on the visits or the gap lectures. Thus the assessment was on continuous basis and finally, at the end of the course the students were awarded letter grades. With the experience gained everytime, this evaluation scheme has also been further improved so as to particularly make its format uniform across all the disciplines. This format is given in Appendix 4.1.

As indicated earlier, the Co-ordinator, Practice School had initiated as early as August, 1972 efforts for the PS-I course to be implemented in summer, 1973. This, in March 1973, was followed by further detailed discussions with Dr. Sam Fleming, who was then at the Institute in the capacity of a Visiting PS expert. The Co-ordinator, Practice School invited the ten 3rd year BE students to opt for the PS stream. Indeed, unlike the pipeline students this was to be the first batch of students who were to be admitted to the full length PS programme inclusive of PS-1. Indeed, at this first attempt itself, as many as 114 students constituting almost 58% of the then 3rd year engineering

students opted for the PS programme. On the basis of merit, 39 were chosen for further interviews. Finally, 15 students were selected on the basis of their performance in the interviews and their CGPA.

Design Practice that Merged with PS–II

As mentioned earlier, the PS structure implemented during years 1973 to 1975 differed slightly from the present one, in the sense that till 1975 the PS for first integrated engineering degree had three components instead of two as is the case presently. These three components were PS–I, PS–II and Design Practice. For the engineering stream, the proposal on Co-operative Education had described these PS–I and PS–II courses as Industrial Training and Engineering Practice respectively. Duration wise the Design Practice component came at the end of the V Year and was implemented during the summer terms.

The batch of 12 V year BE students, who attended their PS–II at Hindalco from June to December 1973, was the first to attend the Design Practice component in the summer of 1974. This course was hosted at Engineers India Ltd., Delhi and a team of two faculty members supervised this course. In the summer of 1975, this course was implemented at EIL, Delhi and other design organisations such as Development Consultants Pvt. Ltd., M.N. Dastur & Co. (Pvt.) Ltd., General Electric Company, Bridge & Roof Co. Ltd. (all at Calcutta), M.M. Suri & Associates, Industrial Consulting Bureau, Projects Division of Indian Oil Corporation, Engineering Projects India Ltd., National Small Industries Corporation (all at Delhi), etc. In all 36 students attended this course which was graded by four faculty members.

However, when the feedback from the running of the Design Practice Course, as obtained from all quarters was analysed, it was realized that for a proper exposure to the methodology of engineering design a longer training duration was called for. Thus in January, 1976 the Senate suggested that from the view point of educational organization this component be merged with PS–II by requiring that some of the round-the-year stations could themselves be design stations and thus this separate two-month Design Practice component was done away with and the present PS structure for engineering stream was adopted.

8. PROOF OF THE PUDDING

The 1973 statistics, showing that right at the first chance itself as many as 114 of the then eligible number of 210 students competed for a meagre quota of 15 PS–I seats, was a sufficient indication to the Institute to

note that it had to heavily increase, in the shortest possible time, its physical facilities to accommodate a larger number of students in the PS programme. This in 1974 was reconfirmed when, in response to the circular dated April 6 inviting them to opt for PS, almost all the 3rd year students belonging to engineering, science and humanities streams, chose to do so; thus making the task of student selection also extremely difficult Further, the summer of 1974 was also the first time when students of 5-year integrated degrees with Practice School leading to M. Sc. (Hons.), M. A. (Hons.) and Master of Management Studies (MMS) attended their PS-I; thus lending more reasons as to why greater PS preparations had to precede the summer vacation. Finally, during the academic year 1973–74, the pressure was understandably on the increase from the then IV Year engineering students to give a larger number from their batch an opportunity to attend PS.

It is against the above background that the Institute had initiated, almost a year ahead of time, efforts towards increasing the student intake for PS. As early as July, 1973 the Institute had got in touch with the Gwalior Rayon Silk Mfg. (Wvg.) Co. Ltd., (GRASIM), Nagda to explore the possibility of a PS-II station with it from June, 1974 onwards. During the early months of 1974, the Institute further approached other organisations such as Solid State Physics Laboratory (SSPL-a defence research laboratory of the Govt. of India) Ahuja Radios, Defence Projects Cell (DP Cell) of the Department of Electronics (all located in Delhi) and Central Electronics Engineering Research Institute (CEERI – CSIR laboratory at Pilani) with a request for similar facilities. It is as a result of these timely efforts that from the first semester of the academic year 1974–75, the Institute was able to increase its PS-II intake to a level, threefold the number the Institute began with in January, 1973.

Simultaneously, during the first half of 1974 efforts were also undertaken to work out PS-I details for the following summer. It so happened that in 1973–74 the Institute had at the 3rd year level in its first integrated degree streams in science, management, and economics, students numbering 22, 26 and 5 respectively. As this entire strength had opted for the PS and as the numbers were manageable a decision was taken to accommodate all of them in the PS programme. However, as the number of engineering students was large, such a thing was not possible in this case even though, in view of the success in the efforts towards increasing the PS-II intake, a decision was also taken to raise the PS-I intake to 36 and accordingly arrangements had been worked out with HCL, Khetri.

The selection of the requisite number of the 3rd year engineering students for the PS programme was done in the first week of May, 1974. The selection was based on their CGPA and their performance in the aptitude test and the interviews. The aptitude test was in 'Mechanical Reasoning'. Two experts from the National Council for Educational Research & Training (NCERT), Delhi were requested to join the selection team in conducting the aptitude test and evolving a more rational method of student selection.

Simultaneously, in view of their keen desire for the PS training and also the increased PS-II intake, 21 of the then IV Year engineering students were selected for PS programme as per the transitory clause approved by the Senate. Along with the 15 engineering students, who were selected for the PS in 1973 itself, these students underwent their PS-II course from June 1974 to December 1974 and their Design Practice component in the summer of 1975. The method of selection for these 21 additional IV Year engineering students was exactly the same as the one described above in the case of the 3rd Year engineering students.

As against 15 students and 4 faculty members as in the summer of 1973, in all 89 third year students and 17 faculty members participated in the PS-I programme, conducted from June to August, 1974. These consisted of 36 third year engineering stream students and 4 faculty members who attended PS-I at HCL, Khetri as also 22 third year science stream students and 9 faculty members who attended the same at four different research institutions, namely, National Physical Laboratory (NPL), All India Institute of Medical Sciences (AIIMS), Indian Agricultural Research Institute (IARI), (all in Dehi) and National Institute of Oceanography, located in Goa. The 26 third year management students accompanied by 3 faculty members attended PS-I at 5 different industrial production units like Century Spg. & Mfg. (Wvg.) Ltd., Indian Plastics Pvt. Ltd. (both situated in Bombay), Chittaranjan Loco Works (located at Chittaranjan), Hind Motors and Texmaco (both located in Calcutta), while the 5 third year economics students accompanied by one faculty member underwent PS-I course at the National Institute of Bank Management (NIBM) situated in Bombay. Thus from one in 1973 the number of PS-I stations in the summer of 1974 rose to eleven.*

* At this stage it will be good to expel the impression, if any, that a given PS-I station is attended by students from one stream only. Indeed this situation, as reflected in the details of summer of 1974, was purely circumstantial. Consistent with the interdisciplinary nature of any industrial or for that matter any professional unit and consistent with the PS educational theme, a given PS station accommodates students from all streams of engineering, science and humanities, thus in turn also protecting the much valued flexibility of the structure.

While the PS-I at HCL, Khetri was implemented on more or less the same lines as the one in 1973, the PS-I for science stream students consisted of six assignments, namely, (a) know your organisation (orientation type activity), (b) study of any on-going research project, (c) study of major scientific equipment, (d) gap lectures*, (e) student involvement in a well-defined problem work; and (f) open-ended projects. Against this, PS-I for the management stream was broadly divided into four parts, namely, (i) knowing the organisation, (ii) study of production/technological processes, (iii) detailed study of a given functional area and (iv) the integration of various concepts learnt throughout the PS-I exposure. Finally, as regards PS-I for economics students, it provided them, through study and design type assignments, an opportunity to see the interplay between various areas like statistics, operations research, economics, engineering, information system, etc. in terms of their applicability to the problems of economic development.

Coming to the evaluation scheme, as this was the first time that in a given session a particular PS course was being conducted at different PS stations, an effort was made to evolve a uniform grading policy. Further, an attempt was also made to bring this PS-I evaluation as close to the PS-II evaluation as possible. In specific terms, the PS-I evaluation was based on (i) quiz on the orientation/familiarization assignment, (ii) quiz on gap lectures, (iii) project evaluation. (iv) written and oral presentation, (v) assessment of the open ended project with respect to the ideas presented, (vi) assessment of the diary, (vii) personality traits, etc. A sample of this evaluation scheme is given in Appendix 4. 2.

Indeed, this first endeavour of operating PS-I across the engineering, science and humanities streams was a unique experience. An interesting outcome of this exploratory journey into the environment was that the group from economics that had been to NIBM was able to participate in a linear programming model building task pertaining to a branch location problem for a district in Bihar. As a result of this contribution to the project in which the host organisation was directly interested, each student was paid an out-of-pocket allowance of Rs. 200/- p.m, as a reward. A similar situation had emerged at Century Spg. & Mfg. (Wvg.) Co. Ltd. where too students were paid per head an out-of-pocket allowance of Rs. 200/- p.m. What struck the students most was that this had become possible mainly because of their strong analytical background and broad-based foundation year education, which, in turn, had enabled them to become ideal under-studies to the members of the project team from the host organisations.

Another outcome concerned the details pertaining to the evaluation scheme. When students returned from PS-I, they had detailed discussions amongst themselves on the evaluation scheme. One aspect of these discussions dealt with the necessity for awarding letter grades for an evaluation that centres around the personality traits such as ability for leadership, team work, decision making, sense of responsibility, self-expression, etc. After an initial confusion a vast majority of students, who to varying degrees had often demonstrated these and similar other abilities, mostly through extra - curricular activities, came forward maintaining that it was the first time that an educational system had been able to recognize the academic merit behind these professional abilitities and therefore the academic advantage thus available to such students must be fully protected and preserved.

The results thus achieved clearly show that when exposed to the environment, students themselves can become the catalysts of change as also the protectors of innovation.

There was yet another outcome. One of the 3rd year students of mathematics, who attended his PS-I at NIO, Goa, was able to bring home with him an interesting research problem involving optimization and simulation studies. His perusal of the work at the Institute resulted in a research publication in the field of computer simulation.

And as similar other avenues, like the one described earlier in terms of PS-I at NIBM, were opening up, the pressure was also increasing from the students' side to open the PS programme to the entire student strength of the Institute.

As indicated earlier, from June, 1974 to December, 1974 the PS-II course accommodated 36 students and 5 faculty members and inclusive of Hindalco, and Renukoot, it was implemented at 6 different PS-I stations, the names of which have been reported earlier. Between January, 1975 and June, 1975 the student number was raised further to 56 as during this session the PS programme was also opened for the first time to students from museum studies, intrumentation and pharmacy. As a result the number of PS-II stations rose from six to

* During a PS course a few 'gap lectures' may be given either by the PS faculty or the professional experts with the objective of introducing students to new concepts.

nine, the three additions being Birla Industrial & Technological Museum, (BITM), Calcutta, Central Scientific Instruments Organisation (CSIO), Chandigarh, and Regional Research Laboratory (RRL), Jammu-Tawi. In all 15 faculty members were involved in this session to supervise these 9 PS-II stations.

And it is against such a scenario of rising expectations that, when in the month of April, 1975 the Incharge, Practice School invited the then 3rd year students of the integrated programmes to apply for the PS stream once again as in the past almost the entire student strength opted for the same. Students from management and economics streams, numbering 37 and 08 respectively, were, as in the past, admitted directly to the PS programme, as their number was manageable. For students from engineering and science numbering 158 and 41 respectively opting for the programme, it was decided to undertake the selection procedure. Accordingly towards the end of April, 1975 these students appeared for aptitude tests as also for interviews. This time in all, three aptitude tests were given in the areas of mathematical formulation, physical science comprehension, and mechanical comprehension. By the first week of May, 1975 the merit list for all these 199 students was prepared, based on 50% weightage for CGPA, 30% weightage for aptitude tests and 20% weightage for interviews. That year the PS-I was implemented in two parts, namely, from 16 June, 1975 to 19 July, 1975 and from 9 December, 1975 to 27 December, 1975. As the preparations were being made to finalize the list of students for engineering and science streams, a rather interesting development took place. Around the end of May, 1975 one night the Director, Deputy Directors and the Incharge, Practice School were pleasantly gheraoed by the students demanding that the PS be thrown open to the entire student population from the engineering and science streams. The discussions went on for almost the entire night. As the things stood, the starting date of the PS-I was only two weeks away and, consistent with past practice, the number of seats that the Institute had with it to accommodate the engineering and science students were hardly 60, while the demand was for about 200.

Seeing the motivation and the desire of the students, the Institute promised to make every effort to meet their demand but in return asked students also to help it in working out a solution. It was also driven home that as time was too short, the major difficulty was that of arranging accommodation and hence, if needed, students must be prepared to stay in the road-side tents. Indeed, all this was agreeable to students. In some sense, the arranging of the PS had become their headache.

It is against this background that the Institute and the students moved on a war footing for the coming two weeks, and to the excitement of all, the PS-I programme, accommodating 158 students drawn from different streams, was arranged in a nearby township of Bhiwani, 50 miles north-east of Pilani. Specifically, at the Bhiwani station, students did (a) PS-I assignments built around the activities of Building & Roads Department, Irrigation Department and Public Health Department, all of them coming under the PWD, and (b) PS-I assignments were based on the activities of spinning, weaving, processing and testing and power house sections of the Textile Institute of Technology (TIT). In all 12 faculty members supervised this programme. As regards the staying arrangements, things worked out well as the hostels of TIT became available and hence even mess arrangement could also be made.

A different type of problem arose during the second part of PS-I that was to be implemented in December, 1975. It so happened that due to the out of the turn location of this time slot, as also due to certain unforeseen problems that had crept up, certain places where accommodation was available during the summer months, could not offer the same in the second part. This created a last minute need for finding new PS-I placements for 50 students. Once again a desire to find the solution helped everyone out. An interesting decision was taken to integrate the NSS activity at the Institute and the PS-I need so as to implement PS-I during the December, 1975 period in a nearby village called Dhandhar, 5 kms. west of Pilani. Students drawn from different streams like management, science, engineering and economics attended this PS-I under the guidance of a team of 5 faculty members. Their work was in terms of the socio-economic-cultural and technical survey of the village, backed up by the study of the energy flow in the village with a view to arriving at suggestions on the possible choices for the alternate energy usages. Some of the specific PS-I assignments which the students undertook were social habits and work schedule (of the villagers), land statistics, rural indebtedess, water requirements and resources, effect of mixing on production of bio-gas, design of a honey-comb collector for solar cooker, working of the village co-operatives, etc.

The most significant aspect of this effort was that it was the first time that it had become feasible to give academic credits to the otherwise extra-curricular involvement of students in the rural environment, and this enabled the Institute to conceive of a rural-based PS-I station. As can be anticipated, obviously with the passage of time this also enabled the

Institute to implement the theme of the round-the-year PS-II station in its immediate rural environment. It may be mentioned that, seeing the seeds of a more relevant model of the NSS type activity, the Ministry of Education & Social Welfare financed the printing of the summary of this educational endeavour so that it could become available for a wider circulation.

And thus from the academic year 1975-76, the PS programme was thrown open to the entire student population of the Institute. This bold decision for heavily committing to the environment, in an unprecedented manner, the teaching and research functions of a technological university of the dimension of BITS was,indeed, a natural corollary to the first modest step that was taken in January, 1973. And the Institute's Forward Plan of 1970 had predicted it.

Thus in all 244 third year students drawn from across the Institute streams attended PS-I in 1974 at 14 different stations and in all around 30 faculty members were involved in conducting the same. In view of the controlled inputs in the earlier years, the PS-II student strength from June, 1975 to December, 1975 was only 31, and 5 faculty members supervised their work at 5 different stations. Century Rayon, Kalyan was the new PS-II station added during this session. In the following session, i.e. January, 1976 to June, 1976 in all 75 students along wlth 12 faculty members attended PS-II course at 15 different stations. A notable feature pertaining to the choice of these stations was that during this session for the first time PS-II was implemented at banking institutions like the Central Bank of India (CBI), the State Bank of India (SBI), the Union Bank of India (UBI), the Agricultural Finance Corporation (AFC), etc. (all situated in Bombay). Further, this conglomeration of PS-II stations also included social science planning and consultancy organisations like the Administrative Staff College of India (ASCI) at Hyderabad and NIBM, Bombay. What is interesting to note is that the above type of organisations right from the first day were asking for students with background in engineering and science along with those from management and economics so as to be able to accelerate their problem-solving efforts in the areas of trend analysis, techno - economics studies, area development, industrial profile preparation, credit plan preparation, sick industries, project appraisals, customer service, advertising, infrastructural engineering, etc. And as was to be the case during the period to follow, students from across the Institute did get excited with these new opportunities in the field of social engineering Though perhaps only of historical importance, it is significant

to observe that it was during this session that students of the first integrated degrees from science and humanities streams attended their PS-II for the first time.

During the months to follow, the number continued to grow. Thus in the summer of 1976 in all 355 third year students, forming 94% of those eligible, attended PS I at 28 different organisations located at 16 various PS centres across the length aud breadth of the country and in all 33 faculty members supervised the programme. This number in the summers of 1977 and 1978 increased to 349 and 335 respectively, and in 1979, all the 490 students attended PS–I. At this stage it will be worth mentioning that the summer of 1976 was also the first time when the third year students of integrated M.A. (Hons.) programme in English attended their PS–I course. In all four students accompanied by one faculty member participated in May to July PS–I course conducted at Hindustan Times and Press Trust of India. The PS–I assignments were built around the areas of news reporting, news editing and science journalism. In the process, students indeed worked as understudies to professional journalists and some of the news reports prepared by them were even published by the *Evening News*.

Coming to the PS-II statistics, during June, 1976 to December, 1976, as many as 121 students attended 15 different stations supervised by a team of 18 faculty members. During this session, consistent with the decision of the 37th Senate Meeting, the design practice stations of yesterday were merged with the PS-II stations, and thus the Development Consultants Pvt. Ltd. and MN Dastur & Co., both situated in Calcutta, from this session onwards, became round-the-year stations. Other new stations added were the National Council of Applied Economic Research (NCAER) Delhi, the Energy Systems and New Products Division (ESNP) and R & D Corporate Unit, both of B.H.E. L , situated in Delhi and Hyderabad, respectively. This establishing of linkage with BHEL was preceded by the organization of a part of the PS-I requirement at ESNP, Delhi during December, 1975.

From June, 1977 to December, 1977 the PS-II component accommodated in all 151 students who attended 16 stations supervised by 17 faculty members. Further, it was from this session onwards that the Gwalior Rayon, Nagda increased its physical facilities substantially, so as to be able henceforth to accommodate at a time, a large group of 50 PS-II students accompanied by 5 faculty members. From January, 1978 to June, 1978 the number of PS-II students, stations, and faculty was 159, 20 and 19 respectively. It was during this session that students of English and

STD attended their first PS-II at Hindustan Times and CSIR Centre for Studies of Science, Technology & Development, both located in Delhi. During January, 1979 to June, 1979 PS-II was implemented at as many as 26 stations, supervised by 18 faculty members and accommodating in all 171 students.

Thus, starting in the year 1973, with only one PS station accommodating a controlled student intake of only 12, accompained by four faculty members, the Institute was able to evolve in a short span of only five years, an educational infrastructure of 'industry-university collaboration', wherethrough at present during any academic year, as many as 800 students of different subjects and classes and 60 faculty members of different disciplines participate in this joint educational endeavour implemented at 60 different host organisations. This, indeed, has been possible mainly due to the enthusiastic involvement of the students, mature contribution of the teachers and the wholehearted and the spontaneous support of the professional world. Today the impressive list of the PS stations scans the entire spectrum of Government, Semi-Government, Private Sector and Public Sector organisations. The types of professional experiences offered by these PS stations are also varied, in the sense that the host organizations, as described earlier, range from production and manufacturing units to design, development and consulting agencies to research laboratories, to social science planning cells to banks to publishing houses to museum and finally, to a village representing the rural backdrop.

However, in order to provide clearer understanding of the degree of commitment demonstrated by the professional world towards the supporting and strengthening of the PS concept of education, it will be sufficient as also appropriate to describe various physical and other facilities provided by different host organisations to the students and faculty participating in the programme. To begin with, organisations hosting PS–I have provided students and faculty with facilities like sitting and working places, library and equipment facility and space for holding seminars, etc. Some organisations have also come forward with help in terms of stationery and typing facilities. Further, while many organisations have provided accommodation arrangements for students and staff, some have even paid students out-of-pocket allowance as high as Rs. 250/- per month.

The details in terms of facilities provided by host organisations where PS–II is operative are still more impressive. All the PS-II stations have provided students and staff with working and sitting places and conference rooms for holding group discussions and seminars along with office facilities like stationery, typing, etc. In some cases organisations have even offered separate office space with necessary furniture. All the host organisations have allowed students and faculty free access to the facilities like library and equipment. Further, while at many PS–II stations students have been provided with free or subsidised accommodation, some other organisations have provided free or subsidised lunch facility, and at many of the PS-II stations students are even being paid out-of-pocket allowances anywhere ranging from Rs. 100/- p.m. to Rs. 500/- p.m. Also while some host organisations pay for local conveyance undertaken for practice school work, some other organisations pay for the travelling cost along with DA if students have to go on tours in connection with their assignments. Indeed, almost all PS-II students are getting some kind of facility from host organisations in terms of either free or subsidised accommodation or travelling allowance or out-of-pocket allowance or subsidised lunch,etc. and at some stations a number of these facilities are available.

Finally, some organisations hosting PS-II have even provided free accommodation to practice faculty. In short, each host organisation has worked out its own framework in terms of facilities it can give and has come forward boldly to support and strengthen the task of building the Practice School. In the process the facilities that they have provided to students along with the students' desire to get a good grade in the practice course seem to do wonders in the sense that PS students are known to fulfil their tasks with a sense of commitment and responsibility, normally not to be observed within the four walls of the university classroom.

Indeed, this entire edifice was built brick by brick. It has meant years of thinking, hours of waiting, and tons of commitment. It has been an innovative adventure like riding a tiger. In the process there were occasions, like the one in May, 1975 when students gheraoed, as mentioned earlier, the Director and his colleagues, demanding the giving of PS option to the entire student population of the Institute. Even the chill of the desert night was then insufficient to bring down the rising temperatures in anticipation of the organisational issues awaiting solution. Once the decision was taken to meet this demand, every possible channel was explored to increase the student intake for PS. And one such effort even found the Director, sitting for hours during an evening on a footpath railing in front of a guest house in Delhi, waiting for an industrial executive from whom the PS station facility was expected and luckily the same was obtained. And, as the Insti-

tute moved with such an intense commitment and convication towards the theme of collaboration, to its pleasant surprise, it soon discovered in the professional world many friends who loved and respected the task of education and at the same time, were also ready to commit their own as well as their organisations' energy, time and money towards strengthening the same. Understandably, very often such men were self-made people with pride in their own development experiences and indeed the Institute has been very fortunate in having had their blessings in implementing such an educational innovation as the Practice School Programme.

9. MASSIVE EFFORT OF 1976

Seen in a historical perspective, when the Institute from the academic year 1975-76 onwards decided to open the PS option to its entire student intake, it also initiated effort towards further strengthening of the PS educational organisation.

To elaborate, the logistical implications of opening the PS to the entire Institute student strength were manifold. On the one hand, it meant accommodating a steady-state number of 400 students and 40 faculty members at about 35 different organistions for PS-I operative every summer, as also arranging at a time for about 200 students accompanied by about 20 faculty members to attend PS-II, implemented round the year at as many as 25 host organisations. This implied the need to ensure physical facilites, particularly at PS-II centres, for the above mentioned steady-state numbers in terms of details like classroom-cum-seminar and conference room-cum-office facility, library and equipment needs, accommodation arrangements for students and staff, local conveyance requirements for the staff to attend to the PS work, medical facility for the staff families as per the Institute rules, schooling as also school transport arrangements for the staff children, etc.

On the other hand,consistent with the principles of the semester system of education characterised by continuous internal evaluation, the above decision also meant the need to work out ways and to simultaneously conduct a given PS course at a large number of stations, attended together by students of different subjects and classes and supervised, individually as also in teams, by a large number of faculty members from different disciplines, while fully satisfying the demands of academic rigour and uniformity in evaluation.

Further, some other equally important implications, resulting from going in for such a heavily committed model of higher education, had also started becoming visible at this stage. These were :

(i) The requirement for further strengthening the organization of the multidisciplinary and flexible educational base during the foundation years, so necessary for the meaningful, PS type student-faculty involvement in the professional world.

(ii) Consistent with the above requirement, the increasing need for adopting an integrated approach to the tasks of manpower deployment, recruitment and development, so as to be able to satisfactorily meet the related demands of teaching, practice school and research, and

(iii) the need for re-orienting the organization of the research base at the Institute in terms of the interdisciplinary and mission-directed demands of industrial situations and problems.

And it is against this background that during the academic years 1975-77 the Institute undertook, as indicated earlier, a massive effort towards strengthening the PS education organization.

Perhaps on the basis of immediacy, the first step in the above context, along the same lines as in the case of the PS-I course, was taken around the month of August, 1975. More specifically, the Incharge, PS Programme appointed a study team of three faculty members, with past experience in PS evaluation to evolve, consistent with the details of Clause 22 of the Academic Regulations, a uniform PS-II evaluation scheme across the Institute disciplines of engineering science and humanities. This was essential as during December, 1975 to June, 1976 the first batch of students from science and humanities streams was to attend its PS-II component. Based on its abstraction of the experiences of various PS-II stations that had become operative by then and based on its intense interaction with a large number of faculty members, the study team prepared its first working paper in October, 1975, describing a PS-II evaluation scheme along with a format of the rating sheet within the guidelines mentioned above. This working paper was then distributed across the Institute and suggestions were invited. Based on the analysis of this second round of interaction with the faculty, the study team then prepared its next version of the evaluation scheme which towards the end of November, 1975 was extensively discussed in an almost $2\frac{1}{2}$ hour long meeting, in which as many as 75 faculty members from across the Institute participated. After incorporating the suggestions of this meeting into the proposed evaluation scheme, a third version of the same got evolved, which was again critically discussed from the point of view of operational details in a similar marathon meeting held in the first week of December, 1975 and thus

the PS-II evaluation scheme and the rating sheet in their present format, as reported in the Appendices 4.4 and 4.5 were finalised.

At this stage, it will be worthwhile to mention that, due to its participatory character, the process described above, by itself, has played a very important role in ensuring the the successful implementation of the evaluation scheme so evolved.

During the above period, another important step that the Incharge, Practice School Programme took towards the strengthening of the educational organisation was to constitute in the month of August, 1975 the first PS student nucleus entrusted with the task of thinking, from the students' point of view, about all the matters regarding their involvement in the PS programme. Side by side, during the months to follow, he also applied his mind to various details such as the streamlining of the PS accounts procedures, the establishing of an effective information network, particularly between the PS-II stations and the various departments and faculties at the Institute, etc.

However, around the same time as above, if there was one subject across the Institute that was keeping everyone's attention engaged, it pertained to the theme of the type of the administrative re-structuring that now seemed to be necessary to effectively meet the earlier metnioned educational as also research requirements of the heavily committed model of higher education. As was expected, this Institute-wide discussion and debate got further intensified as also accelerated and at the same time it turned decisive when it emerged that the same was also circumstantially linked with the possibility of the Institute being able to find necessary savings so as to introduce new UGC salary scales for its staff.

Thus in the first week of March, 1976 the committee appointed to look into the above details submitted its first working paper and within days to come, this was followed by the constituting of as many as 15 additional working groups, which along with the departments and faculties covered the entire cross-section of the Institute activities and hence the entire faculty strength. By the second week of March, 1976 when the various recommendations made were analysed, it was observed that there was a general consensus amongst the entire faculty in terms of the introduction of certain functional divisions such as Instruction Division, Research & Consultancy Division, Educational Development Division, Practice School Division, etc. This was then followed by a meeting of all Deans, Heads of Departments, Unit Chiefs, Senior Officers and Conveners of all the 16

working groups in which a comprehensive picture based on the recommendations received was evolved. This was followed by the task of preparing the final version of the administrative structure, as in the present form, and then the same was put before the entire faculty.

Once the administrative re-structuring became final, a very interesting step was taken by floating before the entire cross-section of the Institute's officers proposed names of the Deans, Chiefs and Group Leaders for the various Divisions, Units and the discipline oriented Groups, respectively and a week's time was then given for anyone desirous to comment on any of the names so proposed. Simultaneously, the details of restructuring were also placed before the students.

It was in the second week of April, 1976 that through such an intense participatory process, as the one described above, involving the entire teaching and the non-teaching staff, the Institute declared its new administrative structure along with the appointments of various officers heading the same and thus the PS programme now acquired a full-fledged Division, designated as the Practice School Division and headed by a Dean, to look after its increasing educational as well as organizationl requirements. While the new administrative structure enabled the Institute to meet its future growth requirements, it also helped the Institute on immediate basis to find the much-needed savings so as to implement the UGC salary scales for the teaching staff, entirely through its own budget. Further, as a natural corollary to this step, the Institute also opted to simultaneously review the salary scales for the non-teaching staff and the incremental expenses for this, too, were found from the above savings. This indeed was possible, basically, due to the fact that the administrative structure evolved had adopted a functional approach to the theme of educational administration, where, along with its traditional functions of teaching and research, the faculty was also called upon to play the role of educational managers at all levels.

During the month of March, 1976 yet another major task at the Institute level also came to its completion and that concerned the review of the entire teaching staff. As can be anticipated by now, the process adopted in this case was also characterized by the participatory theme involving, in addition to the various Institute officers, the entire faculty population. Briefly, discussions and deliberations were encouraged at every possible level in terms of evolving the criteria for the reward policy consistent with the challenges of educational innovations undertaken.

scanning the entire spectrum of activities like examination reforms, interdisciplinary teaching and research, course development, PS progamme, student registration and counselling, etc. Simultaneously, a detailed comprehensive information base, drawing data from every possible source, was also prepared to describe the role played by each individual faculty in the various facets of the Institute's activities, And, it was after such a meticulous thinking in terms of the criteria for faculty assessment and preparation in terms of the information base describing the role of each faculty member in the task of the institutional development, that the review committees met in the month of March, 1976 to finalise their decisions on the assessment of every individual faculty member's contribution to the developmental processes initiated at the Institute.

The very fact that the review committee found it possible to reward in one manner or the other as many as 64.8% of the total faculty strength was itself an ample proof of the broad-based educational organisation that over the years the Institute had evolved across its disciplines. And as a result of the bold massive faculty review effort mentioned above and also as a result of the bold administrative restructuring effort described a little earlier, it was this educational organisation that now received its formal academic sanction as also strength. It was hoped that it would accelerate the process of educational development.

Perhaps reflecting the mood across the Institute, one of the earliest tasks undertaken by the Dean was to form Practice School Nucleus and to define the organizational details pertaining to the PS operations. The PS Division effectively started its operation from June, 1976 onwards with an initial nucleus strength of 9 faculty members and 6 student members drawn from different disciplines of engineering, science, management, economics and languages. Over the years the PS Nucleus has grown further and presently it has as many as 15 faculty members of different disciplines and 10 students of different subjects and classes.

Right since the starting date, the organisational structure of the PS Division has been characterised by two important features, namely, (i) decentralisation of the decision making responsibilities and (ii) functionality of tasks. To this date the PS educational organisation has undergone three versions in June 1976, December 1976 and August 1977, before arriving at its present format operative since June, 1978. In brief, as reported in Appendix 2.1, the PS organisational structure, as of now consists of 5 Division-based cells, namely, (i) PS Planning Cell, (ii) PS Instruction Cell, (iii) PS Accounts and Administration Cell, (iv) PS Publications, Documentation, Liaison and Welfare Cell and (v) PS Organisation, Co-ordination and Development Cell.

Whereas the Planning Cell has the total responsibility for looking into all the futuristic needs of PS-I and PS-II sessions to follow in terms of educational as also physical facility details such as obtaining problem bank, preparation of student profiles, seeking student preferences, allotment of students and faculty to various stations, arranging accommodation for the students and faculty, etc., the Instruction Cell monitors and controls all the day-to-day educational details for all the on-going PS courses. Thus the activities that come under the purview of this Cell are student registration, monitoring the issue of the PS course handouts, continuous analysis of the student progress at various centres, ensuring uniform evaluation scheme in terms of quizzes, viva, seminars, project reports, group discussions, diary, etc. across at all the same level PS stations, semester-wise analysis of PS grades, seeking feedback from students and faculty, submission of PS course grades to the examination committee of the Institute, preparing PS transcripts, maintaining all kinds of semester schedules.

As the names themselves suggest, while the PS Accounts and Administration Cell takes care of all the financial aspects and the day - to - day administrative details related to the PS programme, the Publications, Documentation, Liaison & Welfare Cell has the total responsibility for activities such as publishing of the PS bulletin, giving information on the student work in PS-I and PS-II courses already implemented, binding and documenting all the PS reports (Ref. Appendix-7.2), helping the Central Library staff in classifying these PS reports as per the station-wise and subject-wise details, preparing course-wise as also Institute research area-wise index of PS assignments in order to facilitate diffusion of the experience gained at PS into the teaching and research activities implemented within the campus, bringing out monographs and other research and also study type documents based on the PS involvement of the students and the faculty, maintaining the much needed liaison with the PS students and faculty, keeping track of the welfare needs at the PS centres, etc.

And, finally, the PS Organisation, Co-ordination & Development Cell has the total responsibility in regard to continuous monitoring and control of the entire canvas of the PS routine, the strengthening of PS Division's interaction with other Divisions and Units of the Institute, analysis of student, faculty and alumni feedback,

seeking continuous improvements and developments in the PS educational details, inclusive of the evaluation schemes for PS courses, etc. As regards the PS–I and PS–II centres, in some sense, they constitute the 'production units' of the PS Division and various Incharges of these centres have the direct total responsibility for the successful implementation of the respective PS courses at their centres.

From the details given in Section 5 and from the description of the PS educational organisation given above, it clearly follows that PS is very much a formal method of education. This educational organisation has been reported in greater details in Appendices 2.2, 2.3, 2.4, 2.5 and 2.6. Further, Appendix 5 also reports a typical organisational structure at a PS II centre. Appendices 3.1 & 3.2 give information regarding a typical semester-wise activity calenders at a macro-level from the point of view of the PS Division's task and at a micro-level from the point of view of the PS–II station tasks respectively.

It was in August, 1976 that the PS Division brought out its first issue of the Practice School Bulletin giving details on the PS–II stations then operative and this in October, 1976 was followed by the second issue giving reports on the work done by students at various PS–I stations during the summer of 1975. In the months of August and September 1976, the PS Division interacted with the summer, 1976 batch of the PS–I students and faculty seeking their experiences. From December, 1976 onwards the Division evolved detailed feedback questionnaires for PS–I and PS-II, seeking the necessary information and thus formalising the entire feedback collecting process. In October, 1976 the Dean initiated discussions with various PS faculty members, seeking their suggestions in terms of further strengthening of the task of the faculty assessment during their PS involvement. And the December 1976 to June 1977 was the first PS–II session when the PS Division prepared the problem bank and the student profiles (see Apendix 6). By now the PS Division had, indeed, streamlined many of its essential planning as also implementation details and this, in December 1976, resulted in the PS Division designing its first annual activity calender for the entire year of 1977.

Thus within a limited time span of hardly 7 months since its inception, the Practice School Division had already developed its entire educational and also organisational expertise so necessary to successfully operate the PS programme, accommodating during any academic year the steady-state number of 800 students and 60 faculty members.

10. TIME FOR GET-TOGETHER : 1977

In the affairs of men and organisations, there comes a time when much can be gained by a get-together of people, who are functioning and working towards the same goal. For the Institute, such an occasion came when, as a part of its annual Founder's Day celebrations, it organised at Pilani on 23rd and 24th January, 1977, a seminar on Cooperative Education.

In all 61 contributors, comprising 12 representatives from organisations, hosting PS–I and PS-II stations and comprising a broad spectrum of Government, Semi-Government, Public Sector and Private Sector units, 5 PS–II faculty members from the field, 13 students, 27 Institute-based faculty and 4 Adjunct Faculty members of the Institute, participated in the seminar which consisted of 4 sessions in all.

The first session, devoted to *assignments*, went on to elaborate the multidisciplinary and the result-oriented nature of the real–life problem solving situations, and thus noted the need to ensure inter-disciplinary input at any PS station. It further suggested that the PS–II assignments could preferably be so identified that they could be the sub-problems of the long-term developmental project needs of the host organisations.

The second session dealing with the subject of *evaluation* insistently emphasised that the evaluation must be of a continual type. It was further suggested that through the PS type evaluation the employer could also be made aware of the students' professional capabilities*. The other theme mentioned was that the PS type evaluation scheme should be such that it helped students to discover themselves.

The third session collated the emerging *feedback* by observing that the sponsored research and consultancy could be obvious outcomes of a PS type interaction betweet the university world and the professional world. Another important suggestion made during the course of discussions was in terms of utilizing the PS educational infrastructure to initiate courses of studies in the professional world. Yet another interesting observation made during the course of discussions was the need to evolve a formal mechanism for receiving the feedback, and also the need to develop proper criteria for analysing the same, otherwise it was feared that often apparent difficulties might be confused with the feedback.

* It may be mentioned that from June 1979 onwards the Practice School Division is issuing a Practice School Transcript for each eligible student giving a complete record of his performance in PS-I and PS-II courses, along with the details of his rating sheet.

Finally, the fourth session concluded the seminar by recording the participants' fullest appreciation for the tremendous educational endeavour that had silently gone into the evolution of what in 1973 was a mere idea into a full-fledged educational experiment, in a short time span of only four years.

11. FEEDBACK AND THE VISION UNFOLDING

By any known norms, BITS has evolved through the Practice School Programme a vast infrastructure which can act as an effective meeting ground between the university world and the professional world. The feedback received in the process has been manifold.

Ever since the Practice School was started in 1973, it has caught the imagination of students. Those students who opted for this programme experienced the excitement and satisfaction that come when one transforms knowledge into performance, when one blends subjects learnt into techniques of action. An incident in this context is still fresh in the minds of the PS faculty entrusted with the responsibility for planning. During the PS-II session implemented at CEERI from June to December, 1974, one of the assignments was related to the problem of receiving Delhi TV signals at Pilani in a centralised way by erecting a relatively huge but adoptable structure for antenna site on the Institute Tower and retransmit the received signal, preferably on a different channel. After looking into various requirements from all angles, when the student - station matching was being done, it so happened that one final year B E. mechanical engineering student was allotted to the above assignment. As was natural the concerned student had too many pre-conceived notions about his profession and in whatever manner the Incharge, PS Programme argued his rationale of the assignment, the student just could not appreciate the same. During the summer of 1974 the Incharge, PS Programme was required to be away from the campus for quite some time in order to further expand the PS facility. Thus, by the time he returned to Pilani, the PS-II session had already started. It will not be too much to say that in some sense, the Incharge was just hoping that he would not run into the student, but then it could not be so as he had to come across him during his routine monitoring and control tasks. To his pleasant surprise he found the student smiling and declaring that the assignment provided him the fullest professional challenge. The group working on that assignment had decided their own target date for the completion of the work and it was a challenge to their ability to show on TV in Pilani the India-West Indies Cricket Test match

that was scheduled for Delhi in the middle of January, 1975. Needless to say, the team did it by designing, fabricating, and erecting the antenna as also the necessary booster amplifier. That day when the students were erecting the antenna, our 'mechanical' student was the leader of the team. He thought, planned and worked along with the Workshop Superintendent while the Incharge, PS Programme was keeping track of this entire process. To his utter shock, he found this student, shirtless and literally sweating even in that winter month, coming out from the man-hole located at a height of 142 ft. at the topmost point of the BITS Tower. The student stretching out from the man-hole was trying to support by both his hands the antenna structure that was being slowly raised by mechanical means. The Incharge PS, understandably, shouted asking the student not to bother about the structure but it did not deter the student and, while assuring the Incharge not to worry, he continued to do his job and that too with a broad, delightful grin.

Indeed, there are many similar other experiences to narrate. Further, a PS experience also seems to effectively help students in realising the role that any specialisation plays within the context of the totality of a given real–life problem solving effort.

As regards the nature of PS assignments, it is now clearly established that they are essentially multidisciplinary in character, thus demanding at PS stations student input belonging to a large number of disciplines.

In the Practice School, the studdet plays a dual role, both as a learner and an understudy. For students to effectively participate as contributors to such problem solving efforts, their training prior to PS programme must have a set of foundation years through which they are exposed to certain common subjects across the streams of engineering, science and humanities. Fortunately, the Institute's normal 5-year (4–year) integrated degree structure requires student exposure to core subjects irrespective of whether one is becoming an engineer, a scientist, a manager or a social scientist. The experience stretching over the last six years led us to the conclusion that the challenge of PS assignments could not have been met, if the Institute curriculum structure and integrated programme flow had not been done first.

Further, it is now confirmed beyond doubt that through the PS system of education it is possible to integrate the university educational process with that of the national economic construction. Another interesting observation emerging out of this concerns the fact that when entrusted with a professional responsibility in terms of PS assignments, students have displayed a sense of commitment and desire to

work, in a manner normally not noticed in the classrooms; thus, in turn enabling the educational process to bring the best out of them and help them develop self-confidence.

It will not be far from truth to say that in essence the PS type education basically throws more opportunities before a student. It makes it possible for, say, an engineering student to seek a flavour of a banking institution and simultaneously it allows an opportunity to, say, an economics student to have a taste of production process, and all this during the educational years themselves. Further, all these places where he goes are also the places where he is needed. In the process, new avenues open before the students, and new ideas about professional aspirations, however unconventional they night be, take birth in their minds. One important outcome of this seems to be that it helps lessen the unnecessary intra-professional competitions that have got generated over the years within the university campuses, particularly due to artificial market indicators; thus in turn creating the much needed harmony between students of different streams like engineering, science and humanities.

It is against the above background that one can further appreciate the role that the students have played as catalysts and protectors of this educational innovation. Indeed, this facet of their involvement in the system of higher education can certainly be seen as the single most important revelation that has come to all those who have been actively participating in this educational endeavour.

As regards the response from the professional world, the outstanding success of the programme itself speaks for it. Indeed, the Institute is proud of its PS association with 60 representatives of the professional world.

Even at the cost of repetition, it may be mentioned that the PS system of education is basically an effort towards further reforms in teaching methodology and the examination system. While in the case of teaching methodology it introduces a cognitive approach, the type of examination reform it calls for goes even beyond the efforts so far undertaken in the university system towards adopting internal system of evaluation. PS system aims at multi-objective evaluation of the student performance consistent with the rigours of continuous internal assessment.

In the process are emerging many new issues and challenges of education and evaluation to which the faculty are constantly applying their minds. For instance, what is the exact role of a teacher when students are working on a developmental

type activity ? What teaching techniques should be adopted when discussing problems of which the teacher himself does not know answers ? Can one really ever become a *specialist* within the duration of his degree programme ? How many courses should be taught before a student is considered ready for his profession ? Can a language teacher evaluate an engineering student working on, say, some feasibility study ? What are the characteristics of a leader ? Can, for example, a student of economics be declared a good candidate for working on the problems of international monetary system on the basis of his successful participation in the practice school project dealing with reduction of hostel mess bills ? What is there in mathematics that makes a student of this subject always shy away from even the thought of participating in an engineering project ? How to evaluate student performance when the final answer is known to none, including the teacher ? How to organize the classroom teaching so that various practice school problems are used as home assignments, bringing a touch of reality in the classroom and thus paving a path for writing better textbooks ? How to meaningfully use the practice school as a platform to involve professional experts in the projects such as course development, lab development, textbook writing and joint research activity, etc. ? Obviously, these are not simple questions.

Through the practice school, BITS has posed these problems to itself and is in the process of exploring their answers.

One can clearly abstract from the above feedback, that with the passage of time the PS, which itself is a product and beneficiary of the process of innovation, has slowly got transformed into a fountain head of innovation. As a result, today the Institute is poised to make four major thrusts of far-reaching consequences, namely, (i) initiating at practice centres, with the help of host organisations, collaborative programmes leading to master's and doctoral degrees, (ii) organizing at the campus, sponsored research schemes identified in terms of industrial/professional situations and problems, (iii) initiating the theme of consultancy and (iv) defining, in association with organisations like banks and agencies like NSS, a role for a technological university such as BITS in the task of the rural development.

To begin with, worry and concern has been expressed about the health of the Master of Engineering degree even at the most prestigeous universities in India. It is well established that it is difficult to attract the best undergraduate students to these programmes. Even those who seem to join this venture allured by the 100% scholarship, more often than not, fail to

complete the programme, and generally one is faced with a situation where the originally conceived high standards of education cannot be carried out. Like any other university, BITS has been concerned with this phenomenon and has now concluded that the salvation lies in the direction of building up on the base of the practice school system of education. After a dialogue with major employer groups, it has been discovered that there is a scope for training students on multi-disciplinary function-oriented tasks rather than merely add-on, the so-called advanced courses in the same discipline at the M.E. level. The four areas emerging in this context are Design & Project Engineering, Industrial Planning & Area Development, Industrial Production, Quality Control & Sales and Instrumentation Engineering.

The proposal being evolved* is to start in the above areas collaborative programmes of education at the post-graduate and doctoral degree levels, wherein the courses will be taught jointly by BITS teachers and scientists and engineers as well as social scientists drawn from the collaborating organisations. The venue of these classes by necessity would be right in the premises of the collaborating organisations, which would be gladly meeting the substantial part of the cost.

These degrees are proposed to be postgraduate as they are designed on the basis of an understanding that the entry qualification would normally be one of the five year integrated first degrees of BITS, whether in engineering or sciences or social sciences like management and economics. The design of each degree will be based on a certain prior preparation in respect of special subject matters.

The degree will be of two years' duration. The first year will be devoted to specific course work while the second year will be entirely devoted to supervised internship. In regard to course work, the method of teaching will adopt a process which encourages self-study, discussion, seminars and using cases for pursuit of studies. The course work will be conducted jointly or discretely both by BITS faculty stationed in these towns already in connection with the BITS practice school activity as well as professional experts from the collaborating organisations. It is hoped that during the period of the degree, the scholarships for students would be coming from the organisations participating in these programmes.

* M.E. (Collaborative) programmes have since been launched at Bombay, Calcutta and Nagda PS Centres from July, 1979.

As regards admission to the programme, it is proposed that it will be made by BITS through an All-India advertisement. But in the process of admission a nominee of the collaborating organisation would be a party. It is further proposed that the collaborating organisation itself may decide to sponsor its own selected persons for working towards these degrees. It is obvious that when a collaborating organisation sponsors one of its own employees for such a degree, it would be the decision of the employer as to whether this candidate gets a scholarship or continues to draw full pay.

Indeed, it was as early as its July, 1966 meeting that the AICTE strongly recommended the creation of circumstances whereby a two-way traffic could be established between industry and university, making it possible, amongst other things, for professional experts to come before university students in the capacity of teachers. The structure of the collaborative master's and doctoral programmes described above makes in every sense of the word this dream of our educational planners look a reality. However, what is even more important is that in the process the structure also provides the professional world the much needed opportunity to join hands with the academic community to evolve a relevant and self-reliant model of post-graduate education.

The second thrust now emerging is in terms of the theme of sponsored research. Indeed, the professional interaction through the Practice School scheme has brought about such mutual understanding, enlightenment and respect that many host organisations are now proposing to sponsor specific area-wise research projects at the BITS campus. It is understood that the advancement of knowledge and the pursuit of investigation of a problem differ in their styles of implementation, depending on whether the problem is of an immediate trouble shooting variety or requires a more leisurely and scholarly pursuit without the tension of meeting a deadline as required in a production plant. The BITS and these organisations have been able to separate these problems in such a way that something can be effectively studied and investigated right in the plant only and some other problems may better be investigated in a different climate like the one on the campus. This development together with the perception of BITS in terms of what role it can play in the activities of research relevant to the Indian scene has helped BITS to define certain broad areas of research, instead of allowing all things to be done at the same time. Some of the areas thus identified are: Solar Energy, Waste Treatment, Water Management in Semi-Arid Zone, Detailed Engineering and Associated Management Problems, Management

Information Systems, and Science Teaching, etc.

At least in one area, namely, Solar Energy, the style and methodology adopted by BITS appear to have attracted spontaneous and respectful interest from overseas. The University of Chicago and BITS are now in the process of working out mutually reinforcing and complementary research programmes in the area of Solar Energy.

Another important thrust emerging is in terms of initiation of consultancy activity at the Institute. In specific terms, while carrying on the dialogue on collaborative master's and doctoral education, certain sponsoring organisations discovered that they had reasons for supporting this programme inasmuch as it would help them in terms of their two-fold need, namely, (i) future manpower development for well-defined professional functions and (ii) in-house training of the personnel of their organisation. Thus one such organisation has come forward with a proposal that BITS be their permanent educational consultant to assist them in terms of conducting their in-house training programme. In another situation, based on the expertise developed by the Institute through PS experiences, one of its host organisations from the banking world has approached the Institute for taking up consultancy work in the area of preparation of Credit Plans. Another theme of consultancy emerging is from the side of the Ministry of Education which suggests that possibly the principles of teaching and learning evolved in the process can be applied to the tasks of introducing socially useful and productive work (SUPW) and vocationalisation schemes at the school level. Yet another consultancy project emerging is in the area of evolving methods for functional literacy.

Finally, just as the methodology of the educational process aimed at through involvement in Practice School activities makes no distinction between one discipline and another, similarly from the point of view of productive and developmental work the Practice School Programme does not make any distinction between a sophisticated industry and the village situation. In the process, instead of merely adopting a village and demonstrating an attitude of paternalism, BITS has been able to modify, by establishing a practice station in a village situation, its academic rhythm in order to encourage such students, who care to go to the village to pursue their rural-biased investigation or project work in terms of their own professional goals, tasks and degree requirements. Perhaps it is the only university in the country which has moulded the NSS activity from mere casual involvement to an

authentic professional experience integrated with the process of university degree education. On the surface, this process does not seem to be as glamorous as the NSS presence of other universities through adopted villages. However, from what can be seen, the Institute has already harvested rich dividends through its practice school oriented approach towards rural involvement. In fact, this approach has enabled the Institute research efforts in Solar Energy and Waste Recycle to distinctly identify certain innovative processes, through which new technologies can be discovered and diffused in the country side. Similarly, the Bank of Baroda, through its sponsorship of the round-the-year Practice School activity in its lead district of Jhunjhunu where BITS is located, has recently joined it in the task of delineating new theories of rural development through concrete actions relevant to the past traditions as well as future aspirations of the society.

Indeed, it was through the Forward Plan of 1970 that the Institute had promised the above mentioned directions for itself, and within 8 years from then this promise stands fulfilled. It may be interesting to recall that the concept of Practice School as a workable method of education was initiated and perfected more than half a century ago by the Chemical Engineering Department of MIT, USA. BITS was initiated into this concept, across the university level, through a Ford Foundation supported project of collaboration with MIT in 1964. Even though this programme for Chemical Engineering has been highly successful at MIT, it (MIT) was never able to extend the same to other disciplines. Thus, BITS has transformed a nascent thought and concept borrowed from the Chemical Engineering Department of MIT, USA into something deeper, bigger and wider than what MIT has even been able to think or do. Therefore, it is no wonder that recently it has been possible for MIT & BITS to agree to a new linkage in the area of Practice School activity, where BITS's ability to give something to MIT is recognised. One of the fundamental aspects of this proposed linkage would be an opportunity for Practice School students of MIT to undergo their Practice School course requirements at BITS and *vice versa*. As a natural corollary it then follows that such a Practice School collaboration between BITS and MIT would then have a provision by which BITS students during their stay away from the campus would be graded by MIT professors, while MIT students during their stay at BITS practice stations would be examined and graded by BITS teachers; both universities agreeing to accept these grades for the fulfilment of their respective degrees. This provision will also be available for rese-

arch linkage mentioned earlier with the Chicago University in the field of Solar Energy. Further, the Institute has also taken steps to establish research linkage with MIT on lines similar to those with Chicago University.

This then is the vision unfolding before the Institute. The PS programme has played a pivotal role in the process. As a result, today it has become a way of life with the Institute.

12. CONCLUSION

It will not be far from the truth to say that, if abstracted, the entire case study of the industry–university collaboration in some sense describes an approach to the institutional development. The need for an innovation constitutes an integral part of any development. The world 'innovation' connotes 'to come upon' and it can never be divorced from practice. The desire to act is fundamental to practice and any action, no matter what its specific content, always establishes relationships, and there is an inherent tendency to force open all limitations and cut across all boundaries. It is in this context that one can see why any task of institutional development necessarily, in the ultimate analysis, becomes a wavefront setting a chain reaction of processes where every process is the cause of new processes. In such a case, then, the task of the institutional development assumes the nature of continuing adaptation and change of configuration. In such a dynamic process of a unity of movement where change begets change, it is difficult to say exactly what the next milepost would look like. Certainly difficult are such tasks to face but then they are the challenges of life.

APPENDIX–11

Practice School–I Growth Statistics

Sessions	No. of students who attended PS-I	%	No. of faculty who supervised PS–I	No of stations attended by PS-I students
Summer, 1973	15	(6%)	04	01
Summer, 1974	89	(39%)	17	09
Summer, 1975**	244	(85%)	26	14**
Summer, 1976	355	(94%)	33	28
Summer, 1977	349	(94%)	32	38
Summer, 1978	335	(94%)	35	38
Summer, 1979*	490*	(101%) $	50*	55*

* Figures are projected based on actual planning exercise carried out as early as Feb., 1979.

% Percentage of Practice School students to the total 3rd year students.

** As described in Section 8, a part of this summer session was implemented in Dec. 1975. Including the additional PS–I stations implemented in Dec. '75 the number of PS–I stations for 1975 becomes 16.

$ Number includes some students who were in fourth year and could not go to PS–I in the previous year.

APPENDIX-1.2

Practice School-II Growth Statistics

Sessions	No. of students who attended	No. of faculty who supervised PS-II	No. of stations attended
Jan. '73-June '73	10	04	01
June '73–Dec. '73	12	04	01
Jan. '74–June '74	12	08	01
June '74–Dec. '74	36	05	06
Jan. '75-June '75	56	15	09
June '75–Dec. '75	31	06	05
Jan. '76–June '76	75	12	15
June '76-Dec. '7	121	18	15
Jan. '77-June '77	110	21	18
June '77–Dec. '77	151	16	16
Jan. '78–June '78	159	19	20
June '78–Dec. '78	166	23	20
Jan, '79-June '79	171	23	26
*June '79-Dec. '79	162*	23*	26*
*Jan. '80–June '80	162*		

* Figures are based on actual planning excercise carried out as early as Feb., 1979.

APPENDIX-1.3

Distribution of Practice School–II students discipline-wise from 1973 to 1979

Year	Engg.	Science	Econ.	Mgts	English	M. Tech. Instr	M. Tech. C.S.	M. Tech. MSMS	M. Tech STD	Pharmacy
1973	22	–	–	–	–	–	–	–	–	–
1974	48	–	–	–	–	–	–	5	–	6
1975	70	-	–	–	–	6	–	–	–	14
1976	109	13	5	40	–	7	3	–	–	8
1977	163	36	7	40	–	1	4	2	–	12
1978	179	55	24	41	2	6	2	1	4	15
1979	201	46	23	28	6	9	8	–	–	

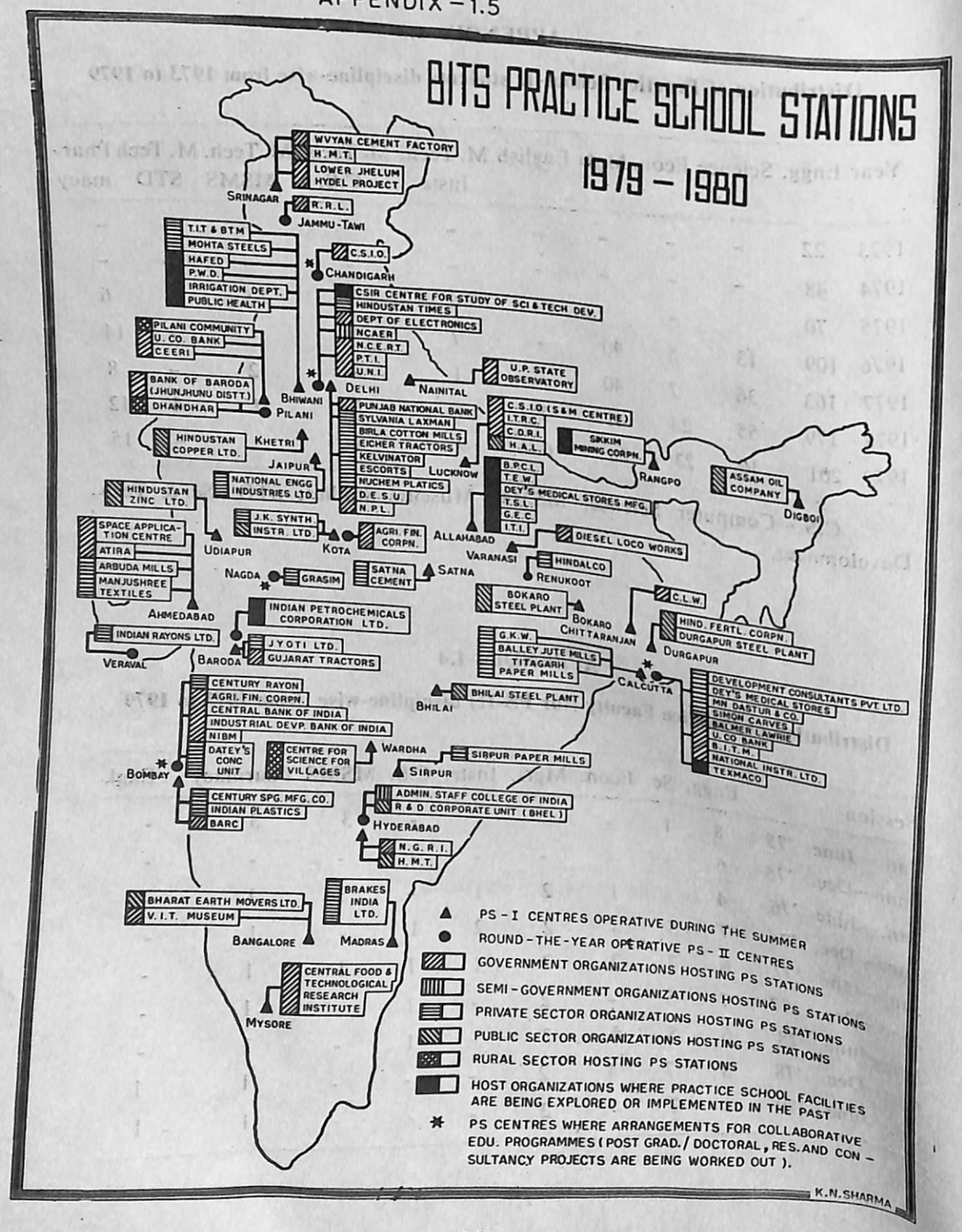
C.S.=Computer Science; MSMS=Museum Studies; STD=Sc. & Tech. Development.

APPENDIX-1.4

Distribution of Practice Faculty (for PS-II) discipline-wise from 1975 to 1979

Session	Engg.	Sc.	Econ.	Mgts.	Instr.	C.S.	MSMS	Pharmacy	Engl.
Jan.—June '75	8	1	-	-	-	-	3	3	-
June—Dec. '75	6	-	-	-	-	-	-	-	-
Jan.—June '76	4	-	1	2	1	-	3	1	-
June—Dec. '76	7	5	-	2	2	1	-	1	-
Jan.—June '77	6	7	2	2	1	1	1	1	-
June—Dec. '77	7	5	-	2	-	1	-	1	-
Jan.—June '78	6	5	3	3	-	1	-	1	1
June—Dec. '78	8	7	4	2	-	-	-	1	1
Jan.—June '79	8	7		2	-	-	-		

APPENDIX – 1.5



APPENDIX-1.6

Classification of PS Stations implemented from 1973 onwards

(i) Production, Manufacturing & Public Works Units

Hindustan Copper Project (Khetri), Textile Institute of Technology (Bhiwani), Irrigation Department (Bhiwani), Building & Road Department (Bhiwani), Public Health Department (Bhiwani), Century Spinning Manufacturing & Weaving Co. Ltd. (Bombay), Indian Plastics (Bombay), Colour Chemicals (Bombay), Calico Chemicals (Bombay), Hardellia Chemicals (Bombay), Mukund Iron & Steel Works (Bombay), Diesel Loco Works (Varanasi), Birla Cotton Mills (Delhi), Chittaranjan Loco Works (Chittaranjan), Delhi Electric Supply Undertaking (Delhi), Fertilizer Corporation of India (Durgapur), Indian Telephone Industries (Allahabad), Triveni Structurals Ltd., (Allahabad), Triveni Engineering Works (Allahabad), Bharat Pumps & Compressors (Allahabad), Hindustan Steel Plant (Durgapur), Hindustan Steel Plant (Bhilai), Hindustan Steel Plant (Rourkela), Assam Oil Company (Digboi), Sikkim Mining Corpn. (Rangpo), Satna Cement Works (Satna). Hindustan Aluminium Corpn. (Renukoot), Ahuja Radios (Delhi), Gwalior Rayon (Nagda), Century Rayon (Kalyan), Hind Motors (Calcutta), Texmaco (Calcutta), Hindustan Zinc (Udaipur), Singh Alloys & Steel (Calcutta), Guest Keen and Williams (Calcutta), Bally Jute Mills (Calcutta), Indian Rayon Corpn. (Veraval), Dey's Medical Stores (Mfg.) Ltd. (Calcutta), Dey's Medical Stores (Mfg.) Ltd. (Allahabad), Western Railway Workshop (Ajmer), Bharat Electronics Ltd. (Bangalore), Escorts Ltd. (Faridabad), Hindustan Kokoku Wires Ltd. (Faridabad), Universal Electric Co. (Faridabad), Indian Tobacco Co. (Saharanpur).

(ii) Design, Development & Consulting Organisations

National Institute of Bank Management (Bombay), Engineers India Ltd. (Delhi), Engineering Projects India Ltd. (Delhi), Industrial Consulting Bureau (Delhi), MM Suri & Associates (Delhi), Indian Oil Corporation (Delhi), MN Dastur & Co. (Calcutta), General Electric Company (Calcutta), Energy Systems & New Products Division of B.H.E.L. (Delhi), Administrative Staff College of India (Hyderabad), Development Consultants Pvt. Ltd. (Calcutta), Bridge & Roof Co. (Calcutta), National Council of Applied Economic Research (Delhi), Research & Development Wing of B.H.E.L. (Hyderabad), Department of Electronics of Govt. of India (Delhi), National Instruments Ltd.,

(Calcutta), Balmer Lawrie & Co. (Calcutta), Simon Carves (I) Ltd. (Calcutta).

(iii) National Research Laboratories

Solid State Physics Laboratory (Delhi), Central Electronics Engg. Research Institute (Pilani), Regional Research Laboratory (Jammu), Central Scientific Instruments Organisation (Chandigarh), All-India Institute of Medical Sciences (Delhi), Indian Agricultural Research Institute (Delhi), National Institute of Oceanography (Goa), National Physical Laboratory (Delhi), Central Drug Research Institute (Lucknow), Central Food Technological Research Institute (Mysore), Bhabha Atomic Research Centre (Bombay), Regional Research Laboratory (Hyderabad), National Geophysical Research Institute (Hyderabad), U.P. State Observatory (Nainital), C.S.I.R. (Delhi).

(iv) Banks

Central Bank of India (Bombay), State Bank of India (Bombay), Union Bank of India (Bombay), Agricultural Finance Corporation (Bombay), United Commercial Bank (Calcutta), Industrial Development Bank of India (Bombay).

(v) Publishing House & News Agency

The Hindustan Times (Delhi), United News of India (Delhi), Press Trust of India (Delhi).

(vi) Museum

Birla Industrial & Technology Museum (Calcutta).

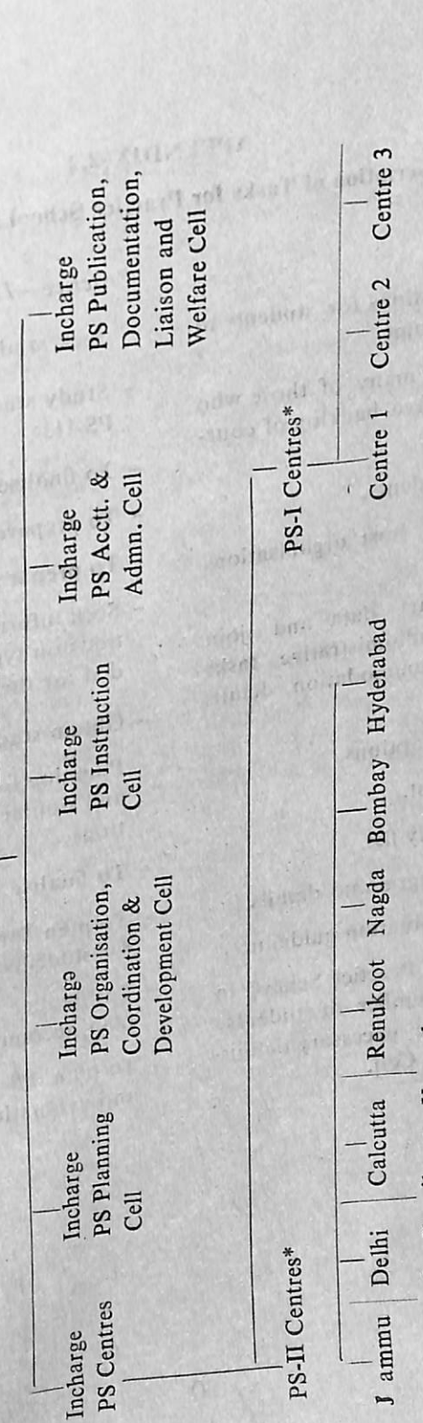
(vii) Village

Dhandhar village about 5 kms. from Pilani. Jhunjhunu and Churu District PS-II stations in association with Bank of Baroda (Bombay).

APPENDIX-2.IX-2.1

Practice School Division

Organisation Chart



* These are located where corresponding practice stations are situated.

APPENDIX-2.2

Description of Tasks for Practice School Planning Cell

Practice—I

- Issue of applications for students to join PS programme.
- Data on how many of those who apply would have backlog of courses till 3rd year.
- Selection of students.
- Finalization of host organisations for PS-I.
- Provide necessary data and join Incharge, PS administrative tasks to work out accommodation details for PS-I.
- Seeking student options.
- Student allotment.
- To finalise faculty list.
- To plan PS-I programme details.
- To plan PS-I Evaluation guidelines.
- To plan for Mini-Practice School in terms of exact number of students, etc. and give the necessary details to PS Instruction Cell.

Practice—II

- Seek student bio-data.
- Study student eligibility to attend PS-II.
- To finalise list for PS-II.
- To prepare student profiles.
- To prepare problem bank.
- Seek information from practice stations on type of student input needed for the problem bank.
- Obtain student preferences.
- Planning for any library, equipment and similar other facilities at stations.
- To finalise student allotment.
- To plan for accommodation needs for students.
- To finalize faculty allotment and plan accommodation needs.
- To plan PS-II programme content and evaluation guidelines.

APPENDIX-2 3

Description of Tasks for Practice School Organisation, Co-ordination and Development Cell

- To co-ordinate and organize various practice school activities.
- To continuously monitor the entire canvas of the practice school in terms of operation, education, physical facilities, future growth, orientation, etc.
- Based on continuous interaction with Practice faculty and based on feedback obtained from students and host organisations to see how content of education and evaluation in practice school can be further strengthened.
- To analyse student grades in Practice-I and Practice-II.
- To strengthen interaction of PS Division with Educational Development Division through initiation of preparation of textbooks, supplementary reading material, lecture notes, case-studies, etc. based on practice school work.
- To organise collaborative post-graduate programmes at Practice Centres.
- To strengthen interaction between R & C Division and PS Division.
- To identify general research areas and specific schemes of interest to host organisations and BITS.
- To organize seminars, conferences, and get-togethers between students, faculty and professional experts.
- To arrange computerization of student profiles.
- To integrate NSS and NCC activities with Practice School.
- To identify manpower needs and take steps to meet them.

APPENDIX-2.4

Description of Tasks for Practice School Instruction Cell

Tasks would cover the entire educational operation of PS-I and PS-II, some of the main details of which are mentioned below :

- Registration of students for PS-I as well as PS-II.
- Progress Reports of PS-I and PS-II.
- Monitoring of PS-I and PS-II course handouts.
- Implementation of Evaluation Guidelines.
- Preparation and monitoring of Practice School Calendar.
- Mid-term Evaluation.
- Receiving of final grades, practice assignment reports and rating sheets from Practice faculty.
- Analysis of grades and their submission to Examination Committee.
- Preparation and despatch of Practice School Transcripts.
- Binding of Practice School Reports and submitting them to Central Library.
- Updating of Practice School proformas.
- Monitoring of feedback from PS-I and PS-II.
- Identification of library, equipment as well as other needs at practice stations in terms of details like space for seminars, group discussions, accommodation, etc. and accordingly to work out operational details.
- To implement "Projects in Engg. Practice", that is, Mini Practice School, in close liaison with Research & Consultancy Division and Instruction Division.
- Orientation for students and faculty.

APPENDIX 2.5

Description of Tasks for Practice School Accounts & Administration Cell

- Entire PS accounts for PS-I and PS-II as well as PS Office.
- To work out accommodation requirements for PS-I and PS-II.
- Office facilities like typing, stationary, postage, staff, etc. at Practice Centres as well as at the Institute.
- Financial implications in terms of library facilities, equipment needs, physical facilties like space for seminars, group discussions, etc.
- Educational facility for Practice faculty children.
- Medical facilities for Practice faculty as well as PS nucleus.
- Financial needs of inspectional visits to stations.
- Dislocation needs.
- Financial needs in terms of field trips, attending of conferences, etc. by practice faculty.
- Practice School allowance, salary statements for PS nucleus and PS faculty.
- Travelling allowance.
- Leave applications, joining reports, student dues, etc.
- Student scholarships. Any other normal PS administrative routine matter.
- Printing activities and purchase details.
- Updating information about details like facilities for student and faculty at practice stations in terms of out-of-pocket allowance, free accommodation, subsidised lunch, etc,

APPENDIX-2.6

Description of Tasks for Practice School Publication, Documentation, Liaison and Welfare Cell

- Publication of Practice School Bulletin.
- Classification of Practice assignments in terms of their usefulness in enriching teaching and research efforts at the Institute.
- Documentation of Practice School reports.
- Preparation of various reports and monographs based on the work done at practice stations.
- To undertake liaison activities with students, practice faculty and host organisations at various levels.
- To look into details concerning student and faculty welfare needs at practice centres.

APPENDIX-2.7

Description of Tasks for Faculty Members Incharge of Various PS Centres

- To conduct Practice School Programme at PS-I and PS-II centres as per the programme guidelines.
- To continuously interact with PS Division.

APPENDIX-3.1

A Typical Semesterwise Practice School Activity Chart

January, 1979

Wed. 3 PS-II Registration (SA), PS-II work starts (SA), Finalization of PS-II profiles for June - December, 1979 (DA).

Fri. 5 Reminder to PS-I stations (DA).

Mon. 8 Last date for PR-I (SA). Coding of PS-II feedback (DA).

Tue. 9 Finalization of PS faculty (DA).

Thu. 11 Last date for distribution of PS-II course handouts and a copy to the Division (SA), Analysis of PS-II Feedback (DA).

Mon. 15 Documentation of PS-II reports (DA).

Wed. 17 Last date for PR-2,3, & 4 (SA).

Sat. 20 Initiation of problem bank for June-Dec., 1979 (DA).

Wed. 31 Last date for PR-II (SA).

February, 1979

Sat. 17 Last date for PR-5,6 (SA).

Wed. 28 Last date for PR-II (SA).

March, 1979

Thu. 1 Last date for despatching problem bank from PS-II stations (SA).

Fri. 9 Display of PS-I stations list and issuing of preference forms (IA).

Tue. 20 Last date for receiving PS-I preference forms (DA).

Thu. 22 Last date for displaying mid-term grades at PS-II stations (SA). Last date for PR 7, 8 (SA).

Sat. 31 Last date for PR-II (SA).

April, 1979

Mon. 2 PS-I station allotment and information to students (DA).

Fri. 6 Display of PS-II problem bank and issue of preference forms for June-December, 1979 (DA).

Wed. 11 Letters to PS-I stations and respective accommodation authorities (DA).

Mon. 16 Last date for receiving PS-II preference forms (DA).

Fri. 27 Last date for PR-9, 10 (SA).

Mon. 30 PS-II station allotment for June-Dec. 1979 (DA). Last day for classwork. Last date for PR-II (SA).

May, 1979

Tue. 1 Preparation and submission of vacation faculty list (DA).

Mon. 7 Letters to all PS-II stations about the student and faculty (DA)

Thu. 24 PS-I starts (SA). Summer Term begins.

Thu. 31 Last date for PR-II (SA). Distribution of feedback questionnaire to students (SA).

June, 1979

Sat. 2 Last date for PR-I from PS-I stations (SA).

Fri. 8 Issue of 'No Dues' forms to PS-II students (SA).

Sat. 16 PS-II ends (SA).

Tue. 19 Last date for despatching grades, rating sheets, dues information, project reports and PR-11,13,14,15,16 (SA).

Sat. 23 Last date for submitting PR-2,3 from PS-I stations and display of mid-term grades (SA).

Mon. 25 Submission of grades and dues list for PS-II (DA).

July, 1979

Mon. 2 PS-II registration (SA). PS-II work starts (SA).

Fri. 6 Last date for PR-I (SA).

Sat. 7 Preparation of PS-II profiles for Jan-June, 1980 (DA).

Mon. 9 Last date for the distribution of handouts and a copy to the Division (SA).

Mon. 16 Coding of PS-II feedback (DA). Last date for PR-2,3, 4 (SA).

Wed. 18 PS-I ends (SA). Analysis of PS-II feedback (DA).

Thu. 19 Initiation of problem bank for Jan-June, 1980 (SA/DA).

Sat. 21 Finalization of PS-II profiles for Jan-June, 1980 (DA).

Mon. 23 Last date for PR-4,5, grades, project reports, dues list from PS-I (SA).

Wed 25 Documentation of PS-II reports (DA).

Sat. 28 Submission of grades and dues list for PS-I (DA).

Tue. 31 Last date for PR-II (SA).

SA — Activity at the Station.
DA — Activity at the Division.
IA — Institute activity.

APPENDIX-3.2

Semesterwise activity calendar for a typical PS-II station as illustrated for BITS PS station at Gwalior Rayon, Nagda

January

3 Students' Registration
Handouts distribution to students
Project allotment

4 Lectures by host organisation personnel about the industry

5 Plant visit for students starts

8 *Last date for PR-1

11 *Last date for handout

12 Discussion & presentation by students on orientation

15 *Faculty meeting
Submission of orientation report by students

17 *Last date for PR-2,3 & 4

23 Despatch PRACTICIANA Bulletin

27 Open House Meeting

30 Quiz I

31 Lecture I of lecture series
*Despatch PR-11

February

5 *Faculty meeting

17 *Last date for PR-5 & 6

19 *Faculty meeting

23 Despatch PRACTICIANA Bulletin

24 Open House Meeting

28 Lecture II of lecture series
*Despatch PR-11

March

1 *Last date for problem bank

5 *Faculty meeting

7 Seminar

8 Seminar

9 Seminar

12 Mid-term report due

13 Viva

19 *Faculty meeting

22 *Last date for announcing mid-term grades & despatching PR-7 & 8

23 Despatch PRACTICIANA Bulletin

31 Lecture III of lecture series
Open House Meeting
*Despatch PR-11

April

2 *Faculty meeting

16 *Faculty meeting

23 Despatch PRACTICIANA Bulletin

27 *Last date for PR-9 & 10

28 Open House Meeting

30 Lecture IV of lecture series
*Despatch PR-11

May

7	*Faculty meeting
21	*Faculty meeting Submission of first rough draft of final project report
23	Despatch PRACTICIANA Bulletin
26	Open House meeting
31	Lecture V of lecture series *Despatch PR-11 Distribute feedback questionnaire to students

June

5	*Faculty Meeting
8	Issue of no dues forms to students
11	Seminar
12	Seminar
13	Seminar
15	Quiz
16	Viva. No dues clearance End of Semester for PS-II students
19	*Last date for despatching rating sheets, project reports, PR-11, 13, 14, 15, 16 (A & B) & other materials
23	Despatch PRACTICIANA Bulletin

* Not applicable to students.

Notes :

1. Meetings of the Tech. Cell with individual groups will be held once a week. Details will be announced after project allotment.
2. Practice School will remain closed on factory holidays.

APPENDIX-4.1

A Typical PS-I Evaluation Scheme as Implemented in Summer, 1973

		Marks
Evaluation Scheme		
1.	Assignments given in terms of 'Exercises' were evaluated in the following manner :	
	(a) Report Writing (i) Exercises 1 to 4 of the orientation type spread over total duration of 20 days. Evaluation on group basis.	20
	(ii) Exercises from 5 to 10. Here ideas are of importance. Total duration 15 days. Evaluated on individual basis.	15
	(b) Diary. Every student was required to keep a diary which consisted of day to day observations.	05
2.	Oral presentation of Group Reports. The exercise work tackled in groups. Each group had a leader who had total responsibility of the assignment. It is the leader who also had the responsibility of presenting the 'Exercise'. During the entire summer term one student gets about four chances to present oral reports.	10
3.	Participation. Every student's participation in his own group's work as well as in the activities of other groups was judged.	20
4.	Personal Characteristics. During the discussions which could be arranged for an hour almost daily every student was evaluated for the following characteristics : (a) Leadership (b) Sense of responsibility (c) Cooperation (d) Initiative (e) Regularity and progress of the group.	15
5.	Quizzes and Short Reports. In two months about 2 quizzes and 7 short reports were written based on visits to various departments of the organisation.	15
	TOTAL MARKS	100

APPENDIX-4.2

A Typical PS-1 Evaluation Scheme as Implemented from Summer 1974

Evaluation Scheme	*Marks*
1. Quiz on 'Know your Organisation'	10
2. Quiz on Gap Lectures	10
3. Assignment Evaluation (Except for the last assignment)	
(i) Knowledge and application of scientific fundamentals	12
(ii) Knowledge of technological operations	12
(iii) Oral Presentation	10
(a) Self-expression	
(b) Material organisation	
(c) Black-board presentation	
(d) Participation	
(e) Platform manner	
(iv) Written Presentation	12
(a) Presentation scheme	
(b) Preciseness	
(c) Logical development of argument	
(d) Force of expression	
(v) Sense of responsibility	03
(vi) Initiative	03
(vii) Co-operation	03
(viii) Leadership quality	03
(ix) Industry	02
4. Open-ended project, i.e. Final assignment evaluated for 'Ideas'	10
5. Diary. Student is required to keep a diary which incorporates his day to day observations.	10
Total marks	100

APPENDIX-4.3

Practice-II Evaluation Scheme as Implemented during 1973-75

I. Weightage	5%
[i] Know your factory [Orientation]	5%
[ii] Gap Lectures	90%
[iii] Projects [to be equally weighted]	
II. Evaluation Scheme	
[a] Know your faculty and gap lectures will be evaluated through quiz/viva.	
[b] Each project will be evaluated once/twice during the course of the project and at the end of the project in respect of the following items with weightages indicated against each.	
1. [i] Knowledge and application of engineering fundamentals	10
[ii] Engineering judgement and decision making	10
[iii] Leadership	04
[iv] Co-operation	04
[v] Sense of responsibility	04
[vi] Initiative	04
[vii] Industry	
2. Quiz/viva conducted during the course of the project.	10
3. Oral Presentation* of the Progress Report during the course of the project.	10
4. (i) Written presentation**	20
(ii) Conclusions and recommendations.	10
(iii) Final oral presentation.	10
Total	100

* Oral Presentation will be judged in respect of :
(i) Self-expression, (ii) Material organisation
(iii) Black-board organisation (iv) Technical quality of answers.
(v) Participation [vi] Platform manners.

** Written presentation will be judged in respect of :
[i] Presentation scheme. [ii] Preciseness.
[iii] Logical development of argument. [iv] Force of expression.

APPENDIX - 4.4

BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI (RAJASTHAN)
EVALUATION SCHEME FOR PRACTIC SCHOOL -II

Practice Station : _____ Academic Year : _____
Name of the Student : _____ Student Discipline : _____
ID Number : _____ Practice Component Attended : _____
Practice Course No _____

EVALUATION METHOD / STUDENT CHARACTERISTICS	QUIZZ		VIVA			SEMINAR				GROUP DISCUSSIONS			PROJECT REPORT				OBSERVATION	DIARY	TOTAL	
	Knowledge	Application	Knowledge	Originality	Expression	Technical Credibility	Expression	Communication	Organisation of material	Inteuectual Ability	Creativity	Approach to Problem Solving	Group Behaviour	Technical Credibility	Methodology	Documentation	Recommendations			
1. Knowlodge of Concepts																				
1.1 With which he is already familiar	3		1			3								2					9	
1.2 Newly introduced at Practice School	4																		4	
1.3 Depth of Knowledge			1											1					2	15
2. Application of Principles																				
2.1 In a given situation		5				2													7	7
3. Intellectual Ability																				
3.1 To comprehend & act in new situations		1				1				2									4	
3.2 To follow logical path in problem solving		1	1											3					5	9
4. Creativeness & Originality																				
4.1 Conceiving new and unusual ideas	1			1						2				2					6	
4.2 Suggesting Practical and Good Solutions											1				2				3	9
5. Professional Judgement & Decision Making Ability							2									3			5	
5.1 In evaluating alternatives.																				5
6. Interdisciplinary Approch																				
6.1 Broad-based Knowledge							1							1		1			3	
6.2 In problem Solving situation														2		1			3	6
7. Skills for Data-Handling																				
7.1 Understanding of data gathering/processing techniques												1		1					2	
7.2 Choice of Measurement tools												1		1					2	
7.3 Skills for hardware implementation														1					1	5
8. Documentation																				
8.1 Review of literature							1							2					3	
8.2 Organizing the material									1							2	1		4	7

P.T.O.

EVALUATION METHOD / STUDENT CHARACTERISTICS	QUIZZ		VIVA			SEMINAR				GROUP DISCUSSIONS			PROJECT REPORT				OBSERVATION	DIARY	TOTAL	
	Knowledge	Application	Knowledge	Originality	Expression	Technical Credibility	Expression	Communication	Organisation of material	Intellectual Ability	Creativity	Approach to Problem Solving	Group Behaviour	Technical Credibility	Methodology	Documentation	Recommendations			
9. Self-Expression					1														1	
9.1 Conveying ideas clearly							2									2			4	
9.2 Delivery & style of presentation							2												1	
9.3 Language								1											1	
9.4 Black-board presentation								1											1	
9.5 Platform manners								1											1	10
9.6 Introducing & ending of the presentation													2				1		3	3
10. Initiative																				
10.1 In taking lead in problem solving situations.																	3		3	3
11. Self-Reliance																				
11.1 Confidence in one's own abilities													2				1		3	3
12. Co-operation :																				
12.1 With group/Instructor & organisation																	2		3	
13. Leadership																				
13.1 Organizing the efforts of the group						1							2				1		3	
13.2 Moderating discussions								1									1		1	7
13.3 Inspiring the group members																				
14. Industry :																				
14.1 Making forceful efforts to know more																		2	2	3
14.2 Desire to exceed minimum effort expectation												1							1	
15. Sense of Responsibility																				
15.1 Reliability in meeting problem objectives																	1	1	2	5
15.2 Planning & meeting deadlines																	1		3	
15.3 Punctuality													2							3
16 Social Sense																				
16.1 Ability to create good impression and to act accordingly																				
TOTAL	8	7	3	1	1	11	4	4	1	2	3	2	8	3	11	6	5	15	5	100
	15		5			20				15				25				15	5	

Date : _____

Signature of Instructor-in-charge

APPENDIX-4.5

RATING SHEET - Office Copy PRACTICE COURSE.....

[To be filled in triplicate. One copy to be retained at Practice Station and remaining two to be returned to Practice School Division Office along with student grade]

Name.....ID.No.....Year.....Semester.....

Practice Station :.....Degree.....Discipline.....

Please rate the student by tick mark (√) in the appropriate column.

Personality Traits	Excellent	Good	Average	Poor	V. Poor
1. Knowledge and Application of Fundamental Principles					
2. Intellectual Ability					
3. Creativity and Art of Guestimation					
4. Professional Judgement					
5. Problem Solving Ability					
6. Decision - making Ability					
7. Ability to Communicate					
8. Initiative and Self-reliance					
9. Team work					
10. Leadership					
11. Punctuality and Ability to Meet Deadlines					
12. Sense of Responsibility aud Common Sense					

Please check traits which best describe personality.

Confident Poised & Curteous	Should be less aggressive	Pleasant curious & forceful	Should be friendlier with group	Likeable	Should be more aggressive

Indicate work for which he is best suited. Check only one or indicate order of choice.

Research.....Development.....Teaching..... Design.....

Production.....Sales & Marketing.....Finance..... EDP.....

Scientist.....Journalist .....Other.....

If necessary, you may elaborate on your reasons for above ratings and add any further comments you may have. Use the back of this sheet, if needed.

Grade Obtained at Practice Course.....Signature of Instructor-in-charge

Name.....

Date.....

APPENDIX-4.6

Some Important and Relevant Academic Regulations for PS Programme

(a) Clause 22.2

In all practice school courses also the continuous evaluation enunciated in clause 13 of Academic Regulations will be followed. Since the educational processes in the practice school courses seek out and focus attention on many latent attributes which do not surface in the normal classroom situation, the process of evaluation in the practice school courses should be designed with care so that information on a continuous basis on the following attributes becomes available: intellectual ability; team work; leadership; initiative; personality; professional judgement; common sense; problem solving ability; sense of responsibily; decision making ability; art of guestimation; punctuality; ability to meet deadlines; ability to communicate through oral and written presentations, etc. Each such student may also be given a statement describing qualitatively the degree to which these attributes have been demonstrated by him in the course.

(b) Clause 22 4

Since the practice school programme interfaces with the world outside the campus and is heavily committed, whenever the progress of a student in any practice school course is found unsatisfactory aud his conduct unworthy of the professional world, his registration may be cancelled and he may be required to transfer to the non-practice school programme without assigning any reasons. All the rules of transfer will apply as usual.

(c) (i) Such of those 5-year integrated B.E. students who do not opt for practice school programme undergo the non - practice school degree stream where they have to, in the final year, do a project in Engineering Practice which is also colloquially termed as Mini - Practice School. From the academic year 1977-78 efforts have been initiated to orient this course as to centre around problem solving activities chosen from the priority research projects of the Institute. In view of the interdisciplinary and mission-oriented character of the Institute research policy, it is proposed to conduct this course, also called as Mini - Practice school, under a similar syndrome as that of Practice-II course. Needless to say that consistent with the Institute research directions, the Mini-Practice school activity will try to draw a large number of its problems from the Institute's immediate industrial as well as local and rural environment.

(ii) Such of those 5-year (4-year) integrated M.Sc., M.A., B.Pharm., M.M.S. and two-year Master's degree students as choose to undergo non-practice school degree are required to do thesis in place of PS II.

APPENDIX-5

BITS Practice School at Grasim, Nagda

Division of Responsibilities for Second Semester 1978-79

Dean, PS Division

Incharge PS at Grasim

Technical Cell
1. Project allotment and coordination
2. Problem bank
3. Technological guidance and support to projects
4. Project report co-ordination

Administration Cell
1. Inventory
2. Coordination of typing and office files.
3. Accounts
4. Housekeeping
5. Students' attendance

Evaluation & Documentation Cell
1. Coordination of students' evaluation
2. Progress reports to PS Division
3. Bulletins
4. PS Manual

Student Welfare Cell
1. Registration and orientation.
2. Hostel Warden
3. PS library
4. PS laboratory
5. Students' activities
6. Notices/Circulars
7. Lecture series

Planning & Pub. Relations Cell
1. Liaison with BITS & Grasim Management
2. BITS-GRASIM project
3. Collaborative education
4. General Public Relations

APPENDIX- 6

Format of the Student Profile*

Name (Identification Number/ Date of Birth/Discipline). Address. Languages Known. (% at the Higher Secondary Stage/Mid-term CGPA normally at the end of five semesters/ Latest CGPA normally at the end of eight semesters). Grades obtained in Science Core (SC), Grades Obtained in Technical Arts (TA), Grades obtained in Engineering Sciences (ES), Grades obtained in Humanities Core Subjects (HUM), Grades obtained in Professional Courses. Titles and grades obtained in some of the courses from Management, Economics and Systems Sciences (along with the Humanities) bringing out the entire breadth of the student exposure. Name of the host organisation, grades obtained by the student and a brief description of work done at Practice-I, i.e. the first component of the Practice School implemented at the end of six semesters. Extra-curricular activities. Long term interest.

* A student profile is prepared for each PS-II session for all those students who have opted for Practice School stream and are eligible to go during that session. The format gives in brief various aspects of practice school probables and also highlights the unique features of students. This in turn forms an important information input for matching students' qualifications, abilities, aptitudes, preferences, and the requirements of the project assignments.

APPENDIX-7.1

List of Various Practice School Publications

1. Introduction to Practice School Programme.
2. Evaluation Guidelines for PS-I and PS-II.
3. List of Practice School-II assignments implemented between June, 1976 and June, 1978.
4. In any one academic year three issues of Practice School Bulletins, two of them dealing with abstracts of PS-II assignments and one dealing with PS-I assignments.
5. Newsletters from various PS stations which periodically give details of the work done there. At present the Nagda and the Bombay Chapter of the PS stations are regularly bringing issues. Others are expected to start from this year.
6. Study Desk : Guidelines in various areas which will be of interest to PS faculty and students are being prepared, e.g. engineering projects, socio - economic survey; inventory Investment Analysis: Area Development, Glossary, etc.

APPENDIX 7.2

PS Project Reports

There are to-date 1200 bound PS project report voiumes which are kept in the Central Library for reference purposes. Some of them have also been found useful as part of the teaching material in classrooms. Each of these bound reports has been classified PS station-wise as also subject-wise. The PS bulletins regularly give information on PS-I work schedule as also on each of the PS-II assignments. Information on PS-II assignments is in terms of abstracts, names of students, PS faculty and professional experts associated with them along with suggestions on the utilization of the work done for the classroom purpose as well as for the purpose of strengthening the Institute-based research efforts.

APPENDIX-7.3

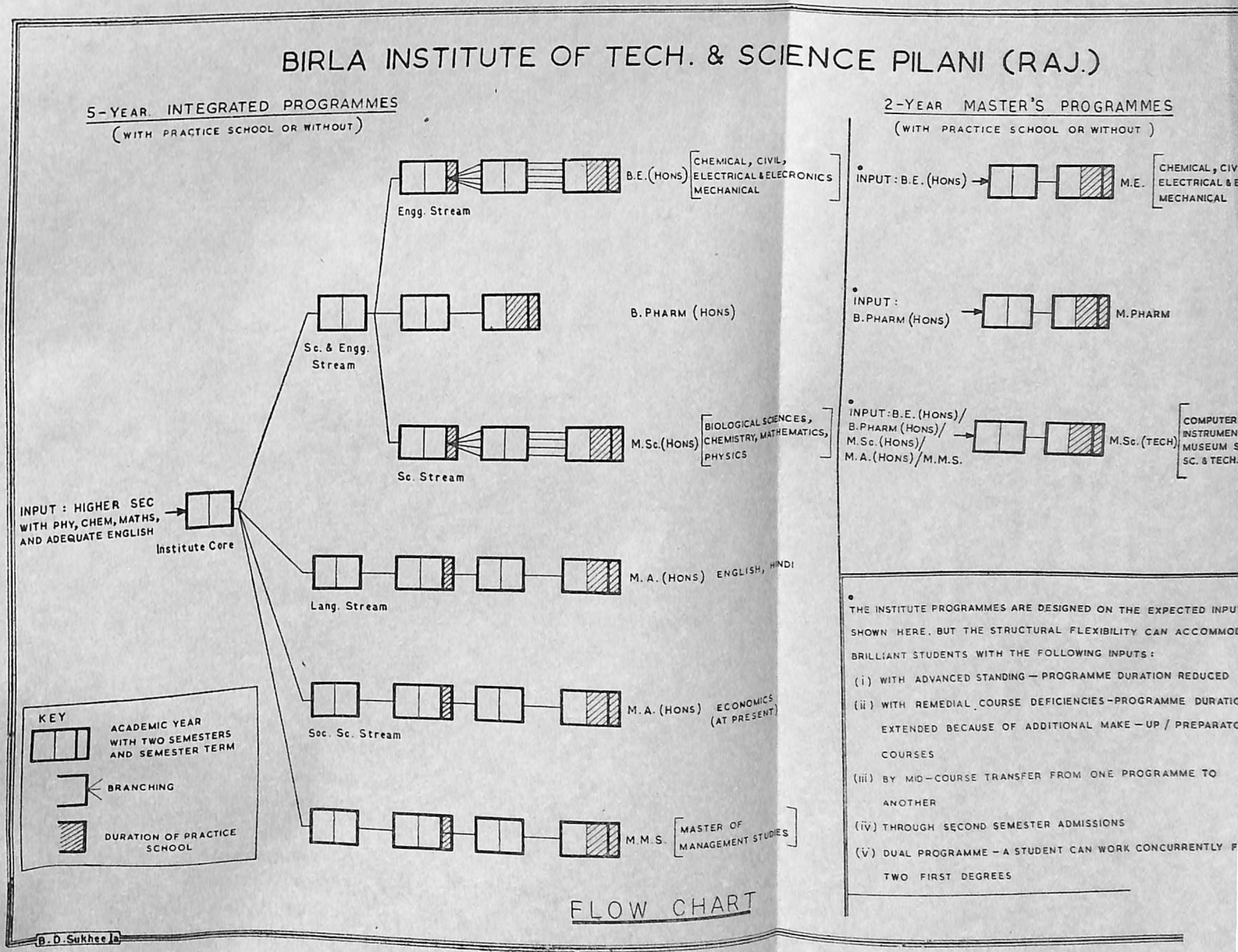
Technical Reports

1. BITS stndents involvement in Dhandhar village through NSS and Practice School (compilation of project reports prepared by BITS students during Dhandhar PS-I implemented in December, 1975).
2. An Annotated Bibliography on Environmental Engineering Science.
3. A Monograph on "An Outline of Century Rayon" (forthcoming).
4. Monograph on "Control of Air Pollution Recovery/Removal of Carbon-Disulphide and Hydrogen-Sulphide from Chemical Plants" (forthcoming).
5. An orientation report on Gwalior Rayon Silk Mfg. (Wvg.) Co. Ltd. (GRASIM), and Birla Research Institute for Applied Sciences (BRIAS), Nagda.

APPENDIX-8

Facilities Available at Various Types of PS-II Organisations

Type of PS-II Orgn. / Facility	Free & Furnished accommodation for students	Subsidised accommodation for students	Free & Furnished accommodation for faculty	Out-of-pocket allowance to students	Office, Library, Stationery, equipment facility	Subsidised Lunch	Subsidised board arrangement	TA/DA for field trips.
Public Sector		✓	✓	✓	✓	✓		
Private Sector	✓		✓	✓	✓	✓	✓	✓
Government		✓	✓	✓	✓	✓		✓
Semi-Government				✓	✓	✓		✓



Note : From Summer 1980 onwards PS–I will accommodate B.Pharm. (Hons.) students after II Year.

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by Dr. V. V. Mandke. Presented at IIT Madras on the occasion of the celebration of 25th anniversary of IIT Kharagpur (Feb, 1976).

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(Paper presented at the seminar-cum-workshop on Alternative Technology held at Simla in Sept, 1975 under the joint auspices of CSIR and the Indian Institute of Advanced Study, Simla.)

(28) BITS Senate Resolutions :
- (a) A proposal for creating Educational and Research Linkages with some foreign Universities - Appendix C, Agenda item 51.05.
- (b) A report on the uptodate position in the effort to create a degree programme in collaboration with industries - Appendix D, Agenda item 51.06.
- (c) BITS experience in running post-graduate engineering and technology degrees - Annexure A, 51st Senate meeting (3rd Nov., 1978).

(29) File No. : IJN/29 - Hindalco Practice School (June, 1973).

(30) File No : IX-64 Practice School general correspondence.

(31) File No : S/3 Practice School Statistics - PS Division.

(32) File No : IJN/22 - Selection of Students for Sandwich Programme & Practice School Programme (May, 1973).

(33) File No : IJN/21 Practice School/Sandwich Programme (May, 1974).

(34) File No : IJN/21 (ii) Practice School/Sandwich Course (Oct., 1972).

(35) File No : VVM/Senate, Practice School Division.

(36) File No : IJN/21 Practice School/Sandwich course (Dec., 1969).

(37) Restructuring File - Office of the Deputy Directors.

(38) Anatomy of Innovation—Initiating Thoughts, presented by Dr. C. R. Mitra during the Seminar on "Educational Innovation - BITS Case Study" held at Pilani on 3 February, 1979.

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