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Internship Projects in Operations Management/ Operations Research: Promise and Practices

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Abstract

Management institutions use internships as a pedagogical approach to promote experiential learning. The significance and relevance of internships in the context of learning styles is first discussed. Three broad approaches to organize internships are plant tours without projects, individual or group projects in several firms undertaken independently and individual or group projects in several firms that constitute one or more supply chains. Examples of each of these types of internships used in some reputed management institutions are reviewed in this paper. Organizing quality internships necessitates an effective industry academic interface. Some institutions have evolved effective systems such as creation of Centers of Excellence, constitution of a Resource Consortium with member companies or creation of Industry Interface departments. Each of these is briefly reviewed. Next the benefits of quality internship programs to students, institutions and participating firms are discussed. Typical benefits are enhancement of quality of teaching and learning, developing students with capabilities to work in teams, awareness of industry expectations, greater opportunities to acquire new knowledge, focus on research of professional value, better placement prospects and overcoming talent dearth problems. These however necessitate interest and active participation by students, institutions and industry. A recent directive to industry and industry associations to enhance the thrust on internships in India is cited. As internships gather greater momentum here, the experiences of reputed institutions could be capitalized for useful insights. Important aspects that need further research or investigation are also discussed.

Keywords: Learning Styles, Experiential Learning, Tacit Knowledge, Explicit Knowledge

JEL Classification: M11, M19

Paper Classification: Literature Review

Introduction

This paper briefly reviews the initiatives of several reputed institutions to develop highly effective Operations Management (OM)/ Operations Research (O.R.) internship programs over the years. This study was motivated owing to the current thrust to restructure educational programs. The importance of reorienting management education in India, arises owing to (i) the anticipated demand for more professional manpower as the Indian economy grows (ii) professionals constantly lament that Indian educational institutions fail to produce readily employable graduates. Educational programs need restructuring both in respect of content and pedagogy. Internship programs offer promise as they enable learners to link theory with practice.

This paper is organized as follows: In the first section, various learning styles and the consequent importance of internship programs is highlighted. Two definitions of internships are also cited. The scope of the study and the research methodology are then detailed. Subsequently different approaches to internships are discussed along with examples of their use in various institutions. The broad span of activities in business schools and the consequent need for effective support systems is then detailed with illustrations of practices in institutions. Potential benefits of internships to industry, academic institutions, faculty and students are stated. The likely challenges and the necessary initiatives to strengthen internships are also discussed. The need for India to draw insights from the experiences of reputed institutions is highlighted. Finally, the limitations of the study and hence areas for further research and investigation are also detailed.

Learning Styles and the Importance of Internships in that Context

Institutions need to align their instructional approaches to the types of knowledge offered. Nonaka (1991) highlights that knowledge is broadly of two types: explicit and tacit. Explicit knowledge is that which can be clearly articulated and hence communicated and shared using documented sources. In contrast, knowledge that cannot be easily articulated but acquired through observation, imitation and practice is referred to as tacit knowledge. Learning and instructional approaches offering explicit and tacit knowledge need to be differentiated clearly.

Behavioral scientists have identified four broad learning styles of executives each of which is appropriate in varied learning environments. The four learning styles are as follows (Aswathappa, 2010):

Accommodating: Individuals who use this style learn from hands on experience rather than logical analysis.

Diverging: Individuals who learn through observation and feeling are said to use this style.

Converging: Individuals who tend to focus on the problem at hand and seek practical use of information, think and act are said to conform to this style.

Assimilating: Individuals who adopt the assimilating style invariably use abstract concepts and logical approaches to analyze a problem.

To acquire tacit knowledge, 'accommodating' and 'diverging' styles are certainly essential. In contrast, 'converging' and 'assimilating' are required to acquire explicit knowledge. The interdisciplinary nature of OM/OR necessitates use of both tacit and explicit knowledge and it is therefore important to draw on all the four learning styles. Hence business schools use a mix of instructional methods such as lectures, role plays, management games, case discussions and

internships to ensure that key concepts are learnt and required skills are also imbibed. Internships serve as a powerful approach to experiential learning and acquire tacit knowledge.

Penny Loretto states "Internships provide real world experiences to those looking to explore or gain the relevant knowledge and skills required to enter into a particular field. Internships are relatively short term in nature with the primary focus on getting some 'on the job training' and taking what's learned in the classroom and applying it to the real field" (About.com Guide)

The National Society for Experiential Education defines internship as "any carefully monitored work experience in which a student has intentional goals and reflects actively on what he or she is learning throughout the experience" (Wallace, 2007).

Internships therefore need to be effectively planned and organized to promote learning. The experiences of some reputed institutions provide useful insights as detailed in the subsequent sections.

Scope of the Study and Research Methodology

This study is a literature review of research papers on 'internship programs' or 'student projects in industry' in reputed institutions. The review mainly relates to the areas of OM and OR. However, the related areas 'Industrial and Systems Engineering' and 'Engineering and Management' are also included. It is intended to identify useful insights for planning and organizing internship programs. The study focuses on the types of Internships, support systems to institutionalize internship programs and their benefits. Research papers that appeared in Interfaces, Production and Inventory Management Journal, Informs Transactions on Education and Harvard Business Review were mainly considered.

Although there are several papers on the topic of internships, a consolidated review probably is absent. This could be useful to other institutions working towards revamping their educational programs.

Types of Internships

Institutions can organize internships in OM in three broad ways. These are:

i. Plant tours without specific projects.

ii. Individual or group projects organized in one or more firms. Two or more projects within a firm may be interrelated.

iii. Individual or group projects in several firms that constitute a supply chain. Two or more supply chains (possibly overlapping) could be involved.

The second and third approaches could be used to organize O.R internships. When an internship includes a project, it would invariably commence with a plant tour of the host organization. The three types of internships are discussed with illustrations.

i. Plant tours without specific projects

This section describes Upton and Macadam (1997) and Godson's (2002) views on the educational value of plant tours. Next the use of plant tours in an OM course at The S. C. Graduate School of Management at Cornell University is detailed.

The paper by Upton and Macadam (1997) relates to executive learning. However, the discussion is also relevant to student learning. The authors state that plant tours could be

categorized as learning tours, assessment tours and teaching tours. Learning tours offer a visitor an opportunity to observe how work is executed in a plant and sometimes offers insights for shop floor innovation. Assessment tours are means to evaluate a plant's operation. For example, a manufacturer may opt to evaluate his suppliers' processes by a plant tour. Teaching tours enable a visitor to provide new knowledge to the host plant. Learning tours clearly are the focus of students. However, the experiences from learning tours could be useful to students later when they assume executive positions and need to undertake assessment tours and teaching tours besides learning tours. Such tours may be necessary during vendor evaluation and education and benchmarking studies.

To maximize learning from a plant tour, a visitor should carefully study the plant processes, systems and procedures and the people orientation. The study should be based on direct observation, dialogue with operating personnel and perusal of records/ databases. A high level of enrichment occurs when an individual undertakes several plant tours and introspects after each visit.

Godson (2002) decided to hone his skills to learn from a plant tour after observing a Japanese delegation's visit to his employer's plant. The Japanese, he observed drew quick insights from a single visit. Godson states that the information culled from a plant tour could range from benchmarking to competitor analysis to strategic acquisitions. For example, during a 30-minute visit to a leading truck manufacturing company, Godson learnt of potential ways to cut costs. These include eliminating material handling bottlenecks, consolidating plants and reducing inventory. He then developed a framework to assess plants. The framework incorporates evaluation of a plant based on several factors such as visual management systems, scheduling systems, condition and maintenance of equipment and tools and commitment to quality. For this, necessary data should be collected by direct observation, dialogue with the workforce and managers.

The S.C. Graduate School of Management at Cornell University offers a one- semester, 16-week course on Management of Manufacturing Enterprises in their MBA program. The course objectives are: (i) integration of theory and real-world practice (ii) integration of shop floor initiatives and strategic issues (iii) integration of functional areas of a firm.

To achieve these objectives, the course includes twenty plant visits besides conceptual inputs. Half day visits to each plant are directed to (i) introduction to the plant by the plant management (ii) a tour of the facility (iii) a question and answer session. A visit to Lord Corporation, a facility that produces chemical and mechanical products for markets world-wide, however has a broader scope. Students spend three days at the plant and learn from the firm's kaizen projects that are executed under the lean manufacturing implementation plan.

During the visit, students had an opportunity to observe and learn the use of continuous improvement tools like single minute exchange of dies (SMED) and statistical process control. Students realized that whereas mastering the tools is easy, their use to drive continuous improvement is difficult. Students learnt the importance of cross functional teams and inclusion of members who are knowledgeable about the processes. They also appreciated the importance of linking operational initiatives like lean manufacturing to the firm's business strategy. Specifically, Lord focused on cost reduction initiatives owing to an economic downturn.

Thus, plant tours effectively complemented the course contents in accomplishing the course objectives (Bradley & Willett, 2004). Clearly plant tours enable students to enhance their observation power and acquire tacit knowledge.

ii. Individual or Group Projects Independently Organized in One or More firms

An institution may contact several firms and assign students to each of these firms where projects are independently executed by one or more students. Many institutions have reported on their experiences in such projects. These are detailed below:

a) University of Tennessee

Helms (1989) observed that most students at the University of Tennessee did not have prior work experience or even visited a manufacturing or service facility. This posed a stumbling block for effective classroom instruction, especially during case analysis.

The institution then drew support from a local firm which permitted students to visit its forging operations and warehousing and distribution facilities. Based on the course contents, the Company's President identified several projects such as developing a marketing plan for introduction of a new product, developing an operations strategy and analyzing product sales by major category & customer class.

The internship commenced with a two-hour tour of the plant. Each project was then assigned to a group of students. Students were given a brief description of the project and informed of a contact executive in the company. The latter and other company employees held meetings with students. Later students collected relevant data and materials to analyze the problem assigned to them. Write ups that articulated project details, methodology used and the analysis were prepared and submitted. The findings were formally presented to an audience comprising entire student group and company executives. Thus, students also learnt from the experiences of peers.

Faculty drew on the project experiences during subsequent classroom instruction for better understanding.

b) School of Hotel Administration, Cornell University

The school of Hotel Administration at Cornell University, a world leader in hospitality management offers five courses in Revenue Management (RM). The instruction and evaluation methodologies include a rich and varied mix such as concept coverage, study and discussion of articles, case discussions, guest lectures by practicing managers, home assignments, take home examinations and most importantly projects. For example, in the Yield Management course, students develop a functioning Microsoft Excel based RM system for a 200-300 room hotel with three to four categories and three different lengths of stay. The project is segregated into three parts: forecasting, availability controls and overbooking, and finally a model that integrates the two. Specifically, in the forecasting project, students develop detailed forecasts for each length of stay and rate category combination for the next 60 days and measure the forecast error. In the second project, results from the first project are used to develop bid prices for each day in the planning horizon and use these bid prices to develop rate and length of stay controls, Finally, students integrate the results of the first two projects into a fully functioning Excel or Visual Basic for Applications based system. Similarly, RM projects are also included in other courses in restaurants, spa etc. In all these projects, students are required to submit reports and make presentations on technical content in a non-technical language so that managers can easily understand.

These initiatives have enabled students to secure placements in the hospitality industry including reputed organizations like Marriott, North West Airlines and Harrah (Anderson, Kimes & Carroll, 2009).

c) College of Business, Florida Atlanta University/ Management Department, Bentley University

Behara and Davies (2010) describe the use of active learning projects in courses on service operations management. Active learning is broadly defined as an approach in which students actively engage in the learning process. Students enrolled for the graduate level programs, have work experience or are employed during the pursuit of this course. They work on consulting projects in sectors such as retail banking, financial services, software development, technology services, car rental services and local government IT services. Projects are in the areas like process improvement, quality improvement, new service development and project management.

During the first three weeks, students focus on problem formulation, a critical facet of the project. Extensive dialogue occurs between students and faculty. This first milestone culminates with a working title and a brief outline of the project. Next an outline of the deliverables is prepared and submitted towards the middle of the semester. This second milestone review serves as an early warning system in case the project is not proceeding as per plans. Students are sometimes required to modify the projects incorporating organizational issues. Finally, during the third milestone, a report is prepared and submitted. The report clearly articulates the problem studied, data used, analysis performed and the recommendations. In addition, students are required to state the implementation plans along with likely impediments and possible contingencies.

There are discernible evidences of benefits to all stakeholders. Sometimes recommendations were accepted and implemented and this led to professional advancement of students. Faculty too, benefitted owing to an opportunity to gain in-depth knowledge about the firms. However, the institution needed to carefully handle aspects of confidentiality and risk.

d) Stanford University, Department of Operational Research

The O. R. Department of Stanford University used internships to enable students to learn the practical aspects of O.R. They introduced a course on Applications of O.R in their MS course which comprised case studies and field projects.

Field projects were solicited from alumni and contacts of faculty and students. Some companies who heard of the institute's initiatives also offered support. Every year new sponsors were added on. After initiation of the contact and receipt of a favorable response, the university communicates the course details through a letter. Interested sponsors are invited to present their problems. Student preferences for various projects are solicited and project teams are constituted. Teams also include faculty members and student assistants who are referred to as coaches. Teams work on problems assigned to them and report to their coaches. Specifically, coaches hold biweekly meetings to assess the progress, provide guidance and monitor team dynamics. The progress reviews the project scope and statement, mathematical models, data collection, model building and other details. A time table of tasks is planned. During presentation by a team member, every other team member participates. Problems of group dynamics are addressed whenever necessary.

Students submit reports on their projects which are graded by faculty. The report also highlights key aspects of team dynamics.

A variety of projects have been handled over the years. These include router maintenance depot location at Cisco Systems; balancing service and obsolescence in inventories at

Hewlett Packard; patient referrals, authorizations, records and billing flows at Stanford Hospital and container shipping at Stolt- Nielson.

Project sponsors have responded favorably to projects. This is discernible from job offers to some students, continued discussions on reports even after a year of completion and citations in newsletters. Encouraging feedback included significant cost savings and an opportunity to view a situation from a fresh perspective based on the new ideas and approaches to problems highlighted by students (Eaves, 1997).

e) Indiana University Business School

The business school at Indiana University offers undergraduate and graduate programs in business administration, both full time and part time. An introductory course on OM is included in these programs. One faculty included an internship project in this course.

The internship project spans a period of 14 weeks when course inputs are offered concurrently. When the term commences, the faculty gives a handout articulating the expectations during preparation of a proposal and guidelines in organizing data collection and analysis, report preparation and final presentation to the clients and the author. Faculty states the types of projects students can undertake and suggest that they peruse reports prepared in the past. The scope of a project is identified after a student holds a discussion both with the company guide and the faculty. Students collect required data through executive interviews, actual observation and retrieval from records. Problems are analyzed using well known OM concepts and techniques. While some techniques are already known to students, others are learnt with guidance from faculty. This became inevitable as course instruction and project execution are scheduled concurrently. Students' exposure to software use facilitates extensive data analysis but this phase spans a relatively long period. Students identify potential qualitative and quantitative benefits that are likely to accrue from implementation.

During presentations to faculty and company executives, other students also attend. All evaluate the presentation based on the content and communication. In addition, the evaluation is based on the quality of reports and impact of the study on product and process quality, customer service, response time and flexibility and response time.

Around 70 projects were completed during the year. The client sectors included steel, automotive, chemicals, financial institutions, hotels, health care and retailers.

Students expressed satisfaction owing to a high level of learning from project execution. The career prospects of students who worked on a part time basis were enhanced.

The faculty could disseminate his research based on these projects in reputed journals or international conferences. After the advisory board noted the high-quality standards of the above initiative, the school decided to explore the introduction of an undergraduate program with OM & Decision Sciences major. Further, regional business associations requested the faculty to extend the scope of their activity to address the needs of various segments of the regional industry (Ahire, 2001).

f) The Villanova University

The Villanova University over a five-year period evolved a successful system to promote quality learning in their Part Time MBA programs. Students are required to work on live projects in their organizations where they apply computer based Management Science (MS) modeling to problems.

Participants in the MBA program represent a spectrum of organizations like Ford, Wyeth Laboratories and Boeing. Further participants constitute a heterogeneous group in respect of their previous academic backgrounds and work experience.

During the MBA program, students are exposed to several concepts with adequate thrust on spreadsheet modeling. Students are then required to work on two projects in teams of four. In the first project, they are required to apply mathematical programming to problems like production scheduling, employee scheduling, menu planning and assembly line in their organization. Topics in the second project are Analytical Hierarchy Process (AHP) and Simulation. Students take one or both topics in businesses like food service, biomedical research, call centers, supermarkets, banks and fast food restaurants.

As facilitators of project teams, faculty members provide knowledge, skills and tools needed to execute the study. Most projects offered insights for implementation, at least in the future. In some cases, organizations used the projects for identifying areas for further study.

Projects are evaluated both by the faculty guide and student peers. Evaluations are based on the quality of modeling and the extent to which project findings were directed to actual implementation. Students make classroom presentations and hence communication skills are also incorporated.

Over a period of years, the system's credibility was discernible through a better appreciation of OR/ M.S (Liberatore & Nydick, 1999).

g) School of Business, University of Dayton

Gorman (2010) describes his experiences in developing a six-credit capstone course comprising an internship project at the School of Business in the University of Dayton. The capstone course is spread over two terms where the first credit is scheduled in the earlier term. Several O.M faculty members solicit projects that are of interest to clients and have a high degree of analytical rigor. Projects are obtained from several sources like professional organizations, individual industry contact and adjunct faculty who are practitioners. Projects span several OM topics and sometimes necessitate addressing of marketing and financial issues.

During the earlier term, students work towards formulating a proposal. At the start, students receive basic training in large scale data analysis, project management, consulting and proposal writing. Some clients address the entire batch and provide an overview of their company operations and an idea about the project. In other cases, once student groups are formed and assigned to clients, groups contact their clients to ascertain necessary details about the project. Project proposals are prepared after site visits where students get a deeper understanding of the problem. The proposal consists of the problem statement, likely methodologies, key milestones' dates and expected benefits to clients. The proposal is vetted through a presentation and reworked if required. During the second phase, the project is formally executed. Students learn new concepts if required, particularly when multidisciplinary projects are assigned.

Three major review phases are a project kick off meeting, a mid-project review and a final client presentation when the team's final recommendations are communicated with necessary feedback.

One or more faculty members are formally assigned charge of the capstone course depending upon the number of students enrolled for the course. Their teaching work load is adjusted owing to the workload arising from managing the internship. Each

faculty member manages around four teams comprising three students. A faculty spends approximately 20 hours with each team besides devoting time in providing technical and writing assistance. Faculty time is also required in soliciting responses and giving time to clients.

The internship is structured like a consultancy. The student team acts as analysts who take formal charge of the project and are primarily responsible for the deliverables. The professors are senior partners who act as advisors. They make recommendations on analytical approaches and intervene when the demands arising from clients, data issues or skill requirements pose a challenge. They monitor progress vis-a-vis schedules and ensure quality and yet provide a fair degree of independence to student teams. The sponsor has a role to break through organizational barriers whenever necessary. The project coach becomes the primary point of contact on matters relating to data requirements, scheduling meetings and coordination. This is important as data collection and analysis are major activities in projects.

The author illustrates the importance of faculty intervention to manage project quality within the constraint of semester duration. This would be important when clients show enthusiasm and propose a broad project with a wide scope. Faculty members then segregate the entire project into several smaller projects that can be executed independently but are complementary.

While students are trained in several sophisticated methods, they are required to apply them only after ensuring relevance. The performance of teams is based on the effectiveness with which problems are addressed rather than only the sophistication of approaches.

Although attempts are to carefully define projects at the start, students often find that they are required to revise the scope and objective later as more insights are obtained. Major challenges relate to data management. Sometimes clients provide summarized data that are inadequate for an in-depth analysis. Often required data may not even be available and must be collected after spending time or money. Alternatively, other data needs to be carefully used as a substitute. When a large mass of data are available, students need to use the Pareto principle and cull 80% of the information from 20% of the data.

h) The U.S. Air Force Academy

The U.S. Air Force Academy offers an interdisciplinary bachelor's degree program in O.R. In the last semester, students work on projects with an O.R. consultancy firm. Clients are identified through the course director's initiatives and employers of the academy's faculty members. Proposed projects are vetted and those that involve only data gathering are rejected. Projects whose focus is too broad are redefined to enable completion within the allotted time. Faculty informs clients on the desired support and details such as the course curriculum, student background and time constraints. Clients then make formal presentations to students. Self-constituted student teams contact some clients for further clarity. Groups then rank order their client preferences with justification. Clients too indicate their preferred student teams. Faculty use this information to allocate student groups to clients.

During the problem definition phase, students learn about the client organization; the planning issues, specific decisions to which their analysis could contribute, time frames for action, implementation schedules and overall client reception to their analytic involvement. Faculty offer extensive guidance as students are not likely to be aware of the importance of this phase. Usually they are more eager to apply tools and techniques already learnt, rather than work towards problem definition. This phase spans three weeks after which students

submit a written proposal that specifies the problem statement, deliverables, schedules, tasks and task delegation and a list of requests of the clients.

Students begin modeling after completion of problem definition. Literature review usually offers good support. Student groups consolidate their learning and share the same with other students. Student presentations are graded by faculty. Peer feedback is also an important part of the assessment.

During model and system development, students begin developing a deeper understanding of the problem and the issues under investigation. Faculty emphasize active involvement with the client by stressing data collection via observation, surveys and employee interviews. There are two milestone reviews at this phase. The first occurs three weeks after the project proposal is prepared and involves both an oral and a written report evaluation. Specifically, students are evaluated for the data collection and analysis, refinement of problem definition, analysis of modeling alternatives and describing technical details of models that students intend to use. Five weeks later, the second evaluation is held when the progress since the first review is gauged. The students also cite tentative recommendations to the client which are vetted.

Lastly, students make their presentations and submit a final report. Senior personnel from the client organization are involved. At this stage, fewer details of modeling and data analysis are presented. Instead, the thrust is on a fully substantiated set of recommendations (Armacost & Lowe, 2003).

i) Krannert School of Business, Purdue University

The Krannert School of Business, Purdue University, USA, developed a highly effective internship program with an Indian industrial partner over a five-year period. Specifically, the anonymous company (ABS) is a two-wheeler manufacturer whose CEO is an alumnus of Krannert. The objective was to provide engineering and management students, corporate exposure in an international environment.

Applications from interested students obtained through brochures and websites are vetted based on academic performance, previous work experience in similar businesses and mental toughness and maturity to work overseas. Finally, 15-20 students are chosen.

Potential projects are identified based on suggestions by students and faculty. Projects have a blend of analytical complexity, urgency for resolution, lack of resources to be executed internally by the company, need for greater external insights beyond the Indian culture and a desire to test a current business situation against international best practices. Those which are too broad in scope are either excluded or redefined. Projects are also excluded when faculty and/ or student do not have the required expertise.

The project scope is identified in advance before coming to India and students initiate contact with faculty and mentors through videoconferencing. Preliminary data are collected and background research is undertaken. A question list is prepared.

Detailed execution is undertaken at the plant where the project definition is refined and approved by the mentor, a model is developed and analyzed using necessary data. A tentative set of recommendations are also prepared. Project teams are required to make time bound presentations followed by question answers. Faculty and mentors assist students in advance to ensure that important aspects are presented within the allotted time. The audience for presentations include key company personnel, faculty guide and other students. During presentations, managers ask questions on model assumptions and

data analysis and feedback is provided which is incorporated in the project report that is submitted later.

Organization of the internship is fraught with challenges such as students having to cope with the stress and uncertainty owing to stay in India. However, the system could cope with these challenges (Pilotte, Kovaichelvan, Chand & Iyer, 2012).

j) School of Science, Aalto University, Finland

Salo (2012) describes the use of client projects undertaken by M.Sc. students in an O.R. course at Aalto University, School of Science, Finland. Students are from Physics, Mathematics or Industrial Engineering and Management major. The course objectives are broadly real-world problem formulation; imbibing skills to work in teams; acquiring communication and presentation skills and enhancing domain knowledge and boosting self-confidence.

Clients are firms or governmental research institutions whose problems are amenable to O.R. methodologies. Clients present their problems to students, provide access to data and interact with students extensively. A Professor and a Teaching Assistant are also involved. Professor identifies the client, scopes the project and constitutes student teams. The teaching assistant arranges client meetings and provides access to software tools. In addition, a student is assigned the role of a project manager who communicates with the client and teachers and provides leadership to the team. A team that works on another project is appointed as a shadow team for every project. The shadow team follows the activities of the team and provides feedback on the deliverables.

The project commences in early January when the Professor briefs the students on the learning objectives and considerations in grading students. Each client gives a 20-minute presentation on the organization and details of the proposed project along with the relevance of O.R. Students communicate their order of preferences and these are used to constitute project teams using an optimization model. Team members then meet and select the project manager who is given the client's contact details.

Project work is initiated with a literature review and the generation of a project plan. Students present their plans to their professors who provide necessary feedback. Students then submit structured written plans that articulate important details such as tasks, schedule and a risk management plan. Students execute their projects based on the specified plan with guidance from clients and professors who assist in the selection of relevant O.R. methodologies.

During project execution, students submit a short interim report that highlights the progress and required revisions in their plans. Towards the concluding stage, students prepare and submit a final report and a two-page summary highlighting the key learnings from the project. A final presentation is held which teachers, hosting client and members of the shadow team attend. Feedback is provided and students are asked to revise the report if required.

Thus, several institutions have turned internships as a powerful educational approach.

iii. Individual or group projects in several firms that constitute a supply chain.

The discussion thus far, was related to projects undertaken independently in various organizations. With the advent of the supply chain philosophy, suppliers, producers, distributors and customers network extensively among one another. Integrated internships that involve several firms in one or more supply chains offer promise to understand networking practices in supply chains.

Wouters and Van Donselaar (2000) highlight such an internship system at the School of Technology Management at Eindhoven, Netherlands. The internship project entitled "Supply Chain Logistics and Information Management" (SLIM) was a 12-month study in which 15 students worked in different companies that operated in the electro technical and pharmaceutical supply chains. The electro technical supply chain included manufacturers, wholesalers and installers while the pharmaceutical supply chain comprised a manufacturer, wholesalers and an association of pharmacists. In all, there were six overlapping supply chains that comprised 11 companies. Each student was assigned to a company and guided by a company executive. One faculty member was deputed to coordinate the entire project. In addition, individual faculty members were assigned to each supply chain. Thus, the entire SLIM project team comprised seven faculty members, 18 company executives and 15 students.

The project commenced with an identification of several improvement opportunities in each supply chain. Project members collected data on delivery performance, inventories, lead times, flow of goods and information flows. These were studied for a period of two or three months. The potential issues were shortlisted and students were required to focus on two or three issues. Similarly, only selective products were considered for further study. This was done to keep the project manageable owing to time constraints. The project team however, remained guarded while making recommendations as the study was not based on an integrated approach that incorporated all products.

The project team was briefed on systems and procedures for production planning and control and procurement and an understanding of companies who are the suppliers/ customers of the firm by the company personnel.

Members of the chain also shared information on operational performance such as lead times and delivery performance with partners. However, data on product costs were not divulged as this enables estimation of profit margins.

The project team's objective was to obtain a financial evaluation of their goals at the level of the supply chain in respect of benefits and investments. While doing so, they did not address the aspect of sharing of costs and revenues as this could deter creative thinking. Negotiations would be handled at the company level. The project team realized that benefits of improvement initiatives could accrue to other firms including competitors. For example, when a better collaborative arrangement is reached between the manufacturer and the wholesaler, the latter may opt to replicate the practice with other manufacturers. This however, did not deter initiatives. Firms recognized that innovative practices cannot be readily copied and it was more important to stay ahead of competitors.

The SLIM project offered benefits at several levels. Students learnt of the importance of total supply chain optimization rather than sub optimization at the firm level. Owing to sharing of information between students, they learnt that solutions need customization. A standard approach cannot be recommended always. Faculty members developed an inter-disciplinary orientation as several faculty from different departments of the school participated and interacted during the study. A greater synergy between teaching and research was also created. The authors reported of payoffs observed by some of the participating firms. One manufacturer reported lower logistics costs and significant increase in delivery reliability to an installer. The manufacturer then decided to replicate the system with other installers. One installer decided to increase his business with a manufacturer who participated in the study owing to the improved operational system.

Some supply chain perspectives however, could also be obtained in organizations with multiple plants that are interdependent, but have a fair degree of autonomy in managing operations. An internship project at the engineering and management schools at the MIT is illustrative of this. MIT instituted a Leadership-for-Manufacturing (LFM) program, a partnership between 13 U.S firms and MIT with the objective of discovering some world class manufacturing principles and teaching them in the institute's dual degree engineering and management program (Balakrishnan, Brown, Dunlap & Paul, 1995). One of the firms is Alcoa, the world's largest aluminium company that produces a wide range of extrusions and drawn tubes for the aerospace, construction and automotive industries. In 1989, one of their plants at Alcoa proposed a student internship program to assist the company in streamlining its tube mill operations. The faculty supervisors from the engineering and management then proposed a collaborative research project to develop an integrated operations planning model for extrusion and tube drawing operations for medium term planning. Over a period, the involvement in numbers grew, both from the firm and MIT. The managers, engineers and planners from Alcoa participated. Later, owing to inclusion of process planning facets, expertise from Alcoa Technical Center was also solicited. Graduate and undergraduate students and faculty members from engineering and management schools participated. In addition, a doctoral student in O.R. and a computer science undergraduate was also involved as data analysis and computerized process planning systems had to be developed.

The manufacturing process comprises broadly of ingot preparation, extrusion and obtaining tubes, each of which is handled by three units operating as plants within a plant. Each plant has a manager all of whom report to the Lafayette Works Manager. A large variety of tubes in respect of specifications are produced. The facility operates as a made to order manufacturer, though the ingot plant operates as a made to stock unit. Operations' planning is performed by two planners, one each from the extrusion and tube mill plants. The tube mill planner, on receiving an order selects an available standard bloom size and determines the sequence of operations within the tube mill. The extrusion planner then decides the billet length, diameter and extrusion parameters and orders the required number of billets from the ingot plant.

The extrusion and tube division embarked on a tube mill rationalization program to reduce lead time and improve yield. Initially the rationalization team involving MIT and Alcoa members considered the bloom sizes currently in use as fixed. However, later these and process plans were reviewed critically. Specifically, the team decided to develop an integrated model for the extrusion and tube drawing operations to select an optimal system. This became important as the operations and tube drawing processes are interdependent. Any finished product could be obtained from alternate bloom sizes but a bloom size that is easy to extrude requires numerous drawing passes while bloom sizes with fewer drawing passes are difficult to produce. Hence standard bloom sizes that optimize system costs were to be determined.

During the study, it was required to analyze the relative demand for various tube sizes ordered by customers. The company did not have a formal system to periodically examine the product mix and yield patterns. The team used the tube mill database first to perform exploratory data analysis. It was found that 16% of the products accounted for about 70% of the total production volume and 7 out of 37 bloom sizes accounted for over 80% of the total bloom usage during a quarter.

When the team proposed heuristics to identify new bloom sizes, the organization recognized a need for closer interaction between the extrusion and tube drawing operations. This entailed a cultural change with a new organizational structure and incentive system.

However, the process offered commensurate benefits. Students committed to a manufacturing career were cross trained in various areas like process planning, data analysis, information systems and operations planning. The success of the project was discernible to MIT as the company became willing to merge the extrusion and tube operations planning into a single group in the tube mill to facilitate multi stage planning. Further, internships continued and recruitment of students commenced.

The long-term vision to promote tighter integration of the entire supply chain from ingot casting to shipping was also set.

Thus, both, projects executed independently in several companies and interdependent projects in firms that constitute a supply chain offer promise. The latter however, also provide supply chain perspectives

The table below briefly details the three types of internship and the institutions that use these approaches.

Table 1: Types of Internships

S. No.	Type of Internship	Reference Citation	University/ Business School Examples
1.	Plant tours without projects	Bradley & Willett (2004)	The S.C School of Management, Cornell University
2.	Independent/ group projects in one or more firms	Helms (1989), Anderson, Sherri & Carroll (2009), Behara & Davies (2010), Eaves (1997), Ahire (2001), Liberatore & Nydick (1999), Gorman (2002); Armacost & Lowe (2003); Pilotte, Kovaichelvan, Chand & Iyer (2012); Salo (2012)	University of Tennessee; Cornell University of Hotel Administration; College of Business, Florida, Atlanta University/ Management Department, Bentley University; University of Toronto; Stanford University; Villanova University; School of Business, University of Dayton; The U.S. Air Force Academy; Krannert School of Business; School of Science, Aalto University
3.	Group projects in several firms that constitute a supply chain	Wouters & Van Donselaar (2000); Balakrishnan, Brown, Dunlop & Pahl (1995)	School of Technology Management, Eindhoven, Netherlands; Sloan School of Management, Massachusetts Institute of Technology

Institutional Systems for Internship Projects

The broad activities of most business schools include conduct of management development programs, handling consultancy assignments, organizing guest lectures, organizing and supervising internships besides applied research and classroom instruction in MBA and other programs. Owing to the broad spectrum of activities, a need for a structure or support system for effectively coordinating and managing the activities became important. This would be so as academic, professional as well as administrative skills are necessary simultaneously.

Some business schools in the U.S. have created "Centers of Excellence" to ensure adequate thrust on future perspectives. These centers enable business schools to ascertain the demands emerging from rapid innovation and emerging technologies and are supported by public and private agencies. Specifically, the centers help to promote faculty and institutional competence in areas like Entrepreneurship, Leadership & Strategic Thinking and International Business. In India, the Hyderabad based Indian School of Business has a center for Emerging Markets Solutions (Drew, 2011). Such centers sometimes take responsibility for managing internship projects too.

The support systems instituted in some business schools are detailed in this section. Besides generating quality internships and ensuring quality work, the systems ensure student discipline, manage project evaluation, handle IPR issues and confidentiality, generate funds for projects and foster research. This in turn offers scope to evolve strong industry interface which should be sustained.

a) Columbia Business School

Fraiman who joined Columbia Business School after an 18-year stint in industry nurtured the W Edwards Deming Center for Quality, Productivity and Competitiveness which was started during the tenure of W. Edward Deming, a renowned Quality Guru. When Fraiman took charge of the Center, its mission was reset as promoting scholarship and pedagogy in the areas of quality, productivity and competitiveness by sponsoring applied research and conferences and by fostering meaningful collaborations among academia and the consulting, services and manufacturing industries.

The Center used several methods of collaboration such as internships, joint research projects, guest speakers, executive development programs and joint curriculum development. For example, through industry contact the school could depute students to work on field projects at Modell's Sporting Goods. After project completion, faculty continued association with the firm and developed a case on Data Envelopment Analysis (DEA). Similarly, during a course on technology management offered by Fraiman, student teams participated in consulting projects with firms. Thus, institution of a center enabled and enhanced the scope of internships (Fraiman, 2002).

b) North Carolina University

North Carolina (NC) University has also evolved a formal university industry collaboration to facilitate offering field based projects to students. The system has been titled 'Supply Chain Resource Cooperative' (SCRC).

The importance of such an initiative became apparent when NC's Poole College of Management observed that industry wanted to recruit management graduates with an ability to address complex, ill-defined real-world problems. At that time, Dave Nelson, Chief Supply Chain (SC) Officer at John Deere offered to support a pilot of field based projects for a semester. Project teams could directly interact with John Deere's SC associates. This initiative was called SC Resource Consortium (later Consortium was altered as Cooperative). The pilot projects' recommendations were implemented and led to performance improvements.

NC then decided to embark on a more ambitious venture to enable more students to participate in field based projects. NC contacted other companies and shared their experiences at John Deere. NC also held an end semester two-day meeting with a focus on (i) exchanging ideas and knowledge about SCM (ii) showcase company, student projects (iii) foster relationships with companies (iv) promote networking among students and business professionals. Other marketing initiatives included the implementation of an SCM information portal, commencement of websites on projects and promotional materials like newsletters and brochures. Thus, the number of donor companies increased.

NC created a structure for SCRC through appointments in the positions of operations director, relationship director and office manager. Their profiles were carefully determined. This provided for a system to promote networking with industry, engagement of faculty in applied research initiatives and administrative matters. The increase in the number of donor companies enabled

NC to include a broad spectrum of industries where grooming of SC professionals was deemed critical. Each company remitted an annual donation of $30,000 without any formal promise of returns owing to NCs reputation. Donations were used to meet operating expenses such as staff salaries, travel costs and equipment purchases. Companies usually continue their association when they spot opportunities for projects.

Overall the system has offered promise. Professionals who participated include CEOs, Vice Presidents, Directors and managers drawn from materials, manufacturing and logistics. The professionals represent construction equipment, financial services, transportation, pharmaceuticals and energy. This provides a broad breadth and executives spot opportunities to learn from other sectors through experience sharing forums.

An executive in each donor company functions as SCRC project liaison to identify projects. Project leaders are then identified for each such project. Projects are led by SCRC directors, faculty and company project leaders. Over an 11-year period, the process of functioning of projects has been refined. The scope of the project to be executed over a 15-week period is first defined. This is completed in the first few weeks. Students learn about the company's business and its environment. This shapes the context and nature of the project. The students maintain contact with the company professionals and get their guidance.

The structure helped to hasten the process of finalizing projects. While the costs of managing, the internships are high, returns too are high. The reputation of the institution was enhanced. The placement prospects in an internship company are beneficial, both to students and companies. Even when placements are not offered, students' learning experiences enhance practical perspectives, improve soft skills, enhance project management skills and their ability to work in teams. These are important requirements and therefore improve placement prospects in other organizations.

Companies sometimes get financial returns from drawing on students' services during interns. Companies that have networked with NC have reported of opportunities to learn and apply SCM concepts. For example, Caterpillar expressed that the latest developments in the field could be applied and Biogen enhanced its understanding of risk management tools. Perhaps these could translate into financial returns in the long run (Handfield, Edwards, & Stonebraker, 2011).

c) S. P. Jain School of Global Management

The S.P. Jain Institute of Management, has two international campuses, one each at Dubai and Singapore where a global one-year MBA Program is offered. Students specializing in Logistics and Supply Chain Management specialization are admitted to the Singapore campus and later shifted to the Dubai campus. The institute's industry interface projects (IIP) comprises two components: Applied Research Project (ARP) at Singapore and Action Learning Project (ALP) at Dubai. Class room inputs are also provided in both campuses. A faculty in the Logistics and SCM area describes the internship system in the institution. He is also an academic mentor for the IIP and spends one semester in each campus.

For ARP, a group of students work on an issue based topic of interest to both the students and a faculty. To execute these projects, students use primary and secondary data from the local business community, chamber of commerce, government or public. This helps students from India to gain knowledge on the Singaporean environment.

During the ALP, students work on a live project in a client organization. Students are guided

by both the academic and industry mentors, both of whom are involved in evaluation. The practical orientation has helped students to project their capabilities during placement interviews. Projects have also impacted client organizations who have reported financial savings or better resource utilization. Clients could also project internships as a Corporate Social Responsibility initiative.

To facilitate effective industry interface projects, both campuses have a position of Director (IIP) who reports to the Dean, Global MBA Program. The director of IIP is a full time administrative person with previous industry experience who oversees student projects. He develops long term relationship with companies. An industry interface committee of eight students who work under the director's supervision is also constituted. The committee sources projects, interacts with academic and industry mentors and schedules final presentations. The committee is also the point of contact from the students' side for smooth execution of ALPs. The director of IIP also handles ideological differences that arise between industry and academic mentors and help reach a mutually acceptable solution. The institute has also constituted a mentors' club. The director holds bi annual meetings with mentors to review past projects and direct improvement initiatives and initiate ideas for new projects. Close interaction with chamber of commerce, industry association and government has served as a powerful means to learn new research areas (Aserkar, 2013).

d) Clarkson University

Clarkson University offers undergraduate degrees in Engineering and Management (E&M). Students of this program are required to work on a team based capstone design project towards the end of the course. Most often, students work on an industry project. Contacts of Program Director, other faculty and students serve as sources of projects. Clarkson University maintains strong ties with industry. For example, career fairs are well attended. When recruiters visit the campus, program directors formally meet executives and solicit industry projects. Projects are also obtained from alumni and members of the University's Business Leadership council. Faculty who obtain quality projects are recognized for their efforts. Such faculty are also in a better position to articulate the scope of projects. Students who obtain a quality project are also given preference over other students for that project. A project is deemed to be a quality project if it has suitable design content, involve consideration and evaluation of alternate solutions based on financial analysis and have a client employee who facilitates the project and serves as a focal point for student contact.

Students are provided brief descriptions of the projects a week prior to registration to enable them to express preferences. The E&M Program Director assigns students to various projects incorporating their suitability and their preferences. A single capstone project is sometimes assigned to two or more teams of students. Faculty are assigned as guides to various projects incorporating their area of expertise, familiarity with client organization and its culture.

At the start of projects, students study reading material and familiarize themselves with necessary instructions. Project expectations are communicated through a class session. Students then deliberate on approaches to design problems in teams. This is followed by a meeting with the client in the organization. Extensive interaction with the client is emphasized to facilitate timely feedback and corrective action.

The faculty advisor holds hourly meetings with students every week to ascertain project status, technical details and plans for further execution. Faculty helps students to learn new concepts and even offer career advice.

Students finally submit reports and make presentations. Clients are also present during these presentations. Some of the project recommendations are implemented by the clients. Clients communicate the final feedback to faculty advisors who incorporate these in future projects. Faculty advisors strengthen the relationships with clients.

Projects have served as a useful pedagogical approach to appreciate the potential of O.R to address ill-defined management problems. Students also imbibe skills to communicate their recommendations to clients. (Milne and Zander, 2012)

e) Georgia Tech H Milton Stewart School of Industrial and Systems Engineering

Georgia Tech H Milton Stewart School of Industrial and Systems Engineering (ISyE) offers a compulsory course on "Senior Design" during the final year of the undergraduate program. As part of this course, students undertake a project in the industry. The School revamped the system of managing the project when some shortcomings in the existing system became a matter of concern. Students were not adequately developed to function in the roles of the new work environment. Effective performance during project work was deterred as students did not have adequate exposure to non- technical areas like public speaking and technical writing. Further, there was lack of uniformity in advising and grading which impacted project quality and students' learning experiences. Each faculty tended to grade students assigned to him liberally owing to the concern that they would otherwise be underrated when compared to students assigned to all other faculty. In fact, students resented faculty who demanded quality. This cascaded into lack of interest among clients who offered projects solely to market their organizations as potential recruiters. In turn, this led to the perception that Industrial Engineering has little potential in business situations.

Certain existing practices continued in the revamped system. A faculty advisor is assigned to each project who offers guidance in technical areas of the project, management of the project and communication about the project. Students are also assigned to a client contact who offers support in drawing company support such as accessing data. Several other facilities of support commenced in the revamped system. These include development or guidance from mentors/ guides/advisors in matters such as etiquettes, professional communication, oral presentation, writing engineering reports. The Georgia Tech Office of Legal Affairs handles negotiation of Non-Disclosure and IPR agreements and advices students on legal & IP issues.

The duration of project execution spans a semester. However, team formation, project identification and scope and proposal /justification are initiated two months in advance and this period is referred to as pre-semester period. Students are required to constitute teams and find projects. They are guided by a Senior Design Coordinator (who is a faculty) in respect of team formation, client selection, project identification and scope, and instructions relating to professionalism and professional communication. He also guides students in their early communication with clients regarding resource and legal issues. Later students are assigned to a faculty advisor who guides students subsequently along with other experts. During the project semester, the coordinator coordinates all the internal and external resources, provides administrative support, gives feedback on the progress to each team and assigns course grades to students.

Several factors such as teamwork, professionalism, written and oral communication, technical and strategic merits of project work are incorporated during grading. Penalties are levied for missing deadlines, unprofessional behavior and sloppiness. Verbal feedback is provided at several

stages: during the pre-semester, the second week of the semester on project proposal, during the eighth week on project presentation, written report and professionalism. Grades are assigned during the eighth week and at the end of the project. Students have opportunities to learn from past mistakes.

Awards have been instituted to motivate performance. Three or four projects are shortlisted as senior design finalists. Posters of finalists are prominently displayed along with names of team members. Finalist teams present their projects before a vast and diverse audience and a winning team is identified as the semester's best senior design project. The competitive spirit created has therefore served as a motivation to faculty, clients and students to strive for quality.

The revamped system has enhanced professionalism. Since grades are assigned by the Senior Design Coordinator (who also draws on the views of faculty advisor but whose ratings are final), there is uniformity in performance expectations from all students. Faculty advisors now focus exclusively on technical guidance.

Faculty, students and clients overall, are more positive of the revamped system. Clients from 29 countries from North America, Europe, Asia & Africa offer projects and the client base includes government, international manufacturers and distributors and global aid organizations. Topics too, span a wider range of areas.

Other positive evidences of the revamped system include scope to access confidential data, and Non-disclosure agreements and IPR becoming common requirements. Students opine that placement prospects have improved owing to effective articulation of project work during placement interviews. Students also feel that the I.E department is rated very highly in the campus.

Students are encouraged to submit results of their projects to international competitions. In some of these competitions students have won prizes. (Hackman, Sokol and Zhou, 2013)

f) Department of Industrial and Systems Engineering, University of Tennessee, Knoxville

The Department of Industrial and Systems Engineering at the University of Tennessee, Knoxville, has a Center for Productivity Innovation (CPI). The Centre conducts a Program entitled "Student Project with Industry" (SPI) that offers students opportunities to acquire real world experiences. Projects are undertaken in the university based on inputs from and sometimes with extensive interaction with industry. Broadly, types of projects undertaken are consultancy, applications development, revision of previous models and pure research. The later three approaches are highly research oriented.

To ensure quality learning experiences, the SPI has evolved an effective structure. The Program team has several resource persons with defined roles and responsibilities. The CPI director takes charge of arranging for funds for the SPI Program; satisfying sponsoring agencies requirements and ensuring that they receive promised deliverables; guiding graduate students to enable them to successfully complete their degree courses and aligning the growth of the SPI program with that of ISyE. A doctoral student who is at the advanced stage of his Ph. D assumes the role of Publications Coordinator who facilitates working on research papers and ensures that publication targets are met with. The Project Coordinator helps the students in planning and executing projects and monitors students' research progress. The Laboratory Coordinator works with the Director to develop laboratory capabilities required by the SPI Program. The Project Team

Leader works with the Director to complete the project and uses the project to prepare his thesis. Each graduate student chooses one research subgroups from the areas healthcare, supply chain, optimization, reliability, natural interaction, environment or energy. Members of each subgroup work and share information and ideas with other students. In every sub-group, a faculty member, post-doctoral fellow or a Ph. D student who is at the advanced stage takes charge as the leader. Thus, roles and responsibilities are well defined.

About 90% of the projects are funded. The sponsors for such research include federal agencies such as National Science Foundation, Defense Logistics Agency and industrial sponsors such as Halliburton, British Petroleum or Volkswagen.

Every new student joins a subgroup based on his area of interest. The SPI Project Program Coordinator assigns a project to a student incorporating his interest and maintaining a balance between his ability to complete the course and his abilities to gain from the project. Team leaders are assigned to projects by the SPI Project Program Coordinator in conjunction with the SPI Program Coordinator.

Projects have helped students extensively. Their motivation levels have enhanced, professional contacts have increased and their technical communication, organizational and social skills have been stepped up. Recruiters have better perceptions of graduates.

The performance of SPI is tracked on other facets besides placement. This would be important to ensure financial stability and academic reputation. One is the research output in respect of publications in refereed journals and conference proceedings. The monetary value of the funding received is also noted. In addition, the competitiveness of firms in the Tennessee region in respect of cost savings, job creation, investment in equipment and facilities as well upgradation of infrastructure is observed. The performance over a five -year period was found to be encouraging (Sawhney, 2013).

Thus, effective support or administrative systems to promote industry academic interface probably better enable quality internship programs.

Benefits from Internships

Internships have offered extensive promise to the institutions considered in the discussion, so far. The benefits accrue to the host organizations, academic institutions and students. The potential benefits from internship are detailed below:

Plant tours enables students to develop their power of observation. This would be important to students during their professional career when they need to undertake benchmarking studies, assess or assist vendors. Besides actual visits to plants, institutions could also capitalize on virtual tours. For instance, the Institute for Operations Research and Management Sciences (INFORMS), a professional body in USA, has instituted the 'Franz Edelman Award' in honor of Prof Franz Edelman, a renowned expert in O.R. The award is given to a firm with demonstrated evidence in the successful application of O.R. Videos and DVDs of past winners are available for purchase (Eaves, 1997).

In management education, concepts are illustrated using real-life examples. Case studies also serve as a powerful teaching methodology. However, internships serve as a more effective approach to reinforce theories. For example, at Eindhoven, students gained better appreciation

of the importance of total supply chain optimization rather than optimization at the firm level (Wouters & Van Donselaar, 2000). Similarly, at Cornell, visits to Lord Corporation provided insights on the strategic role of the Operations function (Bradley & Willett, 2004). This is to be expected owing to the tacit nature of the knowledge acquired and the consequent need for an experiential approach to learning. In the internship at Alcoa, as stated earlier, initiation of an O.R intervention led to the use of data to ascertain the relative demand of various products. This helps to illustrate that the benefit of an O.R intervention may accrue from the initiation of a system of data collection and analysis besides other likely benefits from O.R implementation. Once data collection is routinized, it could have other uses too. Such insights on modeling are better learnt from observation and execution (Balakrishnan, Brown, Dunlap & Pahl, 1995).

Internships also enable students to better assimilate courses after doing one or more projects. At the University of Tennessee, faculty drew on the project experiences during subsequent classroom instruction and this improved students' understanding. Further, quality of analysis during case discussion sessions was enhanced (Helms, 1989).

At the Faculty of Management, University of Calgary, Grossman (2002) states that students' technical communication skills were enhanced owing to their learning experiences from presentations. They invariably included too much formulae and numerical data. Through feedback, these were substituted by graphs and other visual aids. Students were also sensitized to data management. Specifically, they learnt that non-availability of required data need not deter quality analysis.

Grossman et. al. (2008) drew on their experiences in project guidance to identify how to guide students to make managerial rather than technical presentations. Authors expressed that while working on projects students were in the realm of the model world that ignores ambiguity. Later during presentations however, they need to incorporate ambiguity that occurs in the real world and make managerial presentations. He opines that faculty could offer guidance to students to develop the skills during coursework through cases and later during projects. Several authors whose internship systems are detailed in this paper have incorporated his expertise on this aspect.

Grossman (2002) also highlights that faculty contact with professionals during internship better enables them to capture industry expectations. For example, they restructured their courses by focusing on model building rather than extensively teach O.R. tools and techniques. Specifically, it was noted that students need to acquire skills to create useful models that are tractable and cope with complexity, ambiguity and limitations of data availability. Greater emphasis was then assigned to spreadsheet modeling and managerial issues such as sensitivity analysis. After restructuring, it was found that students in subsequent batches could perform better during internships. Such initiatives are a mandatory requirement for reaccreditation by AACSB.

Experience in project guidance was also useful to faculty owing to the scope to develop cases and draw insights for research. Industry gains as students work on areas of relevance to business, especially when current work pressures lead to lack of focus on these areas. Students whose performance is commendable could be easily considered for recruitment.

The benefits from internships to the three groups of stakeholders: students, faculty and business schools and participating organizations are summarized below.

Table 2: Typical Benefits from Internship Projects

Benefits to Students	Benefits to teaching faculty/ business schools	Benefits to participating organizations
1. Quality of learning improves as observation power improves, communication skills especially technical presentation skills are enhanced. Ability to execute data analysis improves owing to the acquisition of data management skills. Tacit knowledge is acquired. Also, classroom instruction offered during or after an internship is better assimilated, especially case studies. 2. Group dynamics is appreciated. This improves a student's ability to work in teams. 3. Placement prospects improve even when a student is not offered a position in an internship organization. Sometimes organizations themselves make offers to interns.	1. An effective industry academia interface system could evolve. There is scope to market emerging theories. Recruiter expectations are captured and get incorporated in academic delivery. Reputation in industry circles gets enhanced. 2. Better service quality leading to greater market reputation. This could lead to greater demand for enrollments. 3. Scope to align areas for faculty research to issues of relevance to industry.	1. Scope to learn and implement emerging and possibly other concepts in management. This could improve operational performance. 2. Help institutions to align education with industry expectations. This enhances the scope to recruit students who possess requisite skills. Helps to alleviate the problem of talent dearth. Sometimes interns could be carefully vetted for suitability for employment in the organization itself.

Discussion

The review highlights the scope for internship projects in a rich mix of firms in the manufacturing and service sectors such as hotels, hospitals, government organizations, retail and manufacturers of automotive components, automobiles, and chemical and mechanical components. Also, both small sized firms like pharmacies, fast food restaurants, spas, car rentals and large sized manufacturers like Lord Corporation and Alcoa served as internship clients. Projects have been undertaken in diverse areas such as quality, process planning, process improvement, project management, inventory management and revenue management. Several concepts/ methodologies such as statistical tools, mathematical programming, simulation, kaizen and risk management have been used during these projects. This highlights the scope and importance of developing a large client base and for projects on several topics and methodologies.

In India, business schools invariably include an internship during the two-year MBA program, often with faculty guidance. Internships are considered a useful component of the program. Sometimes the client makes an attractive placement offer to some students. However, institutes desirous of marketing their institutions need to explore other ways to project their internship programs to boost their image. A strong industry institute interface serves this purpose. The experiences of reputed institutions discussed in this paper could offer useful insights.

Business schools in India usually tend to explore internship opportunities from select organizations which either offer placements or whose brand value helps during placements. Businesses in the small-scale sector are sometimes excluded from consideration. Also, limited sectors are capitalized upon. However, if the thrust on internships should increase and sometimes held concurrently with classroom inputs, greater flexibility is invariably necessary as out station projects cannot be used. Further, emerging areas like healthcare, logistics and research institutions need to be explored.

The importance of internships to imbibe critical soft skills like communication and team work are obvious. Certain techniques like statistical process control and Pareto analysis are easy to assimilate conceptually. However, learning to apply these techniques in real-life situations is better accomplished using internships. Certain O.R techniques like Analytical Hierarchy Process

and Queuing theory need classroom teaching. However, internships could complement classroom teaching and reinforce practical aspects as detailed earlier. Presently, the importance of analytics in decision making is gaining momentum. Products of business schools then need a blend of theory and practice to contribute to the analytic movement. Well-designed internship programs would then be of great value. OM and O.R. faculty need to act swiftly to capitalize on the analytic movement lest the demand for the Operations specialization would continue to be low.

Concern for lack of research activity in Indian business schools has often been cited. Accreditation will create pressure for quality applied research. In the U.S., however, focus on research without incorporating real world issues proved detrimental (Bennis & O'Toole, 2005). Indian business schools could avoid falling in this trap. This review illustrates that several business schools focused their research on real-life issues drawing from the experiences in internships. Hence faculty could integrate internship projects with research activity and even course teaching, owing to the scope to prepare cases and exercises.

Continuing education, especially in business management is not new. Several business schools offer management development programs and part time degree and diploma programs. To increase their utility, schools can emulate the practice at Villanova University and supplement classroom instruction with quality internship programs. This would be important to cope with competition among business schools. Demand for part time programs in Operations would increase as several technically strong engineering graduates need managerial skills.

In the traditional teaching system, several faculty members rely extensively on the lecture method. Their performance depends predominantly on domain knowledge and teaching quality. Those who use the case method also require other classroom management skills like listening, soliciting and promoting participation. Greater use of internships necessitates other skills like developing industry contacts and sustaining relations with executives. Faculty development is then critical. Further, business schools themselves need to reduce faculty teaching load (Gorman, 2010). Otherwise quality of internships could suffer. This would be a challenge owing to a dearth of quality full time faculty in most business schools.

Hence, an incremental and evolutionary approach is required to cope with the challenges arising from the demands of effective internship systems. Effective systems have probably evolved over the years in the institutions detailed above. For instance, the system at Villanova evolved over a period of five years.

The greater potential for internship programs is getting recognition in India too. Mr. S. Ramadurai, Tata Consultancy Services and Advisor to the Prime Minister of India for the National Skill Development Council has urged companies to work out an institutionalized process of recruiting interns. He emphasizes the importance of a commitment to invest in training. This could alleviate the problem of a lack of skilled professionals. He also expressed that academic institutions should emphasize internships. Further, he exhorted the Madras Chamber to play a stellar role to promote internships which other industry bodies could emulate (Business Line, 2012). For this, the practices at Informs Career Center in U.S which offers support both to employers and students in respect of analytics internships can probably be incorporated.

At the industry level, Unilever, Procter and Gamble and Siemens Financial Services already offer international assignments to students in Indian Business Schools. Students are therefore exposed to different cultures and markets. This would be useful to students during their careers owing to a better exposure to the global business context (Singh, 2014).

Simultaneous initiatives from academics, industry and industry associations could be a driver of effective internships systems and serve to upgrade the quality of education.

Limitations of the Study and Scope for Further Research

While the literature review offers useful insights to business schools for future initiatives, several other interrelated issues are of significance. These could be considered for future research/ investigation. These are as follows:

i) Planning and organizing internship projects in conjunction with other pedagogical approaches

The discussion in this paper is almost entirely devoted to internship projects. Several other pedagogical approaches however, offer learning potential. Management games or simulation games and case studies are in fact, extensively used.

Behara and Davies (2010) highlight that besides active learning detailed earlier, experiential learning and action learning constitute student centric pedagogical approaches. Experiential learning is defined as "the process of creating knowledge or learning by reflecting upon an individual's direct experience". Plant tours and games are illustrative of this.

Action learning involves learning through reflections on actions and experiences by working on real life problems either independently or in groups. Dobson and Tilson (2016) suggest use of cases, but with a thrust to mimic real life situations and as illustration of action learning. The authors developed such a case using a past student's project in a pharmacy. The project relates to process improvement to reduce waste. The case comprises three parts: a brief description of the setting, a plant tour in written form and finally, the deliverables which requires students to propose an approach to schedule production along with recommendations. Students use Excel to draw and analyze data. Data are not provided in the required format that can be readily comprehended. Further, students are required to choose data appropriate for analysis. Authors found that this posed a challenge to students but was a rewarding experience and this mimics a project situation. Authors state that such cases could follow typical cases normally used, but precede industry projects. Probably this provides for an effective process of transition. Authors therefore advocate development and use of such cases.

Even in respect of active learning, Behara and Davis (2010) did not entirely focus on company projects in their Service Operations Management course. For undergraduate students who did not have much work experience, projects that enabled students to learn from personal experiences were used. Specifically, students collected and analyzed real world data from Web-Based archival data sources maintained by government organizations, industry or news media. For example, some students collected and classified customer complaints on common dimensions on service quality such as reliability, responsiveness and empathy. Suggestions of customers were also studied. Using the entire data, students prepared a brief report and proposed recommendations. This enabled them to appreciate difficulties in maintaining service standards.

Owing to a variety of approaches to promote learning, institutions should identify an appropriate mix incorporating several factors such as students' profile, institute location and the current standing in respect of industry interface. For example, scope for internships in industry is less when an institute is in areas with limited business activity and when projects are to be planned concurrently with course work.

ii) Planning internship programs incorporating course learning outcomes

Currently, several business schools identify important course learning outcomes and then plan course contents and pedagogical approaches to promote effective learning. Specifically, learning outcomes are the new repertoire of knowledge, skills and capabilities to be acquired in the process of learning. For example, a business school set several learning outcomes such as learning to learn, problem solving and skills in business and skills in assessing and evaluating information (Goodman & Beenan, 2008). Some institutions use the technique "Quality Function Deployment" to identify course contents incorporating learning outcomes. Similar initiatives could be explored in the context of internships.

iii) Timing of internship programs

Besides basic conceptual inputs, students preferably require exposure to other experiential learning approaches prior to internships. Hence internships should not be offered too early in the program. However, once students undergo internships, their ability to learn practical aspects, particularly through cases get enhanced. Deferring internships until the end of the program therefore is also undesirable. Timing for internships therefore need to be planned. Other factors such as duration and number of internships offered during the program also need to be considered.

iv) Planning course contents

When institutes offer long duration internship programs, reduction in course contents become inevitable. Contents then require to be chosen carefully. Students however, may have to learn new concepts possibly with faculty assistance during internship. The course content to be covered could be planned on completion of internships incorporating what is learnt during internships.

v) Institutionalizing internship programs

As stated earlier, effective support or administrative systems are required to ensure quality internships. Recruitment of professionals with administrative capabilities could be important to manage internships and several industry interface issues. Aspects like team building, marketing and institution building are of significance. Manpower planning, selection, training and development then become critical and challenging.

The above is not intended to be exhaustive. However, they are indicative of the numerous challenges that need to be addressed to organize internships. Probably ongoing study and research of best practices could be a powerful driver of quality internships. Grossman et.al, (2008) developed a useful framework to enable faculty to guide students to develop their abilities to make managerial presentations. The authors however advocate development of more material in this area. Similarly, development of materials related to other aspects like those detailed above could be useful to business schools intending to reengineer their educational programs.

References

August 5, (2012), *The Hindu Business Line*. Industry Must Institutionalize Process to Recruit Interns.

Ahire, S.L. (2001). Linking Operations Management Students Directly to the Real World, *Interfaces*, 31(5), 104-120.

Anderson, C.K, Kimes & Carroll, B. (2009). Teaching Revenue Management at the Cornell University School of Hotel Administration, *INFORMS Transactions on Education*, 9(3), 109-116.

Armacost, A.P & Lowe, J K. (2003). Operations Research Capstone Course: A Project Based Process of Discovery and Application, *INFORMS Transactions on Education*, 3(2), 1-25.

Aserkar, R. (2013). Learning through Industry Interface Projects, *INFORMS Transactions on Education*, 13(2), 93-101.

Aswathappa, K. (2010). *Organizational Behavior: Text, Cases and Games*, Himalaya Publishing House.

Balakrishnan, A., Brown, S., Dunlap, D. & Pahl, R (1995). Interdisciplinary Industry- University Collaboration: Lessons from an Operations Improvement Project, *Interfaces*, 25(5), 12-41.

Behara, R.S & Davies, M. M. (2010). Active Learning Projects in Service Operations Management, *INFORMS Transactions on Education*, 11(1), 20-28.

Bennis, W.G &. O. Toole, J. (2005). How Business Schools Lost their Way, *Harvard Business Review*, 83, 96-104.

Bradley, J.R. & Willett, J. (2004). Cornell Students Participate in Lord Corporation's Kaizen Projects. *Interfaces,* 34(6), 451-459.

Dobson, G. & Tilson, V. (2016), Case Article: Medication Waste Reduction in a Hospital Pharmacy: A Case That Bridges Problem Solving Between a Traditional Case and an Industrial Project, *INFORMS Transactions on Education*, 16(2), 68-70.

Drew, S.A.W. (2011). Strategic Roles of Centers in Business School Development, *Journal of Management Development*, 30(9), 793-815.

Eaves, B.C. (1997). Learning the Practice of Operational Research, *Interfaces*, 27(5), 104-115.

Fraiman, N.M. (2002). Building Relationships between Universities and Businesses: The Case of Columbia Business School, *Interfaces*, 32(2), 52-55.

Godson, R.E. (2002). Read a Plant Fast, *Harvard Business Review*, 80, 105-113.

Goodman, P.S. & Beenen, G. (2008), Organizational Learning Contracts and Management Education, *Academy of Management Learning Education*, 7(4), 521-534.

Gorman, M. F. (2010). The University of Dayton Operations Management Capstone Course: Undergraduate Student Field Consulting Applies Theory to Practice, *Interfaces*, 40(6), 432-443.

Grossman, T. A. (2002). Students Consulting Projects Benefit Faculty & Industry, *Interfaces*, 32(2), 42-48.

Grossman, T.A.; Norbak, J.S.; Hardin, J.R. & Forehand, G.A. (2008), Managerial Communication of Analytical Work, *INFORMS Transactions on Education*, 8(3), 125-138.

Hackman, S., Sokol, J. & Zhou, C. (2013), An Effective Approach to Integrated Learning in Capstone Design, *INFORMS Transactions on Education*, 13(2), 68-82.

Handfield, R.B., Edwards, S.A., & Stonebraker, J.S. (2011). N. C State's Supply Chain Resource Cooperative Educates in the Real World, *Interfaces*, 41(6), 548-563.

Helms, M.M. (1989). To Produce Interest in Production, Just Open the Factory Door. *Production & Inventory Management Journal*, 30(2), 72-74.

Liberatore, M. J., & Nydick, R.L. (1999). The Teacher's Forum: Breaking the Mold A New Approach to Teaching the First MBA Course in Management Science, *Interfaces*, 29(4), 99-116.

Milne, R. J. & Zander, A. K. (2012). Operations Research Capstone Courses for Business Majors with Analytics Background, *INFORMS Transactions on Education*, 13(1), 2-9

Nonaka, I (1991). The Knowledge Creating Company. *Harvard Business Review*, 69, 96-104.

Pilotte, M., Kovaichelvan, V., Chand, S & Iyer, A. (2012). Global Experiential Projects with a Manufacturer in India: Five Years of Experience, *INFORMS Transactions on Education*, 13(1), 31-43.

Salo, A. (2012). A Seminar for Solving Client Problems in Project Teams, *INFORMS Transactions on Education*, 13(1), 17-27.

Sawhney, R., Malek, S., Wilck, J & Hashemian, P. (2013). Centre for Productivity Innovation's Student Project with Industry at the University of Tennessee, Department of Industrial Engineering and Systems Engineering, *INFORMS Transactions on Education*, 13(2), 83-92.

Singh, N (2014, November 17). Summer Interns Land Global Projects, *Times of India*.

Upton, D.M., & Macadam, S.E. (1997). Why (and How) to Take a Plant Tour, *Harvard Business Review*, 75, 97-106.

Wallace, P. (2007). Using Collaboration to Provide Students with an Internship Experience in an Information Systems Course, *Journal of Information Systems Education*, 18(2), 145-148.

Wouters, M.J.F., & Van Donselaar, K.H. (2000). Design of Operations Management Internships across Organizations: Learning OM by Doing, *Interface*s, 30(4), 81-93.

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