An Assessment and Teaching Strategies of An Integrated Model For Management and Economics Instruction for Engineers[1]

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Recent rapid advances in technology, fierce corporate competition, and tremendous uncertainty in today's economy have made the engineering function more complex and multifaceted than conventional or traditional forms of organization. Organizations are continuously trying to adapt to changes not only in technology but also in markets, regulations, financial innovations, socioeconomic conditions, and work force diversity. The computer and telecommunication revolution places technocrats in closer more direct contact with internal workers, suppliers, competitors, and clients. Moreover, the recent significant shift of U.S. companies towards a more service-oriented global network and changing scenarios demand engineers who are capable of assuming the multiple role of technology experts with efficient management skills. However, academic institutions have not focused on the increased need for a more integrated approach to educational training for our engineering scientists to cope with their emerging roles.

Bordman and Hasan (1996) projected some thoughts on how an educational background could be re-organized in order to better prepare today's engineering and technology scientists. More specifically, the article outlined a combined effort by the School of Industrial Management and College of Science and Liberal Arts at the New Jersey Institute of Technology in redesigning the basic economics and management courses for our new technological and global society. The redesign was an attempt to develop a joint curriculum for both courses with an applications emphasis**.** This paper is a follow-up to the previous paper with an assessment that concentrates on learning style, teaching strategies, and student performances.

The paper proceeds in the following manner. First, we briefly discuss the growing literature on the roles and required skills for engineers followed by a description of our approach to integrating management and economics courses as part of an integrated engineering and management education. In the third section, the paper discusses the literature on appropriate learning styles and environments followed by an analysis of different accepted assessment indicators useful for assessing the learning environment and student performance in our integrated

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economics and management course at the NJIT. Section five discusses the results of the study followed by a concluding discussion in section six.

II. Changing Environment and the Need for New Skills

Multifacet initiatives of engineering and manufacturing firms are crucial to survival in the global competitive market place. Moreover, technological advances, changing organization structures, and rising competition from newly industrialized countries [Porter (1986)] have affected the career directions and expectations of many engineers. Increased concentration on cost efficiency and product differentiation may be the key to the new direction for firms to regain or maintain competitive advantage [Porter (1985, 1990)]. Babcock and Lloyd (1992), however, note that engineers must link their technical practice with accounting and marketing personnel. Lake (1992) believes that engineers need to have communication, interpersonal relations, negotiation, and conflict resolution skills in addition to technical skills.

Most engineering education programs still center on knowledge of technology [Lake (1992)]. The reason for this is both traditional and the criteria established by the Accrediting Board for Engineering and Technology (ABET, the accrediting organization widely used in the U.S.) regards the "humanities and social sciences," which may only include traditional economics but not "subjects such as accounting, industrial management, personal administration, [or] engineering economy." Babcock and Lloyd (1992) stated that although ABET does not oppose management content in an undergraduate engineering program, management content has to compete with other courses and other program objectives for an unspecified 25 percent of the curriculum. Hauck (1986) and Kirchhoff and Lin (1994) quoted ABET requirements and believe that the purpose of engineering training is limited to teaching students the application of theoretically based principles of the natural sciences to real problems. Hence, students are expected to focus on one segment of a technology specialty. It is quite natural that these students will, after graduation from schools, become engineers involved predominately with technical concerns. Exposure to the overall topic of business, its management, and its operation is difficult to affect within the ABET approved four year curriculum. A large number of ABET accredited engineering schools have adopted business management education requirements under an engineering management major [Sarchet and Robert (1986); Babcock and Lloyd (1992)]. Such programs, designed to link the gap between engineering and management knowledge, are typically housed in industrial engineering departments and include many courses that stress the technical aspects of management - production efficiency models, scheduling models, quality control, etc.— all of which meet ABET's definition of applied technology, but treat subjects such as accounting, finance, marketing, personnel management, and business strategy only superficially, if at all.

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The impact of changes in the global business environment upon engineering education has been fully appreciated by NJIT. In order to provide engineering students with an integrated knowledge of engineering and management, NJIT has made some changes to its education programs. Instead of offering engineering students traditional economics and management courses which are taken with business and social science students - where an appropriate emphasis is reflective of either a social or financial environment suitable for social science and business majors - the New Jersey Institute of Technology segregates its engineering students so that the inter-relationship of the materials covered by its Principles of Management and Economics courses may be emphasized. These two courses have been redesigned as a joint curriculum in order to overcome the shortcomings of the traditional curriculum and teaching in these areas.[2] This effort is part of a grant program funded by the National Science Foundation.[3]

III. Literature Review

A number of studies have focused on teaching patterns, learning approaches, and student accomplishments.[4] Dewey (1938) stressed the importance of practical knowledge in developing a successful learning process. Lewin (1951) concluded that a proper learning environment is the key in creating appropriate learning processes. Following the earlier studies, Piaget (1971) reported that intelligence is an important aspect of the dynamics between the individual and learning environment. These findings were the basis of learning-style models such as Dunn's Learning Style Inventory, Kolb's Learning Style Inventory, 4MAT, and the Myers-Briggs Type Indicator.

Holley and Jenkins (1993) and Filbeck and Smith (1996) used Kolb's Learning-Style Inventory (1985) to correlate student performances with their learning styles on four types of examination questions. This paper closely follows the analyses of the above papers in developing similar correlations. The learning style used in these papers categorizes individuals into four groups of learners under two scales. One scale indicates how individuals understand information through concrete experience (CE) or abstract conceptualization (AC). The other

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[2] See Appendix I for a comprehensive analysis and detailed syllabus of the integrated course.

[3] The National Science Foundation (NSF) recognizes the importance of integrating engineering and management knowledge. A manufacturing education program, which aims at preparing engineering students to design, manufacture and sell products, was proposed by NJIT, funded by NSF, and is now under development. The proposed program integrates courses related to product design, manufacturing systems engineering and management. Also, by offering seminar series conducted by industry experts and summer employment in manufacturing factories, this program tries to provide students with experiences from the real world. The Dean of the Engineering College leads this education program initiative with key inputs from professors, students, and administrators of all related disciplines at the Institute.

[4] See Murrell and Claxton (1987) for a detail literature review.

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scale indicates how individuals transform information through active experimentation (AE) or reflective observation (RO). The interaction of these two scales categorizes the learners' groups into accommodator (CE-AE), diverger (CE-RO), converger (AC-AE), and assimilator (AC-RO).

Given the newly developed, integrated economics-management course, we felt the need to learn more about the learning preferences of students registered for such courses. This would enable us not only to assess the course but also to develop an optimal learning environment for the students while simultaneously helping us strengthen weak areas of their cognitive process.

Myers-Briggs Type Indicator [MBTI]

More than five decades ago, Katherine Briggs and Isabel Myers began work on an instrument to operationalize Carl Jung's (1921, 1971) theory of psychological types which postulated that certain psychological preferences play a major role in our judgment and interaction with the world. Jung developed his method of typology based on three scales or dimensions of personality. Briggs and Myers extended this study and developed a questionnaire, the MBTI, which they tested over the years. Today, over three million people a year complete the MBTI [Myers and McCaulley (1985)], and it is the basis of thousands of articles on different subjects. Myers and McCaulley reported strong evidence of the reliability of MBTI indicators, especially on adults. The split-half reliabilities of continuous scores for numerous samples repeatedly exceed .75 for each scale [Carlyn (1977)].[5]

Briggs and Myers included a fourth scale for Jung's three dimensions of preferences. These dimensions measure and reveal preferred modes of individuals toward their attention and orientation - introversion (I) and extroversion (E); perception and methods of acquiring information from the surroundings - sensing (S) versus intuition (N); decision making - thinking (T) and feeling (F); orientation toward the outer world - judgment (J) and perception (P). Dimensions are based on strength of preference ranging from zero to approximately fifty where higher scores indicate higher preferences for the particular function. Table 1 displays a brief summary of MBTI scales. These four sets of preferences combine sixteen distinct personality types. An understanding of type preferences and their interactions serve as a core of "individual types."[6] Given that the scales are a continuum, individuals within each of the sixteen types are likely to vary and at the same time share certain common characteristics.

IV. MBTI and the Assessment of the Integrated Course at NJIT

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[5] Lawrence (1988), Myers and McCaully (1989), Gardner and Martinko, Filbeck and Smith (1996) provide further detail on the reliability of MBTI.

[6] For a complete description of these dimensions and 16 combinations see Jung (1921, 1971), Myers and Myers (1980), Myers and McCaulley (1985).

MBTI's application has not been limited to corporate management [Reynierse (1993), Walck (1992)], job satisfaction, [Scarborough (1993)], or management attitude [Johnson (1992)]. In recent years, MBTI's application to education has become increasingly popular [Myers and McCaulley (1989), Myers and Myers (1980), Lawrence (1988)]. Eggins (1979) extended previous investigations on the correlation between learning styles and student performance using alternative learning models. The author reported a overwhelming dominance of SJ and NJ types with success. Campbell and David (1990) suggested ISTJ as the most effective strategies for classroom learning. A number of papers in the literature have applied MBTI's application to education.

In the first stage of the integrated economics-management course offering, we developed an ad hoc assessment procedure. This initial assessment focused on assessment of student achievement, regarding the new curriculum, other than classroom participation and testing.

The following scenario was developed and presented to the students at the beginning of the first semester of the two-semester economics and management sequence:

A manufacturer of plastic kitchen bowls and containers is not able to meet the market demand for its products, even though it has continually raised the price of its products. It is considering a major increase in production, either by a new plant in the United States or an overseas facility. The company has been very fortunate due to the fact that there have been many returns of its product because of defects, and yet, its sales have still increased. Despite its growing revenues, the company is in a precarious financial position due to its large debt-to-equity ratio. Also its Chief Financial Officer recently suffered a stroke and his position as yet remains unfilled. Fortunately, the company enjoys good relations with the employees and their union. A new three year contract with the union was just signed calling for wage increases equal to cost-of-living increases.

1. Discuss the various opportunities and problems facing the company (especially delineate the pertinent factors for each area under discussion).

2. What course of action would you employ for the company? Why? What are the bases for the decisions?

At the beginning of the semester, the students were divided into groups of four members each and worked on their respective analyses of the scenario and its attendent questions for a period of two weeks, after which the reports were collected. During the last two weeks of the semester, the reports were given back to the groups. They were requested to make any changes, additions, deletions or revisions of any type that they might feel necessary in view of the semester's work.

The summary results of evaluating the students' reports are as follows:

1. Virtually all the groups were able to delineate the problems of:

        a. Poor quality control.
        b. Loss of the Chief Financial Officer.
        c. Large debt-to-equity ratio.
        d. Inability to meet product demand.

2. Also, the strengths of the company were easily discerned by the groups; for example

        a. Good employee relations.
        b. Good union relations.
        c. Union contract for three years held to cost-of-living adjustments.

The students were then asked what to do about the problems, what course of action the company should employ, as well as the bases for their decisions. It is in this part of the analyses that the results were somewhat disappointing and yet enlightening. First, to our disappointment the students readily recognized the problems, but their response to the problems was, at best, trivial. While they all were appalled by the large debt-to-equity ratio, their solution to the problem was "that the large debt-to-equity ratio has to be reduced." Similarly, while the students were equally dismayed by the large number of defects in the production of the products, only around 20 percent of them were able to apply the theoretical aspects of the course (e.g. elasticity of demand, costs of production, and different models of international enterprise and management) to the scenario. Based on our own scoring of the answers as they relate to the appropriate theory, we found that on average the class had a score of 74 or C, which was less than our enthusiastic expectation.

It may well be that the course content is too demanding (e.g. the one semester covers both macro and micro economics along with inputs from finance and management). The content of the management course sequence is also very ambitious. Students are taught to think as a multi-function manager. First, they are trained to evaluate projects from a financial analyst's perspective (cost-benefit analysis). They are also taught to think from the perspectives of a product manager and a human resources manger, employing management decision criteria in a global economy characterized by innovation and technical changes.

At the beginning of each semester, students are also assigned a technology-based industry as a case study. As each segment of finance, marketing, and management theory is taught, students are asked to relate the issues to their respective companies through in-class analysis, data gathering using SEC information available in the library, and, in some cases, through interviewing appropriate personnel. All students are required to analyze all aspects of the theory taught in the class relative to their projects; however, detailed attention is given to one particular area of the materials covered in class (e.g. product planning or product marketing).

The students are given several basic financial valuation problems as homework assignments. A case study (similar to a Harvard Case Study approach) is included to test a student's ability to decide whether management should lease or purchase machinery for a particular project. Both projects are due at the end of the semester. These assignments are required in addition to the mid-term and final examinations.

The second initiative applied MBTI instruments following Holley and Jenkins' (1993) assessment using Kolb's Learning Style Inventory (LSI) model and Filbeck and Smith's (1996) assessment using the MBTI model. The latter study claimed MBTI to be a superior method because of its comprehensive assessment of personality, learning style, and the learning process. These papers investigated student performance on four different types of exam questions: (1) multiple-choice theory (MCT), (2) multiple choice quantitative (MCQ), (3) open-ended theory (OET), and (4) open-ended quantitative (OEQ). Holley and Jenkins showed that students "inclined to excel at doing things [i.e. active experimentation (AE)]" and students with "high abstract conceptualization style [abstract conceptualization (AC)]" performed better on the MCT and OET questions respectively. Filbeck and Smith (1996) reported **a** strong relationship between student performance on MCT questions and MBTI perceiving (P) preference and student performance on MCQ and OEQ questions and MBTI introversion (I) preferences. MCQ also indicated a positive relationship with sensing (S) preferences. Overall, the paper provided strong evidence of the positive impact of teaching and testing style on students' performance.

V. Empirical Issues

We used the MBTI to investigate and assess personality preferences for forty-eight students enrolled in the first semester sequence (ECO-MGT I) and seventy students enrolled in the second semester sequence (ECO-MGT II) of our integrated course.[7] Two courses, freshman design and technology communication, are prerequisites for the fist sequence, ECO-MGMT I, which must be completed before students participate in the second sequence, ECO-MGMT II.[8] It should be noted here that unlike traditional economics and management courses, our integrated course offers topics that involve economics, finance, and management with a strong manufacturing emphasis over a two-semester period in which the sequences are taught jointly by professors with respective expertise. Topics covered include *Manufacturing in a Global Economy, Planning a Product, Producing and Marketing a Product, Basic Understanding of Finance and Markets, Cost-Benefit Analysis,*

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[7] The course listings in the Institute Catalog lists the courses as ECON 201(E) and MGT 390 (E). E indicates that the course can only be taken by engineering and technology related majors in an integrated two-semester sequence.

[8] The pre-requisite restriction in the first sequence classes could not be implemented as there were a number of transferred students who did not have the freshman design classes at NJIT.

Business, Economy and Role of Public Institutions, Managing Manufacturing Innovations and Organizational Change, Managing the Manufacturing Firms in the 21st Century, Role of Motivation and Leadership, Manufacturing and Physical Environment, Economic and Management Decision Making.[9]

During the semester, the MBTI was administered to students, along with a learning-style survey to assess what they value in terms of classroom instruction. The learning-styles survey followed surveys developed by qualified and certified professionals (Association of Psychological Type) to administer and evaluate the MBTI. Twenty-eight statements were developed to distinguish potential type differences with respect to learning styles (see Table 2). Statements include items that proxy (correlate strongly) for MBTI preferences discussed earlier (as shown in Table 1). Each statement in the survey asked for responses on a 1 (strongly agree) to 5 (strongly disagree) scale. This survey was used to determine how well students' MBTI scores correlated with their instructional preferences. Next, we investigated the key determining factors associated with student performance in examinations in MCT MCQ OET OEQ (multiple choice and open ended questions with focus in theory as well as in quantitative issues) types of questions.

Table 2 portrays correlation coefficients between the testing format and the four dimensions of student personality in both classes. Our next goal was to investigate the importance (correlation) of teaching style, examination format, academic environment, and related variables on student preferences and success (performance).[10] The investigation considered a number of other tests involving issues related to individual characteristics (sex, age), past performance (grade point average), previous training (prerequisites), and various examination formats. Tables 3 to 9 represent results associated with such investigations. For our measure of learning styles, we used results from the MBTI. We hypothesized that the MBTI score plays a role in the types of questions in which students excel. In order to distinguish the poles of the scales, we assigned negative values for the preference scores for the E, S, T, and J functions and positive values for the I, N, F, and P functions. Our basic regression format was

PERFORM = $a_0 + b_1$ **SEX** + b_2 **AGE** + b_3 **GPA** + b_4**OGPA** + b_5 **EI** + b_6 **SN** + b_7 **TF** + b_8 **JP**   **(1)**

where,

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[9] A course syllabus is included in the appendix.

[10] The statements in Table 2 include items such as "I think it is very important to me for my teacher to be friendly and understanding in class" which we hypothesize to be correlated with a feeling (F) preference and "I prefer critical feedback on how to improve rather than praise for what I have done right" which we would hypothesize to be correlated with a thinking (T) preference. This is exactly similar to the process followed by Filbeck and Smith (1996).

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PERFORM   =   performance on four exam formats [MCT, MCQ,
                                OET, OEQ]
SEX   =   sex of the student (1=female, 2=male)
GPA[11]   =   GPA of the student in prerequisites
OGPA[12]   =   Overall, current GPA
EI   =   scale preference score on extroversion-introversion
SN   =   scale preference on sensing-intuition
TF   =   scale preference score on thinking-feeling
JP   =   scale preference score on judging-perceiving

Results

The MBTI class profile (Table 3) shows that thirteen of the sixteen personality types are represented in the class. The most prevalent groups are ISTJ, which account for 17.7% of the students, NTJ (15.3%), ESTP (14.4%), INTP (13.6%), INFP (11.9%), and ISFP (10.2%). It shows that engineering students are interested in decision making and thinking (T), judgment (J) process, information from surroundings (S). Distributions of students types
show an overwhelming number of sample students indicated a preference for introversion [(I) 57%] as their focus of attention [(as opposed to 43% preference for extroversion(E)], thinking [(T) 81%] as their primary decision making process [(as opposed to 19% preference for feeling (F)], judging [(J) 76%] as a means of orienting to their outer world [(as opposed to 24% preference for perceiving (P)], and sensing [(S) 79%] for acquiring information [(as opposed to 21% preference for intuition (N)].[13] In all categories the percentages exceed those of the general population and therefore provide some indication of preferences of a technologically-based student body in the above categories compared with the general population.

Table 2 shows the results of students' MBTI preferences with our learning-style survey of preferences. In most cases, we found strong correlations that are consistent with MBTI theory. Overall, we found intuitive and perceiving (NP) types prefer unconventional methods (see question number 8, 13, 14, and 18), sensing-judging (SJ) students prefer more conventional and traditional

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[11] Pre-requisite for ECO-MGT 1 is Humanities and Social Science (HSS 101) and Freshman Engineering Design (FED 101). The HSS course is on writing skills, communications, and oral presentations and the FED class is an introductory design course taught with a practical "hands on" approach rather than the traditional theoretical approach.

[12] For a number of students in the ECO-MGT I class, this was their first semester of college at NJIT. Previously, they were either in high school or were enrolled in a junior college. In such cases, we used their high school GPA during their senior year or GPA of the courses taken in the junior college. We also have calculated an approximate GPA from previously taken relevant courses as their GPA in the pre-requisite. Estimations excluding these 8 students from our sample data did not reveal any differences from the reported results in the text.

[13] The general population is approximately 75% (E) and 25% (I), 75% (S) and 25% (I), 50% (T) and 50% (F), 55% (J) and 45% (P).

methods (see question number 4, 5, and 9), thinking-judging (TJ) students prefer more planned and logical methods (see question number 10, 11, and 22), extrovertion type students prefer to volunteer their services and are concerned about others (see number 15, and 17) and so on. When we looked at the relationship between each of the MBTI dimensions and test question formats and performances (Table 4), we found performance on OEQ (open ended quantitative) questions to be positively and significantly correlated with MBTI introversion (I) preference, OET (open ended theory) questions to be positively correlated with MBTI judging (J) preference and extroversion (E), and MCT (multiple choice theory) questions to be negatively correlated with MBTI feeling (F) preference.

We report the descriptive statistics in Table 5 followed by the correlation coefficients for each of the testing formats with SEX, AGE, GPA, and OGPA of the sample students. There are more men than women as indicated by an average of 1.61. The average student age was 22.30 years for the combined sample. The average OGPA of the students was 2.8, and average GPA of the prerequisites was 2.9. The most prevalent personality type among the students in our sample classes was INTJ. However, while evaluating the ECO-MGT I class alone, we find more influence of extroversion with more prevalent types are ENTJ. The correlation coefficients of the testing formats with the independent variables reveals strong relationship. Both GPA and OGPA are significantly correlated with all four types of question formats (Table 6). We also find significant relationships among the various testing formats except for MCQ and OET. In a separate estimate (not reported in the text), we find significant correlation between the performance in ECO-MGT I and ECO-MGT II classes with the prior performance in pre-requisite courses.

The results for the regression model are shown in Table 7. Again, we only report combined estimates because the results do not differ significantly from the separate estimates for the ECO-MGT I and ECO-MGT II classes. GPA, OGPA, SEX, and MBTI preference for perceiving (P) and intuition (N) tend to explain success in determining the MCT (multiple choice theory) question format. Women performed better than men in this category. With respect to the success in the MCQ (multiple choice quantitative) format, GPA, OGPA, and MBTI sensing (S) preferences played a significant role. For the success in the OET (open-ended theory) format, AGE, GPA of prerequisites, MBTI preferences for intuition (N), thinking (T) and judgment [(J) marginally significant] were found to be significant determining factors. Finally performances in OEQ (open-ended quantitative) format were influenced significantly by the GPA, OGPA, and MBTI preferences for introversion (I), sensing (S) and perceiving (P).

Analyzing the results, it is obvious that student grades in prerequisite courses are important predictors of performance irrespective of the types of questions. Overall grade point average is also important except for explaining open-ended theory questions. We find that performance on both types of

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quantitative questions is influenced by sensing preference, and performance on both theory questions is effected by intuitive preferences. These correlations are consistent with MBTI theory, as sensing individuals tend to prefer concrete facts, whereas data and intuitive individuals prefer theory and to a certain extent other abstractions. Similar explanations can be implied from observing the role of thinking and judgment preferences in determining performance in OET and perception in MCT questions respectively.

The evidence seems to explain why MBTI sensing types seem to perform better in quantitative questions, while MBTI intuitive types tend to excel in theory types of questions regardless of whether they are multiple choice or open-ended questions. Given that the two formats are quite different, it is logical to assume that students associated with such opposing preferences may require a different way of processing information in order to perform well in class. This experience tells us that an effective teaching and testing strategy should incorporate both formats in the classroom. Evidence also suggests that MBTI thinking preference is associated with better performance on OET questions. Although the literature did not indicate any significant role for the thinking preference, it is likely that thinking preference, which stems from skills of logic and reasoning, will contribute to success on open-ended theory problems. Insignificance of feeling preference is not surprising given the overwhelming concentration of think type (82%) over feeling type (18%) in the sample classes.

VI. Conclusion

This research should be of interest not only to engineering-management educators but also to the other disciplines where student background and learning style are diverse and distinct and where these learning styles correlate with their MBTI personality types. Although, we found strong evidence of training, exposure, and performance in prerequisite courses as the strong determinants of performance in all types of test formats, we also observed that no particular types of test questions should be used to measure student performance, as students with different personalities excel in different types of questions. The evidence in this paper indicates that sensing individuals perform better in quantitative questions, while intuitive individuals seem to have an advantage in theory questions.

This research has a great significance for an interdisciplinary curriculum such as the ECO-MGT integrated course. It argues for innovative teaching and testing methods not only to extend MBTI sensing types but also to encourage more intuition and thinking as well as perception for the disciplines. Given the average personality types (introversion, thinking, judgment, and sensing preference) of engineering students, it is important to introduce issues and topics that encourage them to examine, analyze, and communicate not only the overview, patterns, and connection between materials but to approach situations in a creative and innovative way in order to grasp the complexities of the business environment.

Students with these skills will not only do well in technical matters but will also succeed in the corporate world in an uncertain and changing global business environment.

Table 1. Summary of the Four Scales of the MBTI

Dimensions Measured by the Myers-Briggs Type Indicator

Preferences for focusing attention	Extroversion(E)- People who prefer extroversion tend to focus their attention on the outer world of people and things. Since they draw their energy from what goes on around them, they gain energy from interacting and being engaged. They understand the world around them best when they are able to be engaged in activity.	Introversion(I)- People who prefer introversion tend to focus Their attention on the inner world. Since they draw their energy from what goes on inside them , they prefer to reflect before acting. Their need to Think before acting makes it necessary for them to under- stand their world before being engaged in their surroundings.
Preferences for acquiring information	Sensing(S)- People who prefer sensing focus on the concrete aspects of the situation. They value what can be seen, touched, felt, smelled or heard. They tend to be practical-minded and grounded in the present. Their concern for details and facts tend to make them accept what is given and be less interested in change.	Intuition(I)- People who prefer intuition focus on the abstract, even using a "sixth sense" or "gut feeling" to acquire informa- tion. They value relationships not immediately recognizable to The senses, striving to underst- and the "big picture" with an orientation toward future possi- bilities. They are fascinated by change.
Preferences for making decisions	Thinking(T)- People who prefer thinking focus on objective decision making, based on a desire for fairness and detachment. They seek logic in their analysis of situations and any consequences that result. They desire to achieve objectivity and prefer to work to discover what is wrong with situations that arise.	Feeling(F)- People who prefer feeling focus on subjective decision making, based on a desire for harmony. They seek to consider the impact on people in their analysis of a situation. They value interpersonal relation preferring to affirm what is right with situations and offering appreciation and sympathy as needed.
Preferences for orientation to the outer world.	Judging(J)- People who prefer judging focus on Leading a life that is organised and orderly. They seek closure and want things settled. They prefer control over their lives and plan accordingly They desire to work, then play.	Perceiving(P)- People who Prefer perceiving focus on leading a life that is flexible and spontaneous. They seek to keep decisions open and avoid closure. They prefer to experi- ence life and adapt rather than control it. They desire to play, then work.

The combination of preferences on the four scales result in 16 possible combinations:

ISTJ	ISFI	INFJ	INTJ
ISTP	ISFP	INFP	INTP
ESTP	ESFP	ENFP	ENTP
ESTJ	ESFJ	ENFJ	ENTJ

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Table 2. Questionnaire on the Learning Styles and Strategies in the Integrated Course

This table reflects relationships between our survey of students attitudes toward learning preferences and their MBTI profile

Question	Myers-Briggs Personality Indicator Correlation Coefficients(N= 118[#]).				
	EI	SN	TF	JP	Relation
1. I prefer classes that allow interaction with my classmates and/or instructor.	.42[*]	- .38[**]	- .15	- .27[**]	EPN
2. I think it is essential that instructors have real world experience.	- .01	- .04	- .06	.03	----
3. It is very important to me for my teacher to be friendly and understanding during class.	- .07	- .11	.10	- .08	----
4. I understand better when presentations and lectures are well organized.	.08	- .07[**]	.03	.12[***]	SJ
5. I prefer classes that are primarily lecture-oriented.	- .16	.08[*]	.17	.10[**]	SJ
6. I prefer assignments that allow me to use innovative and unusual methods.	.18[**]	-.26[**]	.10[**]	.06	IT
7. An instructor should consider extenuating circumstances in assigning grades.	- .08	- .03	.10	.01	---
8. I learn better by being able to talk about material or assignments.	.13	- .24[***]	.08	- .18[**]	NP
9. I prefer to see the "big picture" for a chapter BEFORE the topic areas within a chapter are introduced.	- .08[**]	- .06[***]	- .11	- .20[**]	SJ
10. I prefer critical feedback on how to improve rather than praise for what I've done right.	.04[*]	- .06	- .18[**]	.32[***]	TJ
11. I prefer a tentative schedule of topics to be covered and deadlines for assignments well in advance.	.28[*]	- .11[*]	- .20[**]	.45[**]	TJ
12. I need some time to compose questions when opportunities arise in class to ask questions.	- .06	.10	- .03	.07	---
13. I enjoy classroom debate and argumentation.	.26	- .32[**]	.15	.41[***]	NP
14. I work best under the pressure of a deadline	.08	- .23[***]	- .10	- .24[***]	NP
15. I volunteer quickly to answer instructor's questions when I know the answer.	.15[**]	.10	.08	.12[*]	E
16. I prefer test questions where I have to compare/contrast material.	.01	- .03	.13	.07	E
17. I prefer to see how classroom material affects people's personal lives.	.21[**]	- .18[*]	.08	- .26[**]	E
18. I prefer open exploration of material without a pre-planned structure.	.08	- .22[***]	- .26	- .17[***]	NP
19. I am good at ignoring distractions and am able to concentrate while studying.	.04	.01	.06	.10	---
20. I prefer objective test question to essay questions.	- .13[**]	.26[**]	.07	.11	IS
21. I prefer instructors to cut off digressions of students even if it hurts people's feelings	- .02	.04	.18	.22[**]	J
22. I organize my study time well in advance.	.14	.12	.40[***]	.29[***]	TJ
23. I prefer to ask my questions to the instructor on a one-on-one basis.	- .30[**]	.02	.16	.11	I
24. I prefer to see linkage between material across the entire course.	- .08	.13	.02	.18	---
25. I prefer personal achievement over group cooperation.	- .27[***]	.36[**]	.03	.14	IS
26. I prefer when class participation is a portion of the grading criteria.	- .32[***]	.03	.18[**]	.07	ET
27. I often have trouble completing tests within the time allowed.	- .13[**]	- .12	.06	.18	I
28. I prefer competition within a classroom.	.28[***]	- .10	.06	.01	E

[***]Significant at the 0.01 level.
[**] Significant at the 0.05 level.
[*] Significant at the 0.10 level.

[#] The number includes both classes (70+48).
  Separate estimate shows a correlationship similar to the combined estimates (Table 2) therefore does not reported,
  Available upon request.

Table 3. Class Profile

This table shows the breakdown of the classes categorized by MBTI profiles.

Myers-Briggs Personality Indicator (N= 118)			
ISTJ	ISFJ	INFJ	INTJ
17.8%	3.4%		15.3%
(N= 21)	(N= 4)	(N= 0)	(N=18)
ISTP	ISFP	INFP	INTP
5.1%	10.2%	11.9%	13.6%
(N= 6)	(N=12)	(N=14)	(N= 16)
ESTP	ESFP	ENFP	ENTP
14.4%		0.8%	0.8%
(N= 17)	(N= 0)	(N=1)	(N=1)
ESTJ	ESFJ	ENFJ	ENTJ
3.4%	1.7%		1.7%
(N=4)	(N= 2)	(N=0)	(N=2)

Distribution of types:

E	51		T	96
I	67		F	22
S	93		J	90
N	25		P	28

Table 4. Myers-Briggs Personality Indicator Preferences and Performance on Differing Testing Formats

This table shows relationships between superior performance on different testing formats and MBTI preferences.

Type of Question	EI	SN	TF	JP		Relation
Overall test performance	.04[*]	.06[*]	.10	-.14[*]		INS
Multiple-choice Theory (MCT).06	.07[*]	-.08[**]	.13		F	
Multiple-Choice Quantitative (MCQ)	.21	-.12[**]	-.02	-.08		S
Open-ended Theory (OET)	.08[**]	.18	.01	.14[***]		EJ
Open-ended Quantitative (OEQ)	.22[***]	-.18	-.03	.07		I

[***]Significant at the 0.01 level.
[**] Significant at the 0.05 level.
[*] Significant at the 0.10 level.

Table 5. Descriptive Statistics for Variables

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Variable	Mean	Standard Deviation
Sex	1.61	.36
Age[*]	22.30	3.01
EI	2.16	(I) 18.28
SN	-12.03	(N) 35.36
TF	-14.68	(T) 28.24
JP	4.28	(J) 18.49
GPA	2.9	.51
OGPA	2.8	.58

[*] average age for the ECO-MGT II class was 25.62.
In ECO-MGT II the popular personality type was INTJ.

Table 6. Differing Testing Formats and Variables Correlation Coefficients

This table shows correlation relationships between the four testing formats and relevant variables

Variable	MCT	MCQ	OET	OEQ
Sex	.12[*]	.08	-.06	.08
Age	-.04	-.11	.06[**]	.03[*]
GPA	.18[***]	.27[***]	.44[***]	.36[***]
OGPA	.24[*]	.42[**]	.20[*]	.18[**]
MCT		.15[**]	.06[**]	.28[**]
MCQ			.18	.42[***]
OET				.47[***]

[***]Significant at the 0.01 level.
[**] Significant at the 0.05 level.
[*] Significant at the 0.10 level.

Table 7. Differing Learning Styles and Variables

This table uses regression analysis (using overall GPA) to determine potential causality relationships between independent variables and performance on the four testing formats.

Model	MCT	MCQ	OET	OEQ
Intercept	2.026 $(3.05)^{***}$	1.684 $(2.92)^{***}$	3.780 $(1.99)^{**}$	2.363 $(3.86)^{***}$
Sex	-.036 $(1.92)^{*}$	.047 (1.03)	-.051 (0.88)	.176 (1.14)
Age	-.014 (1.29)	-.025 (0.92)	.045 $(1.86)^{*}$	.036 (1.32)
GPA	.743 $(2.46)^{**}$	.603 $(3.89)^{***}$	.524 $(4.02)^{***}$	.786 $(3.24)^{***}$
OGPA	.502 $(2.02)^{**}$	.728 $(3.72)^{***}$	.608 (1.30)	.527 $(2.30)^{**}$
EI	-.021 (.321)	.010 (.90)	-.034 (1.03)	.073 $(1.95)^{**}$
SN	.014 $(1.90)^{*}$ (N)	-.026 $(2.36)^{**}$ (S)	.041 $(1.86)^{*}$ (N)	-.034 $(2.52)^{**}$
TF	-.036 (1.01)	.008 (.86)	-.036 $(1.79)^{*}$ (T)	.067 (.42)
JP	.026 $(1.96)^{**}$ (P)	.003 (.86)	-.022 $(1.64)^{*}$ (J)	.045 (1.07)
Adjusted R^2	.1263	.0944	.1072	.2143
F Value	6.92^{***}	11.42^{***}	12.32^{***}	18.60^{***}

[***]Significant at the 0.01 level.
[**] Significant at the 0.05 level.
[*] Significant at the 0.10 level.

Appendix I
ECONOMICS-MANAGEMENT I & II [SS201E-MGT390E]
New Jersey Institute of Technology

Economics & Management Topics For An Industrialized Society

Course Material

(Required) <u>Economics</u>, Samuelson, Paul and Nordhaus, R, Fifteenth Edition, McGraw Hill.
(Required) <u>Management</u>, Griffin, Ricky, Houghton Mifflin Company, 1993.
(Required) <u>Financial Analysis</u>, Notes Distributed by the Professors.
(Optional) Study Guides of the text books mentioned above.

Additional Reading Assignments and Solutions will be kept in the Library's Reserve Desk for your convenience.

Course Objective

        The 1980s and early 1990s represented an increasingly problematic decade for manufacturers. Evidence suggests that the environment in the next decades is becoming even more challenging. Increased competition, globalization, and changes in technology and labor force is putting massive pressure on manufacturers to become more agile, responsible and flexible. This requires quick and efficient readjustment in product design, innovation and customization, responsiveness in delivery system, and continuous improvement in costing and marketing strategies. Such an environment demands a more integrated approach in training manufacturers and managers of the future.

        With this in mind, this economics-management course sequence is intended to assist in identifying economic and management factors requiring and understanding of basic concepts as well as the ability to construct and evaluate alternative scenarios. The course will emphasize both economic and non-economic ramifications of developing and implementing manufacturing decision makings. It will attempt to integrate basic principles of economics, finance, and management with the realities of the market place. The course sequence will put special emphasis on management practices in the area manufacturing. A broad course syllabus is given below.

<u>Week No 1</u>
Module No. 1:
<u>Group Based Simulation Game of Economic and Management Decision Making (First Round)</u>

<u>Week No 2-4</u>
Module No 2:
<u>Manufacturing in a Global Economy</u>

Management Considerations: The Corporate Decision; The Global Marketplace; Assessing the International Environment; Types International Ventures; and Types of International Ventures; Economic Considerations: International Trade; Foreign Exchange; Hedging Risk; Balance of Payments; and Market Share

<u>Week No 5-6</u>
Module No 3:
<u>Planning a Product</u>

The Planning Function; The Focus and Elements of Planning; Coordinating and Preparing for Change; Developing Performance Standards; Setting Priorities and Objectives; Strategic Planning; Relating the Strategic and Operational Plans.

<u>Week No 7-10</u>
Module No 4:
<u>Producing and Marketing a Product</u>

Demand and Supply Concepts; Elasticity; Costs of Production; Law of Diminishing Returns; Economies of Scale and Scope Issues; the Firm and its Revenue Under Different Markets; Competition; Monopoly;

Oligopoly; Marketing Process; Product Classification and Positioning; Market Segmentation and Distribution Channels; Pricing Decisions; Consumer Satisfaction.

<u>Week No 11-13</u>
Module No 5:
Basic Understanding of Finance and Markets

Financial Statements, Taxes and Cash Flows; The Balance Sheet; The Income Statement Corporate and Personal Tax rates; Ratio Analysis; Solvency, Efficiency, Profitability and Market Value Measures; Benchmarking; Introduction to Money and Capital Markets; Stocks and Bonds Characteristics; Investment Banks; Interest Rates Risk; Future and Options Markets.

<u>Week No 14-16</u>
Module No 6:
Cost-Benefit Analysis

The Time Value of Money; Simple, Compound, and Effective Rate of Interest; Uniform Series; Cash Flow; Opportunity Cost; Depreciation; Cost Benefit Analysis for Multiple Alternatives; Alternative Comparison Format; Ranking Mutually Exclusive Projects; Break-Even Analysis; Capital Budgeting; Net Present Value; Payback Rule, Accounting Rate of Return; Internal rate of Return, Profitability Index; Making Capital Investment Decisions; Tax Considerations; Cost of Capital; Concepts of Risk-Return; Approach and Determination of Sensitivity Analysis; Uncertainty, Expected Value, and Risk Analysis.

Group Based Simulation Game of Economic and Management Decision Making (Second Round)

<u>Week No 17-18</u>
Module No 7:
Business, Economy and Role of Public Institutions

Alternative Economic Systems; Free Market Economy and Role of Public Sector; Circular Flow Model; Unemployment and Gross National Products; Keynesian Economics; Fiscal Policy; Government Actions: Taxation and Expenditures; Concepts of Social Goods and Services; Money, Banking System and Monetary Policy; Banking System; Federal Reserve
and Organizational Culture;

<u>Week No 21-23</u>
Module No 9:
Managing the Manufacturing Firms in the 21st Century
Social and Ethical Responsibilities; Changing Expectations for Corporate Performance; Managerial Ethics; Ethics and

Social Responsiveness; Consumer Protection; Product Safety; Environmental Protection; Actions Needed to Implement Social Responsibility; Managing Cultural Diversity; The Impact of Diversity on Organizations; Diversity as Competitive Advantage; Diversity as a Source of Conflict; Antitrust Laws and Regulations; Consolidation of Firms and Competitive Markets

<u>Week No 24-25</u>
Module No 10:
Role of Motivation and Leadership in Manufacturing Process

Motivating Employee Performance; The Importance of Employee Motivation in the Workplace; Content, Process and Reinforcement Perspectives on Motivation; Goal Setting Theory; Japanese Approach; Using Reward Systems to Motivate Performance; Leadership and the Nature of Leadership Behaviors; Situational Approaches to Leadership; New Perspectives on Leadership; Political Behavior in Organizations

<u>Week No 27-28</u>
Module No 11:

Manufacturing and Physical Environment

Management and Environment; The External and Internal Environment; Bi-Products, Manufacturing Process, and Pollution; Understanding the Basic Pollution Consequences of Production Process; Waste Management; Concepts of Multi Life Cycle Products. Cost-Benefit Analysis Incorporating Pollution; Corporate Image and Revisit of Strategic Planning

Week No 29-30
Module No. 12:
Group Based Simulation Game of Economic and Management Decision Making (Final Round).
Course Outcome Assessment and Overall Review

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