Learning style preferences in cross-functional teams: Discipline-specific or personality-related?

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ABSTRACT

In this paper, research in cross-functional work and the impact of successful teaming is extended to investigate the manufacturing engineering – finance interface and to determine whether differences that exist between learning-style preferences related to a teaming project would be attributable to the choice of discipline-specific majors, and/or personality differences as measured by the Myers-Briggs Personality Indicator (MBTI). Some differences are explained by academic major while others are better explained by personality type. Application for education and practice are offered as a result of the findings.

This research supports the difficulty in successful implementation of cross-functional teams and provides an avenue for study of other dyads and triads in such teams. There are also implications for practice from this study. As students from one discipline have opportunities to interact in a team environment with students from another discipline, they have the ability to gain a better understanding of differences that exist not only between others with whom they may directly work, but also in the cross-disciplinary teams for which they are likely to be involved. The more cross-functional team-based experiences that college students can experience, the better prepared they will be as they enter the work force.

Keywords: learning styles, personality, MBTI, cross-functional teams

INTRODUCTION

The ability for college students to work in teams after graduation is an essential skill to organizations that hire them. Surveys indicate that approximately 80% of organizations actively use teams as a part of their work environment (Hammer & Huszczo, 1996, P. 171-172; Messmer, 1999). Developing teaming skills result in enhanced productivity, quality, and employee satisfaction (Wisner, 2001). Clearly the needs for teaming extend beyond those within the same discipline. Cross training is one method to expose individuals to discipline-specific language barriers and tools. For example, placing manufacturing management master's degree students in an Engineering Designs Principles course is shown to enhance the effectiveness of product design for software tools (Okudan & Zappe, 2006).

The Myers-Briggs Type Indicator (MBTI) is an effective tool in meeting the challenges that occur in teaming environments based on differences in personality types among team members. In fact, the MBTI serves as a pioneer in this area with work as early as 1974 on the effectiveness of the use of MBTI among health care teams (Myers, 1979). Numerous studies (Blaylock, 1983; Futrell, 1992; Kandall, 1991; Webster & Howard, 1989) show that diverse groups perform significantly better and create better synergy than groups consisting of more heterogeneous members.

The theory on competitive advantage indicates that firms must develop distinctive competencies that could lead to competitive advantage over other like firms (Porter, 1980). Attainment of enhanced internal capabilities through a resource-based view of the firm is identified as one path to competitive advantage (Barney, 1991; Wernerfelt, 1984). The importance of the use of cross-functional work is shown to contribute to these enhanced internal competencies in the investigation of the manufacturing and marketing interface (Kahn & Mentzer, 1994). In this paper, some of the cross-functional work is extended to investigate the manufacturing – finance interface and to identify differences in the personalities of the two disciplines relative to differences that extend beyond discipline in order to explain preferred learning styles.

OPPORTUNITIES FOR TEAMING FOR FINANCE AND ENGINEERING STUDENTS

A dynamic work environment is one that fosters opportunities for collaboration and strategic input from a variety of disciplines. Superior results are noted in simulation analysis when a team-based management approach is incorporated into the decision making process (McKone & Bozewicz, 2003). Corning Glass Corporation finds success in the goal of enhancing communication with vendors by utilizing a teaming approach within corporate treasury departments (Pridmore, 1986). Engineering programs are on the forefront of recognizing the need for teamwork, innovation, and cross-disciplinary collaboration (Mehrabi, 2005; Payton, 2005; Todd, Magleby, & Parkinson, 2005). When the collaboration extends to disciplines outside of engineering (e.g., with marketing, operations, finance, human resources), greater synergies exist in a manufacturing firm (McLaughlin, Pannesi, & Kathuria, 1991); technology and arts students in the entertainment industry (Sirinterlikci & Mativo, 2005); and with business and technology (DeSio, 1990).

Manufacturing engineering and finance are two disciplines well suited for a team-based approach. Manufacturers must be able to balance the needs of technical precision with the requirement of a positive contribution margin (McCormick, 2002). Manufacturing engineering

students benefit by realizing that production has to be driven by the realities of market size and potential market share rather than by machinery efficiency. Ideas for product development must meet capital budgeting decision criteria in order to satisfy outside constituencies such as board members and other stakeholders. As companies become more inclusive in the budgetary process, engineers in a team-based environment offer important feedback and serve to improve bottom-line results. Likewise, finance students benefit by realizing the complexities associated with obtaining reasonable cost and contribution margin estimates as well as having exposure to parameters by which a manufacturing firm can gain a competitive advantage in the market place. Financial managers offer a fresh perspective to product development and non-technical feedback about the usefulness for a lay person for productive innovations.

COMPETITIVE ADVANTAGE, RESOURCE VIEW, AND THE MANUFACTURING-FINANCE INTERFACE

The theory on competitive advantage was introduced in Michael Porter's book (1980). The basic idea is that firms must develop distinctive competencies that could lead to competitive advantage over other like firms. Barney (1991) later built on work by Wernerfelt (1984) that expanded the notion to one now known as the resource-based view of the firm. The resources that may be tapped to attain competitive advantage can be either tangible or intangible. Of the intangible resources, capabilities are the key to attaining competitive advantage. Further, the development of internal capabilities is not easily imitated by other firms and forms the foundation for sustainable competitive advantage. The cross-functional relationships that exist within firms are notably important in the development of inimitable capabilities.

Although not the only cross-functional relationship to be studied, the manufacturing-marketing interface has long been recognized as critical to successful firms. The differences between manufacturing and marketing have been of interest for some years. Lawrence and Lorsch (1967) were among the earliest researchers to study this phenomenon. While they focused on the competing tensions of differentiation and integration between the functions, later researchers such as Shapiro (1977) went several steps further in identifying differences in many aspects of these two functions. He described production and sales personnel driving different cars and filling their free time differently as examples of two ends of the spectrum in interests. Numerous other authors continued the discourse on the relationship on many fronts of manufacturing and marketing. Among these were Berry et al. (1991) ,Crittenden (1992), and Konijnendijk (1994).

Kahn and Mentzer (1994) wrote a well-cited paper on the norms that distinguish manufacturing personnel from marketing personnel. They went on to discuss the issues and benefits of these differences. This paper is intended to extend some of the cross-functional work to investigate the manufacturing – finance interface and to potentially identify differences in the personalities of the two disciplines.

LEARNING STYLES, PERSONALITY TYPE, AND THE MYERS-BRIGGS TYPE INDICATOR

Learning style models are necessary to bridge the gap between and among the students of the different disciplines. Based on concerns expressed by U.S. manufacturers, the National Center for Manufacturing Sciences consortium was created, with the goal of assisting students in keeping up with the rapidly advancing manufacturing systems by better linking educational efforts, including learning style differences, between business and engineering (Ehmann, Jones,

& Johnson, 1993). Students learn best when they are able to use life experiences to better understand principles (Dewey, 1938), are actively engaged in the learning process (Lewin, 1951), and are placed in a learning environment that encourages use of their psychological type (Piaget, 1971). The Myers-Briggs Type Indicator (MBTI) is extensively used to better understand student performance on the basis of their learning style (Campbell & Davis, 1990; Eggins, 1979; Geary & Rooney, 1993; Keirsey & Bates, 1978; G. Lawrence, 1984, 1994; McCaulley, 1976; Myers, 1979, 1980; Myers & McCaulley, 1989; Schroeder, 1993). Filbeck and Smith (1996) find significant correlations between the four dimensions measured by the MBTI and both the performance of undergraduate business students on alternative test formats and the students' instructional preferences. Filbeck and Webb (2000) find evidence that students in executive MBA programs have distinct preferences toward their classroom instruction that appear to differ from undergraduate business and traditional MBA students.

The Myers-Briggs Type Indicator (MBTI), based on theoretical work by Carl Jung, has a variety of applications (e.g., conflict management, business) and is a common instrument used for exploring learning style preferences in a classroom setting. The MBTI explores four dimensions of personality: (1) how individuals derives their energy (extraversion vs. introversion), (2) how they process information (sensing versus intuition), (3) how they arrive at decisions (thinking versus feeling), and (4) what type of order they prefer in their outer world (judging versus perceiving). The four scales of the MBTI that appear in Exhibit 1. Most studies show that the US population is approximately "75% extraverted, 25% introverted; 75% sensing, 25% intuitive; 50% thinking, 50% feeling; 55% judging, 45% perceiving"(Filbeck, Hatfield, & Horvath, 2005, p 171-172). There are no differences based on gender, with the exception of the thinking/feeling dimension: approximately 2/3 of males prefer thinking and 2/3 of females prefer feeling (1989). While females disproportionally prefer feeling to thinking, Gridley (2006) using the Gregorc Style Delineator (which is also driven by two of the Jungian Dimensions related to information processing), finds that women engineers prefer concrete thinking styles.

On the basis of these four dimensions, an MBTI profile emerges with sixteen possible combinations. For example, an individual whose MBTI type of ENFP, would tend to draw his or her energy from external forces (E), process information based on possibilities (N), make decisions based on feeling (F), and prefer a flexible and adaptive environment (P). Obviously, two individuals with the same MBTI type can appear quite different based on experiences during their lifetime and how mature they are in type development.

With increasing frequency, the MBTI is being utilized for enhancing team effectiveness, both in academic environments and in industry. Amoto and Amoto (2005) find that an understanding of personality type helps teams in their communication efforts as students gained a better understanding of their differences. Likewise, Clinebell and Stecher (2003) find that students report that knowledge of team members' personality types was helpful in understanding behavior and managing team dynamics. Outside of the classroom, Rekar (2001) shows that a team development model based on the MBTI resulted in high performing teams in the workplace. Myers and McCaulley (1989, p. 293) point out that type remains useful in focusing on both specific jobs and job clusters and potential skill sets. According to Jean Kummerow in the Myer and McCaulley publication (1989, p. 293) "MBTI types would be distributed in occupations consistent with the characteristics of the work environments of those occupations. Occupations may both require and reward specific ways of perceiving information and making decisions on that information; thus different types would be expected to be attracted to different occupations." For example, Muller and Gappisch (2005), using factor analysis, note that five

personality types of entrepreneurs emerge that correspond with Myers-Brigs Type indicator types, Thus, as more companies utilize a team-based approach, it is essential that students gain exposure to others outside their discipline and with different personality types.

Research Question**:**

> Are differences that exist between learning style preferences related to a teaming project attributable to the choice of discipline-specific majors, and/or personality differences as measured by the MBTI?

METHOD

Instructors for the collaborating courses (Problems in Corporate Finance and Engineering for Manufacturing) have offered a cross-disciplinary team-based project on three occasions thus far. The information given in the following few pages are directly taken from the syllabus for the course and the project (Filbeck, 2010). Teams are formed across the two courses with the task of proposing a manufacturing company that produces actual parts and must demonstrate that it is economically viable within a 100 mile radius of the university's location. Problems in Corporate Finance is a course which extends topics covered in the introductory corporate finance course and investigates corporate policy, financial analysis, and risk management. Engineering for Manufacturing is a course that deals with manufacturability, the selection of the most effective materials and processes, and quality assurance. The project is worth 20 percent of each course's final grade.

Manufacturing students on each team are instructed to self-divide into the following roles: operations engineer, facilities engineer, resources engineer, and design engineer. Finance students in each team are instructed to work jointly in the role of CFO, in which they would oversee the following areas: economic and industry analyses, the pro forma set of financials, determination of an capital structure, sources of capital, the cost of capital, cash flow projections, and the criteria for project decision making. The class enrollment in a given semester determines the extent to which roles must be modified.

Each team is charged with accomplishing the following set of objectives for the project:

- Provide information on all manufacturing components required on the production floor. The company must not purchase over 50 percent of the product.
- Determine all of the required support structure for the facility to operate.
- Provide an economic analysis (limit 2 pages) and industry analysis (limit 2 pages – related to financial aspects only).
- Develop a five-year pro forma set of financials for your company, including the calculation of cash flows.
  - Determine the appropriate capital structure.
  - Identify the sources of capital.
  - Conduct an appropriate calculation of a cost of capital.
  - Perform a sensitivity analysis on projections.
  - Decide on the viability of the project using NPV, IRR, PI, and payback period.

Other information that has to be included in the final report includes the following:

- Product(s) being produced.
- Approximate production size/rate.
- Approximate number of employees.
- Approximate financial size/resources involved.

- Chief competition in product arena.
- Market area (regional, national, global).

The grading guidelines for the joint project consist of the following breakdown: teaming (15 percent), project proposal (15 percent), final report (40 percent), and final presentation (35 percent). One grade is given for the entire group for the proposal, report, and presentation. Individual grades are given based on teaming.

A mandatory lecture (all students attended) on teaming, incorporated into the syllabi for each class, is presented in the second week of class. The goal of the presentation is to assist each cross-disciplinary team in establishing team guidelines (which were due in the third week of the course). Students are allowed to improve their teaming guidelines by the end of the fifth week of class based on feedback provided jointly by the professors. The teaming guidelines, along with peer evaluations are used to assess the teaming portion of the grade for the project.

In order to better understand student expectations concerning learning preferences (in general) and toward the project (specifically), at the beginning of each semester, surveys are distributed to a non-random sample of undergraduate students enrolled in each of the two classes. A total of 156 surveys were collected at the beginning of the courses. In addition, all students are also given the Myers-Briggs Personality Indicator (MBTI). A total of 166 MBTI profiles were returned at the beginning of the courses. The surveys and the MBTI responses were matched through a random code assignment. Only students who had completed both surveys were used in this study which resulted in 146 usable responses.

MEASURES

The learning styles preferences of the students were measured by a series of a priori questions rated on a 7-point scale from not very important (1) to very important (7). The exact items are shown in Table 1 in the Appendix. Exhibit 2a, 2b, and 2c, in the Appendix, shows the MBTI profiles of the aggregate sample, the finance students, and the manufacturing engineering students, respectively.

SAMPLE CHARACTERISTICS

Students were identified by class. There were 70 valid responses from the finance class and 76 valid responses from the manufacturing engineering class. Nearly all of the finance students were finance majors (65/70) and nearly all of the Manufacturing students were mechanical engineering majors (69/76). Approximately 75% of both classes were seniors while 25% were juniors. Eighty-nine percent of the students classified themselves as either average or above average academically. About 52% of the students were employed while 48% were not. The average income of those employed was $180 with an average number of hours worked per week at just over 16.

ANALYSIS AND RESULTS

The first set of results identified if there are significant differences between the finance and manufacturing engineering classes in the four dimensions of the MBTI. As shown in

Table **2** in the Appendix, cross-tab calculations with a $\chi 2$ test of significance (sig. = .02) showed that by a ratio of 60% to 40%, statistically more finance students showed a preference for extraversion than introversion, while 65% of engineers showed a preference for introversion. No statistically significant differences were observed in the proportion of students preferring sensing versus intuition between finance and engineering students. With respect to the thinking-feeling dimension, statistically more Finance students preferred feeling (65% vs.40%) and engineering students had a proportionally greater preference for thinking (60% vs. 35%). The significance of this calculation was χ 2 = .03. This result is consistent with Beauchamp and McKelvie (2006) , who finds that students in more people-oriented disciplines scored higher on empathy than those in less people-oriented disciplines.

Likewise, on the JP dimension, by a significance factor of .03, 60% of the finance students were more likely to prefer judging, while 63% of the Manufacturing students were more likely to exhibit a preference for perceiving. Thus, on three of the four dimensions of the MBTI, statistically significant differences exist between the personality profiles of the finance students compared to the manufacturing engineering students. These findings are consistent with Garcia-Sedano, Navarro, and Menacho (2009), who find differences between personality profiles and vocational interests based on observed differences using the 16PF5 personality trait. They note three first-order personality traits; warmth, dominance, and sensitivity; which are related to the MBTI thinking/feeling dimension. In addition, they discover three second-order factors; extraversion, control, and independence; which are related to the MBTI extraversion/introversion dimension. Finally, they note variations in professional interest; mechanical, arithmetical, artistic, persuasive, and welfare; which are related to the MBTI sensing/intuition dimension.

Manufacturing and Finance Students' Differences

Students from each class were asked to rate several items as to the importance of each in their learning environment. Each item was rated on a scale from 1 to 7 as not very important to very important, respectively.

Table 3, in the Appendix, identifies the significant differences between finance students and manufacturing engineering students in their ratings as identified by independent sample t-tests.

Interestingly, in all items in which there is a significant difference, the finance students indicate a greater importance for each learning mechanisms. These items include reading the text, having prior copies of the professor's notes, rewriting or taking their own notes outside of class, mastering one concept before moving to the next, solving problems in recitations lead either by the instructor or a student who had taken the course, learning pneumonic tips, attending sessions with a tutor, and taking a small number of comprehensive tests. The statistically different items are shaded in Table 3 in the Appendix.

Influencing Factors in Preferences

Finally, whether the propensity toward learning mechanisms are driven by the discipline or personality types was identified.. Thus, a series of regressions with the responses to the learning mechanisms as the dependent variables was used. Five categorical variables were used as the independent variables. Membership in the finance class or the manufacturing engineering class and the dichotomous variables of each of the four Myers-Briggs Personality Indicator (MBTI) dimensions are used as the independent variables in each regression. Eight of the eighteen learning mechanisms result in significant results at the $p \leq .05$ level.

In Table 4 in the Appendix, the results for the first two significant learning mechanisms are shown. The regression is significant at the .01 level and accounts for 12% of the variance. In the case of student preference for reading the textbook, the discipline is the only significant factor ($p \leq .05$). Therefore, the discipline is important in the preference, while personality type is not significant and finance students are more likely to find reading the text important.

Also, in Table 4 in the Appendix, the preference toward participating in discussions during class as a learning mechanism has two significant factors accounting for 16% of the variance. The results of the regression show that the more important the preference of discussions during class, the more likely the student is to exhibit a preference for extraversion (prefer external processing) rather than introversion, and the more likely the student has a preference for intuition (exploring possibilities) rather than sensing. The discipline factor is not significant.

In Table 5 in the Appendix, the learning mechanism of rewriting or taking notes outside of class also demonstrates a discipline basis for the preference. In this case, the finance students are more likely to have a preference toward rewriting notes. None of the personality dimensions are statistically significant.

Also in Table 5 in the Appendix, having to master one concept before moving to another is significant as a learning mechanism. The overall regression is significant at the $p \leq .01$ level, accounting for 11% of the variance. However, as seen in the table, the discipline is not a significant factor, but the personality factor TF is significant at the $p \leq .05$ level. Mastery of a topic or concept is more important to those with a preference for feeling versus those with a preference for thinking.

In Table 6 in the Appendix, solving problems in a recitation led by the professor of the course is a significant learning mechanism. Fourteen percent of the variance is accounted for in the regression with the only significant factor shown as the SN personality dimension. In this case, those students with a preference for sensing are more likely to have a preference for the importance of solving problems with the professor than are those with a preference for intuition. Type theory would support that individuals with a preference for sensing are noted for a greater preference for hierarchy than those with a preference for intuition.

Also in Table 6 in the Appendix, solving problems in a recitation led by a student who has taken the course, is a significant learning mechanism. Those students with a preference for feeling are more likely to have a preference for this learning mechanism than are those students with a preference for thinking. Type theory would support that individuals with a preference for feeling may be more inclined to be intimidated by authority figures (instructors) than individuals

with a preference for thinking. These factors account for 16% of the variance and the overall regression is significant at the $p \leq .001$ level.

In Table 7 in the Appendix, learning memorization tips also exhibits a difference between finance and manufacturing engineering students. However, once again it is the discipline that appears to be the driving force. The overall regression is significant at the $p \leq .003$ level and 14% of the variance is accounted for. Memorization as a learning mechanism is more likely to be important for finance students.

Finally, also in Table 7 in the Appendix, attending learning center sessions with a tutor is a significant learning mechanism and the regression illustrates 12% of the variance in these factors. However, the discipline is not significant, while the EI factor is significant. In this case, the use of a tutor is more likely to be important for those students with a preference for extraversion rather than introversion. Since extraverts tend to benefit from external processing of information, type theory would support their desire to meet with a tutor in order to ensure that they have grasped key concepts.

DISCUSSION

In this paper, cross-functional research is extended to the impact of successful teaming to investigate the manufacturing – finance interface. This research also intends to determine if differences that exist on a pre-course survey of preferred learning environments of a cross-disciplinary team-based project can be attributed to differences in preferences of students based on disciplines or differences in personality type as identified by the Myers-Briggs Type Indicator (MBTI). The central question of this research related to type is whether differences that exist between learning style preferences related to a teaming project would be attributable to the choice of discipline-specific majors, and/or personality differences as measured by the MBTI.

Starting with survey questions for which a statistically significant result exists between responses of finance and manufacturing students, regression analysis is used to determine whether these differences are attributed to discipline or type. Finance students are more likely to prefer reading the textbook, writing or taking their own notes outside of class, and learning memorization tips (e.g., mnemonics).

Other differences are better explained by differences in personality type that go beyond academic major. Students with preferences for extraversion and intuition prefer participating in class discussion. Students with a preference for feeling prefer to master one concept before moving on to the next. Solving problems in a recitation led by the professor of the course is preferred by students with a preference for sensing, while having the recitation led by a student who has taken the course is preferred by student with preference for feeling. Those students with a preference for extraversion have a greater desire to attend sessions with a learning center tutor.

The implications for education are many. The type of class presentation to students should vary whether the students are in manufacturing or finance. As an example, finance students will be more inclined to prefer reading the text and having copies of the professor's notes whereas these mechanisms are less likely to be effective for manufacturing engineers. These preference differences impact the dynamics associated with the cross-disciplinary teams. In addition, since significant differences in preferences are also noted based on personality type, instructors – and peer-based teams – must be sensitive to the type dynamics by offering instruction and discussion that transcend all dimensions of the MBTI.

There are also implications for practice from this study. As students from one discipline have opportunities to interact in a team environment with students from another discipline, they have the ability to gain a better understanding of differences that exist not only between others with whom they may directly work, but also in the cross-disciplinary teams for which they are likely to be involved. As this study indicates, some environmental preferences may be tied to discipline and others by personality type – but ultimately, the more cross-functional team-based experiences that college students can experience, the better prepared they will be as they enter the work force.

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APPENDIX

Exhibit 1
Dimensions Measured by the Myers-Briggs Type Indicator

Preferences for focusing attention	Extraversion (E) – Individuals focus attention on the outer world of people and things. They draw energy from interacting and being engaged and so learn most effectively when they are engaged in an activity.	Introversion (I) – Individuals focus attention on their inner world. They draw energy from internal reflection, and so learn best through reflecting and understanding the context of a problem before being engaged.
Preferences for acquiring information	Sensing (S) – Individuals focus on the concrete aspects of a situation and value what can be seen, touched, felt, smelled, or heard. They tend to be practical minded, concerned with details and facts, and have greater acceptance of what is given.	Intuition (N) – Individuals focus on the abstract, van value relationships not immediately recognizable to the physical senses. They strive to understand the "big picture" and are interested in change and future possibilities.
Preferences for making decisions	Thinking (T) – Individuals focus on objective decision making based on a desire for fairness. They seek logic in their analysis of a situation, desire to achieve objectivity, and to discover what may be wrong in situations that arise.	Feeling (F) – Individuals focus on subjective decision making based on a desire for harmony. They consider impacts on people in their analysis of a situation and prefer to affirm what is right with situations, and are more likely to offer appreciation and sympathy.
Preferences for orientation to the outer world	Judging (J) – Individuals focus on leading a life that is organized and orderly, seeking closure, prefer control over their lives, and plan accordingly.	Perceiving (P) – Individuals focus on leading a life that is flexible and spontaneous, they seek to keep decisions open and prefer to adapt to situations rather than control them.

Source: Filbeck and Smith (1996)

Exhibit 2a - MBTI Profile
Aggregate Data

(N=166)

ISTJ ++++++++++ ++++++++++ ++++++++++ + 31 (18.68%)	ISFJ + 3 (1.81%)	INFJ ++++ 6 (3.61%)	INTJ +++++++ 12 (7.23%)
ISTP +++++ 5 (3.01%)	ISFP + 1 (0.60%)	INFP ++++++++ 14 (8.43%)	INTP +++++++++ 15 (9.04%)
ESTP ++++++ 11 (6.63%)	ESFP ++ 3 (1.81%)	ENFP ++++++ 9 (5.42%)	ENTP ++++++++++ ++++ 23 (13.86%)
ESTJ ++++++++++ + 18 (10.84%)	ESFJ ++++ 6 (3.61%)	ENFJ ++++ 6 (3.61%)	ENTJ ++ 3 (1.81%)

E – 87 (52.41%) S – 78 (46.99%) T – 118 (71.08%) J – 85 (51.20%)
I – 79 (47.59%) N – 88 (53.01%) F – 48 (28.92%) P – 81 (48.80%)

+ - represents 1%

Exhibit 2b - MBTI Profile

Finance Students

(N=69)

ISTJ ++++++++++ +++ 9 (13.04%)	ISFJ +++ 2 (2.90%)	INFJ +++++++++ 6 (8.70%)	INTJ ++++ 3 (4.35%)
ISTP + 1 (1.45%)	ISFP 0 (0.00%)	INFP ++++ 3 (4.35%)	INTP + 1 (1.45%)
ESTP +++++++ 5 (7.25%)	ESFP ++++ 3 (4.35%)	ENFP ++++++ 4 (5.80%)	ENTP ++++++++++ +++++ 10 (14.49%)
ESTJ ++++++++++ +++++ 11 (15.94%)	ESFJ +++++++++ 6 (8.70%)	ENFJ +++++++ 5 (7.25%)	ENTJ 0 (0.00%)

E – 44 (63.77%) S – 37 (53.62%) T – 40 (57.97%) J – 44 (63.77%)
I – 25 (36.23%) N – 32 (46.38%) F – 29 (42.03%) P – 25 (36.23%)

+ - represents 1%

Exhibit 2c - MBTI Profile

Engineering Students

(N=97)

ISTJ ++++++++++ ++++++++++ +++ 22 (22.68%)	ISFJ + 1 (1.03%)	INFJ 0 (0.00%)	INTJ +++++++++ 9 (9.28%)
ISTP ++++ 4 (4.12%)	ISFP + 1 (1.03%)	INFP ++++++++++ + 11 (11.34%)	INTP ++++++++++ ++++ 14 (14.43%)
ESTP ++++++ 6 (6.18%)	ESFP 0 (0.00%)	ENFP +++++ 5 (5.16%)	ENTP ++++++++++ ++++++++++ +++ 13 (13.40%)
ESTJ ++++++++++ ++++++++ 7 (7.22%)	ESFJ +++++ 0 (0.00%)	ENFJ ++++++ 1 (1.03%)	ENTJ +++ 3 (3.09%)

E – 43 (44.33%) S – 41 (42.27%) T – 78 (80.41%) J – 41 (42.27%)
I – 54 (55.67%) N – 56 (57.73%) F – 19 (19.59%) P – 56 (57.73%)

+ - represents 1%

Table 1 Learning Mechanisms Survey Questions

Rate the following as you perceive their importance in your own learning
….. reading the textbook
….. working in groups during class
….. attending lecture presentations by the professor
….. participating in discussions during class
….. having copies of the professor's notes
….. rewriting or taking my own notes outside of class
….. having to master one concept before I can move on to the next
….. having a clearly defined set of concepts I have to master
….. solving assigned problems on my own
….. solving problems during class
….. solving problems in a recitation led by the professor of the course
….. solving problems in a recitation led by a student who has taken the course
….. learning memorization tips (mnemonics, etc.)
….. meeting with the professor during office hours
….. attending sessions with a learning center tutor
….. a small number of comprehensive tests
….. a large number of less comprehensive quizzes
….exams that I will be allowed to retake until we passed.

Table 2 Significance of MBTI Dimensions by Discipline

Dimension	Finance	Manufacturing Engineering	χ^2 sig.
EI	E	I	.02
SN			n.s.
TF	T	F	.03
JP	J	P	.03

Table 3 Differences in Learning Preferences between Manufacturing and Finance Students

Item	Finance (mean on 7 pt scale)	Manufacturing (mean on 7 pt scale)	t-value
….. reading the textbook	4.91	3.97	3.75***
….. working in groups during class	4.33	4.52	-.88
….. attending lecture presentations by the professor	6.36	6.07	1.74
….. participating in discussions during class	5.22	5.23	-.08
….. having copies of the professor's notes	5.98	5.20	3.60***
….. rewriting or taking my own notes outside of class	5.24	3.96	4.98***
….. having to master one concept before I can move on to the next	5.15	4.62	2.54*
….. having a clearly defined set of concepts I have to master	5.72	5.14	2.68**
….. solving assigned problems on my own	5.85	5.58	1.42
….. solving problems during class	6.73	5.54	1.34
….. solving problems in a recitation led by the professor of the course	5.39	4.65	3.29***
….. solving problems in a recitation led by a student who has taken the course	4.38	3.69	2.95**
….. learning memorization tips (mnemonics, etc.)	4.42	3.57	3.53***
….. meeting with the professor during office hours	4.53	4.96	-1.82
….. attending sessions with a learning center tutor	3.71	2.86	3.34**
….. a small number of comprehensive tests	4.64	4.13	2.04*
….. a large number of less comprehensive quizzes	5.14	5.43	-1.27
….exams that I will be allowed to retake until we passed.	4.65	4.74	-.32

*p≤.05 **p≤.01 ***p≤.001 All tests were two-tailed; scales were 1 to 7.

Table 4 Regression Results - I

	….. reading the textbook		….. participating in discussions during class	
	β	t-value	β	t-value
Fin/Mfg	-.25	-2.54*	.09	1.00
EI	.07	.74	-.36	-4.04***
SN	.06	.56	.25	2.66**
TF	.14	1.50	.04	.41
JP	-.10	-.98	-13	-1.32
F Statistic	3.15		4.59	
F Significance	.01*		.001***	
Degrees of Freedom	5,120		5,119	
R^2	.12		.16	

Table 5 Regression Results - II

	….. rewriting or taking my own notes outside of class		….. having to master one concept before I can move on to the next	
	β	t-value	β	t-value
Fin/Mfg	-.39	-4.19***	-.16	-1.61
EI	.13	1.47	-.08	-.87
SN	-.10	-1.01	.04	.39
TF	.09	1.09	.23	2.43*
JP	-.00	-.04	-.02	-.21
F Statistic	5.42		3.01	
F Significance	.00***		.01**	
Degrees of Freedom	5,119		5,119	
R^2	.19		.11	

Table 6 Regression Results - III

	….. solving problems in a recitation led by the professor of the course		….. solving problems in a recitation led by a student who has taken the course	
	β	t-value	β	t-value
Fin/Mfg	-.18	1.88	-.10	-1.01
EI	-.09	-1.00	-.17	-1.86
SN	-.21	-2.23*	-.09	-.88
TF	.18	1.94	.27	2.93**
JP	-.04	-.43	-.16	1.64
F Statistic	3.90		4.61	
F Significance	.003**		.001***	
Degrees of Freedom	5,120		5,119	
R^2	.14		.16	

Table 7 Regression Results - IV

	….. learning memorization tips (mnemonics, etc.)		….. attending sessions with a learning center tutor	
	β	t-value	β	t-value
Fin/Mfg	-.21	-2.16*	-.18	-1.85
EI	-.06	-.64	-.20	-2.21*
SN	-.08	-.83	.01	.11
TF	.13	1.37	.13	1.36
JP	-.06	-.57	-.05	-.55
F Statistic	2.63		3.23	
F Significance	.027*		.009**	
Degrees of Freedom	5,120		5,119	
R^2	.10		.12	