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Industrial Engineering Students' Perceptions of the Logistics and Supply Chain Industry

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Abstract

A shortage of logistics and supply chain talent is a significant and growing problem in the industry. However, little research has been done to study why industrial engineering (IE) students are not entering the field in sufficient numbers. This paper addresses several questions to begin to close that knowledge gap. First, what are undergraduate IE students' awareness of and interest in the logistics and supply chain industry? Second, what are IE students' desired job attributes? Finally, are there differences between IE students' responses to these questions and those of business students that would suggest a need to market to IE students differently? Data is collected from more than 1,500 undergraduate industrial engineering and business students throughout the state of Georgia. Analysis is presented for various demographics, including gender, age, and ethnicity.

Introduction

Logistics is an important and growing field. In 2014, total US logistics costs were $1.45 trillion, which represents 8.3% of GDP [1]. However, there is a need for more college students to choose careers in this field. Traditionally fed from business and industrial engineering programs, logistics faces a current shortage of students entering the field. The Georgia Center of Innovation for Logistics reports that there was a gap of more than 270,000 logistics related job openings in the US in 2012 [2]. Many other sources mention the same shortage of logistics talent entering the workforce (see, for example, [3,4,5]). Ozment and Keller studied AACSB accredited business schools and found that 90% of their students likely graduate with little or no understanding of logistics [6]. While part of the problem may be that students don't know about the field [7], others believe both that it is difficult to get students interested in logistics even when they are informed [8] and that the field has an image problem [9].

Industrial engineering faculty have an opportunity to help pair students' interests and job expectations with the logistics industry. The authors believe that many students would be interested in a career in logistics if they were better informed about the options available to them. For these reasons, the authors partnered with the Georgia Department of Economic Development to study the career expectations of undergraduate students in industrial engineering and business programs as well as their thoughts about logistics careers. It is the authors' hope that results from this study can be used to determine gaps in our students' understanding of logistics careers and to motivate their interest in the field of logistics. Knowing more about what students are looking for in a job can also help faculty to better mentor them about realistic workplace expectations.

Methods

To obtain information about students' awareness of and interest in the logistics and supply chain industry and about their future job expectations, students from seven public universities in Georgia were surveyed. The survey was administered to approximately 7,000 undergraduate industrial engineering and business students in Qualtrics. Students were sent several e-mail reminders of the survey over the time period that the survey was open from faculty/administrators at their home college and, to further incent participation, students who completed the survey were entered into a drawing for a free iPad. This resulted in almost one fourth of the students completing the survey. The 1,618 usable undergraduate student responses were split into 253 from industrial engineering students and 1,365 from business students. Table 1 includes demographic information for both subsamples.

Table 1: Self-reported demographics for the engineering and business students

	Engineering Students	Business Students
Percent male	54.2%	43.1%
Average GPA	3.3	3.2
Average AGE	22.8	26.3
Ethnicity		
Asian	23.7%	6.6%
African American	7.9%	24.6%
White	60.5%	63.8%
Hispanic	10.3%	7.0%
Other	2.4%	3.9%
Student Status		
Freshman	3.5%	9.6%
Sophomore	12.2%	20.2%
Junior	23.2%	26.6%
Senior	61.0%	43.7%
Work Experience		
Previous part-time job	60.1%	67.1%
Previous internship	67.2%	27.9%
Previous full-time job	21.3%	45.3%
No work experience	4.7%	5.7%

To design the survey, the authors studied the literature on job characteristics and generated a comprehensive list of job expectations. Using the collective knowledge of the authors with respect to psychology and organizational behavior, the list was reduced to 44 specific characteristics. The authors then ran a pilot study with 409 undergraduate students to further reduce the characteristics studied in the final survey to the 22 most significant. The final survey asked students to evaluate each of those 22 characteristics using the prompt "Thinking ahead to after college graduation, how important is each item below for your ideal job?" Students were requested to choose their answer on the Likert scale from 1=not important to 5=essential.

Using exploratory factor analysis, the 22 characteristics were categorized into seven different factors, defined in Table 2. Five of these factors (intrinsic, extrinsic, social, altruistic, and leisure) directly align with factors found in the work by Twenge et al [10] with a large longitudinal data set from the Monitoring the Future project. The two additional factors (long-term and supervision) were from other literature on work expectations found in these age groups [11,12,13].

Table 2: Job Expectation Factors

Factors	Description
Intrinsic	Does the job provide a sense of personal meaning (be creative, learn, see results, maintain current skills)?
Extrinsic	Does the job provide financial rewards, promotion, respect, and prestige?
Social	Does the job provide contact and common interests with others, opportunity to make friends?
Altruistic	Does the job provide the opportunity to help others, be worthwhile to society?
Leisure	Does the job provide balance (slow pace, vacation, time for other things)?
Long Term	Does the job provide stability and long-term benefits (health care, retirement)?
Supervision	Does the job provide detailed instruction, frequent feedback, personal support?

The survey then asked students questions to gauge their familiarity with and interest in logistics. The first was, "Prior to this survey, what was your familiarity with the field of logistics"? They were then provided a brief definition of logistics and asked to rate their agreement with the following three statements on a Likert scale of 1=strongly disagree to 5=strongly agree:

1. A career in the field of logistics seems like a good idea to me.
2. It is likely that my career will be in the field of logistics.
3. I am interested in a career in the field of logistics.

Results were then analyzed statistically for the various demographics and are presented below.

Results

Interest in Logistics

Figure 1 displays the answers to the questions about students' knowledge of and interest in logistics. The difference between the means of the answers from the engineers and the business students were statistically significant for each question, at an alpha = 0.001 level. Overall the industrial engineers were more familiar with logistics, were more likely to agree that a logistics career was a good idea (mean = 3.96 vs. 3.56), that they were

interested in a career in logistics (3.72 vs. 3.19), and that a logistics career was likely for them (3.27 vs. 2.67).

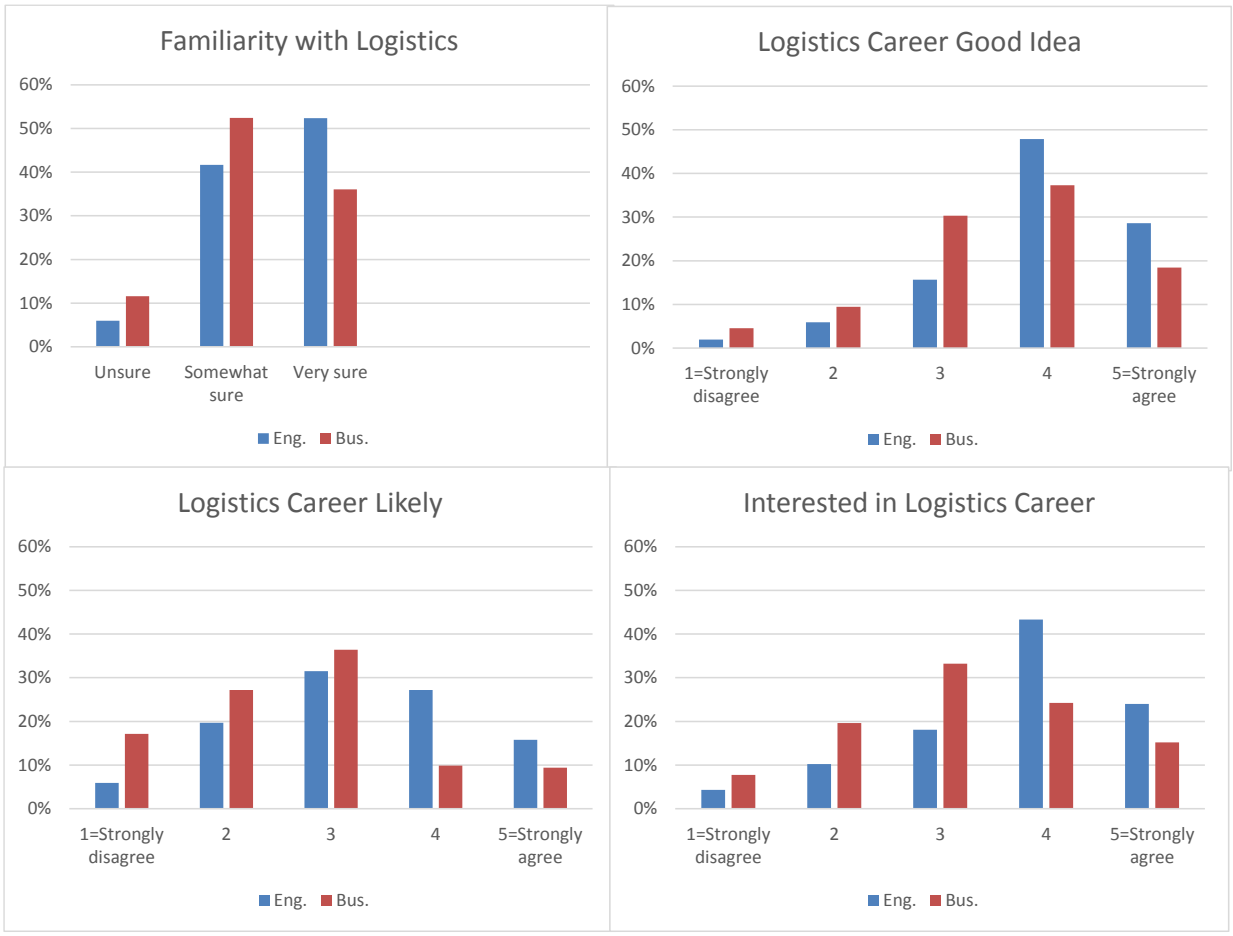

Figure 1: Knowledge of and interest in logistics for engineering majors versus business majors.

While few industrial engineers (6%) said that they were unsure about the field of logistics, only about half (52%) said that they were very familiar with it. If we look at the subset of engineering students that are upperclassmen, the numbers were very similar (6% unsure and 54% very sure). This clearly illustrates an opportunity for further education about this significant field within industrial engineering.

Seventy-six percent of the engineering students agreed or strongly agreed with the statement that a career in logistics seems like a good idea, and 67% agreed that they were interested in such a career, but only 43% said that a logistics career was likely. Perhaps this represents a lack of knowledge of the career opportunities that exist in logistics. Reducing the gap between students who think that a career in logistics is a good idea and

those that end up eventually choosing such a career is a significant opportunity for workforce growth.

It is notable that among the engineering students who reported that they were very familiar with the field of logistics (n=132), the percentages of students interested in logistics careers were significantly higher. Eighty percent of those engineering students agreed or strongly agreed with the statement that a career in logistics seems like a good idea, 71% were interested in such a career and 49% said that a logistics career was likely. That is a statistically significant difference (p-value = 0.06) in those saying a logistics career is likely between those engineers that reported they were very familiar with logistics and those that reported that they were only somewhat familiar or that they were unsure about logistics. This implies that simply educating students about logistics could potentially be a viable area of growth.

Industrial engineering is one of the engineering majors that tends to have a larger percentage of women undergraduates, as represented by 46% of the industrial engineering survey respondents being female. However, within the jobs that IEs fill, logistics still tends to be a male-dominated field. Drilling further down to look at just the female responses (n=115) in the engineering subsample, seventy-seven percent of the women agreed or strongly agreed with the statement that a career in logistics seems like a good idea, 70% were interested in such a career, and 51% said that a logistics career was likely. Compared to the male engineers, a higher percentage said that a logistics career was likely (p-value = 0.025), but the other two questions were not statistically significantly different between gender. It is encouraging that female IEs appear to be interested in logistics careers in significant numbers. Further encouraging is that interest could improve some of the gender imbalances in the field as well as growing the overall number of students choosing a career in logistics.

Desired Job Attributes

Table 3 provides the means of the student responses to the question, "Thinking ahead to after college graduation, how important is each for your ideal job?" Results are sorted from most to least important for the whole sample. Questions where the difference between the IE students' response and the business students' response was statistically significant are noted with asterisks.

In the general sample, students indicated that extrinsic (specifically: chances for promotion, pay), intrinsic (see results, learn), long term (secure future, retirement, benefits), and supervision (support personal commitments, frequent feedback) factors were most important to their future careers. Leisure (vacation, slow pace) and social (friends, contacts, common interest) factors ranked low relative to the other factors.

There were some significant differences between business and engineering students. The top four factors were the same, but in different order with the intrinsic (see results of what you do, learn new things) the top two for the engineers. Opportunities for promotion and good healthcare benefits also ranked highly. In general, all long term

factors (secure future, retirement, benefits) and some extrinsic (promotion, money) characteristics were less important to engineers than business majors. Two social characteristics (friends, contact) were higher in importance for engineers. These differences show that marketing messages should be tailored differently to recruit engineers versus business students.

Table 3: Student Importance of Job Factors

Factor	Survey Question	Average Student Responses		
		All	Business	Engineer
Extrinsic	Chances for promotion are good	4.33	4.35	4.20*
Intrinsic	See results of what you do	4.31	4.31	4.31
Intrinsic	Learn new things, skills	4.25	4.23	4.32
Long Term	Good health care, benefits	4.24	4.27	4.03**
Long Term	Predictable, secure future	4.17	4.21	3.87**
Long Term	Good retirement plan (e.g., 401K)	4.09	4.13	3.85**
Extrinsic	Chance to earn good deal of money	4.07	4.10	3.87**
Supervision	Supervisor supports personal commitments	3.97	3.98	3.91
Intrinsic	Skills will not go out of date	3.96	4.00	3.68**
Intrinsic	Chance to be creative	3.68	3.67	3.67
Supervision	Receive frequent feedback	3.67	3.66	3.69
Altruistic	Opportunity to be helpful to others	3.65	3.65	3.59
Altruistic	Worthwhile to society	3.62	3.61	3.61
Leisure	Leaves time for other things in life	3.52	3.53	3.46
Extrinsic	People look up to, respect	3.49	3.49	3.41
Supervision	Receive detailed instructions	3.48	3.52	3.21**
Leisure	Have more than 2 weeks' vacation	3.28	3.29	3.23
Extrinsic	High status, prestige	3.24	3.25	3.18
Social	Chance to make friends	3.12	3.07	3.43**
Social	Contact with a lot of people	3.10	3.07	3.36**
Social	Have common interests with co-workers	3.09	3.08	3.17
Leisure	Easy pace, lets you work slowly	2.24	2.25	2.17

(Scale: 1 – not important to 5 – essential)
*** significant difference between business and engineering at $\alpha=0.001$, * at $\alpha=0.01$*

Looking within the engineering group at just the students who agreed or strongly agreed with the statement that that they were interested in a logistics career (n=171), there were no notable differences with the whole engineering group, implying that IEs who are interested in a career in logistics are not different from IEs as a whole.

Table 4 summarizes the average student responses by gender and ethnicity (self-reported). Most significantly, female engineering students rated both altruistic categories higher than men. This supports previous research that women are drawn to fields that have the potential to make a difference [14]. This suggests that stressing ways that logistics helps society would be good in explaining the field to women. Women also rated two of the three long term factors (retirement plan and benefits) as slightly more important than their male peers. The sample sizes were unfortunately too small for the various ethnicities to produce statistically significant differences between the subsamples, but there were some differences that warrant further study.

Table 4: Student Importance of Job Factors, by Demographic

Factor	Survey Question	Average Student Responses					
		Men (n=137)	Women (n=115)	African-Amer. (n=20)	Asian (n=54)	Hispanic (n=20)	White (n=140)
Intrinsic	Learn new things, skills	4.36	4.28	4.20	4.57	4.55	4.22
Intrinsic	Skills will not go out of date	3.74	3.63	4.05	3.91	4.00	3.49
Intrinsic	See results of what you do	4.22	4.41	4.25	4.28	4.70	4.26
Intrinsic	Chance to be creative	3.74	3.61	3.80	3.69	4.20	3.59
Extrinsic	Chance to earn good deal of money	3.96	3.76	4.20	3.91	4.15	3.74
Extrinsic	Chances for promotion are good	4.26	4.14	4.45	4.04	4.50	4.16
Extrinsic	High status, prestige	3.20	3.15	3.40	3.41	3.80	2.94
Extrinsic	People look up to, respect	3.37	3.44	3.45	3.43	4.05	3.26
Supervision	Receive frequent feedback	3.69	3.70	3.90	3.78	4.15	3.55
Supervision	Receive detailed instructions	3.14	3.30	3.35	3.33	3.60	3.06
Supervision	Supervisor supports personal commitments	3.85	3.97	3.55	3.93	4.00	3.89
Altruistic	Opportunity to be helpful to others	3.39	3.83**	3.45	3.67	3.70	3.53
Altruistic	Worthwhile to society	3.40	3.85**	3.50	3.70	3.70	3.55
Leisure	Have more than 2 weeks' vacation	3.15	3.33	3.15	3.61	3.45	3.12
Leisure	Leaves time for other things in life	3.35	3.57	3.10	3.61	3.55	3.45
Leisure	Easy pace, lets you work slowly	2.09	2.27	2.10	2.57	2.25	2.01
Long Term	Good retirement plan (e.g., 401K)	3.72	4.02*	3.85	3.78	3.80	3.88
Long Term	Good health care, benefits	3.91	4.17*	4.10	3.98	4.10	4.03
Long Term	Predictable, secure future	3.77	3.99	4.21	4.06	4.05	3.74
Social	Contact with a lot of people	3.28	3.46	3.00	3.48	3.60	3.34
Social	Chance to make friends	3.34	3.56	2.85	3.69	3.55	3.40
Social	Have common interests with co-workers	3.09	3.27	2.79	3.35	3.40	3.11

(Scale: 1 – not important to 5 – essential)
*** significant difference between men and women at $\alpha=0.001$, * at $\alpha=0.05$*

Conclusions and Future Work

Results from this survey yield some interesting insights and opportunities to grow the IE talent pool pursuing careers in logistics. With only a small majority of IEs reporting that they are

well-informed about logistics, there is clearly opportunity for further education. Educating industrial engineering faculty about logistics so they can promote it in their classes and including information about logistics in the introductory engineering course are two possibilities. Providing logistics guest speakers or tour opportunities (such as distribution centers, airports or sea ports) or partnering with logistics companies on class projects can be other exciting options for students.

Survey results imply that students who are better informed about logistics may be more likely to plan to enter a career in logistics. There is a significant difference between the percentage of students who believed that a career in logistics is a good idea and those who said they are likely to pursue a career in logistics themselves. The gap was smaller for students who reported that they were very familiar with logistics. Determining what causes this gap and how to make it smaller would be a good direction for future study. In addition, female IEs were slightly more interested in a career in logistics than their male peers, which represents an opportunity to reduce gender imbalance in the field.

Industrial engineering students reported that the most important career aspects to them are a job that lets them see results of what they do and one that allows them to learn new things/skills. A job with opportunities for promotion and good healthcare benefits also ranked highly. That can be a starting point for marketing efforts toward IE undergraduates. It is notable that business students had slightly different priorities than IEs, information which should be helpful to logistics companies hiring IEs. Also, women more highly rated jobs that will let them be helpful to others or worthwhile to society, factors which companies might want to consider when recruiting women. For example, industry may also wish to enhance their websites to highlight the more impactful factors or develop a section of their website specifically targeted to engineers and women.

This work has several limitations. It is not possible to determine causality, so there is no way to prove whether interest in a logistics career led to students becoming very familiar with logistics or vice versa. In addition, while the demographics of the students who responded to the survey appear to be representative of undergraduate students enrolled in IE programs in the state, the data does come from a sample which potentially could be biased.

In future work, the authors plan to align the student expectations about the 22 factors in this survey with a survey of logistics practitioners about the presence of those factors in the field. This will help companies to better market to the strengths of the logistics field and help faculty educate students about careers in logistics. The authors also plan to expand the study to additional colleges.

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