

COMPETENCY REQUIREMENTS FOR LOGISTICS PROFESSIONALS IN SUPPLY CHAIN MANAGEMENT

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Abstract

Logistics and supply chain management has been playing a critical role in the national economy. With business environments continue to change rapidly, it is critical that logistics professionals are well trained and equipped with important skills and knowledge. This study aims to explore the current profile of skills and knowledge of logistics professionals and identify important requirements for the future. It is found that all proposed business-, logistics- and management-related skills and knowledge are important for logistics professionals. In addition, logistics-related skill and knowledge set was found to be the area that educational and training institutions should particularly aim at to further equip local logistics workforce with substantial skills and knowledge to perform their job successfully.

Keywords: *skill requirements, logistics competencies, logistics professionals, BLM framework*

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1. Introduction

Logistics and supply chain management plays a critical role in the national economy. Like any other economic sector, skilled workforce in logistics and supply chain contributes greatly to the success of the sector. As business environments continue to change rapidly, logistics and supply chain sectors face many challenges, of which the need for well trained and skilled logistics professionals is absolutely essential. To reflect this, Closs (2000) suggested that ‘one of the major challenges to management in the next decade is the scarcity of trained supply chain managers’, and that ‘substantial change in logistics and supply chain education is necessary’ to meet these challenges. Until recently, this perception has been reinforced by Carter and Carter (2007) who argued that supply management organisations would take on a higher value role in the coming decade, and thus success would hinge on whether they can attract, develop, and retain individuals with the right skills and capabilities to excel in the future. This view is further elaborated by Green (2010) of the Accenture Supply Chain Academy in that leading companies in recent years have recognised the vital role that people play in driving innovation in their supply chain and improving their ability to produce results, rather than investing only on technology and processes.

Managing the supply chain has become increasingly more complex as logisticians attempt to adapt to turbulent and competitive market environments. Adding to the complexity is managing the paradox of achieving cost efficiencies whilst improving customer service and improving customer and supplier relationships within the supply chain (Christopher 1998). Whereas logistics professionals may have focused on managing traditional logistics functions

such as logistics information systems, transportation and warehousing, their contemporaries no longer operate in isolation from the organisation's value chain and instead must constantly interact with other functional areas within an organisation such as marketing and production, as well as integrate with those of their suppliers and customers. The issue that arises is what knowledge and skills are necessary for logistics professionals to be able to meet the broader challenges of their role in a globalised market. Logistics professionals must be multi-talented across a range of management skills as well as having the depth of logistics knowledge and abilities, which means they must have both generalist and specialist knowledge and skills (Gammelgaard and Larson 2001; Razzaque and Sirat 2001; Murphy and Poist 2006).

This paper aims to address the above mentioned issue and is organised in four sections. First, a literature review is conducted to examine how the research issue has been addressed in the contemporary literature and identify rooms for further investigation in this study. Secondly, research methodology in this study with the adopted conceptual framework, data collection and sampling methods will be explained. Findings and conclusions will be presented next, followed by a discussion on both academic and managerial implications. Finally, a conclusion is presented together with some notes on directions for future research.

2. Literature review

During the 1990s, a number of studies emerged that drew attention to the range of skills that logistics managers may require (for example see La Londe 1990; Williams and Currey 1990; Murphy and Poist 1991a, 1991b, 1993, 1998; Minihan 1998; Trunick 1998; Gibson, Gibson and Rutner 1998). What is apparent from the studies is that logistics managers require many skills to be effective. Researchers have tested the importance of a wide variety of skills ranging from the four broad sets of people, analytical, communication and computer skills (see

Gibson, Gibson and Rutner 1998) through to 83 items classified by Murphy and Poist (1991a) as business skills, logistics skills and management skills. In a variety of other studies (for example, see Young 1998; Le May 1999) necessary skills for logistics managers spread over from technological, to organisational and interpersonal ones. What becomes apparent is that to become a successful logistics manager, one may need to take on super-human characteristics to take on the plethora of activities.

The BLM framework of 33 business, 18 logistics and 32 management skills developed by Murphy and Poist (1991a) has since become a backbone model of research on skills and competencies of logistics professionals. It was found from this study that management skills are seen as the most important component for logistics executives, with emphasis on traditional managerial skills such as motivation, planning, and organising. Next in importance is the logistics skills followed by the business skills. These results are said to have implications for practitioners, head-hunters, employers and educators. Murphy and Poist have since conducted some other studies to explore the above mentioned implications. The above finding was replicated in the subsequent study by Murphy and Poist (1991b) to compare the views of head-hunters and practitioners which also found that some disagreements between these two groups of respondents were in the logistics and management skills. Respondents who were educators in the study by Murphy and Poist (1993) rated management skills as the most important, followed by logistics and business skills, and this finding was also confirmed by respondents who are practitioners in the later study (Murphy and Poist 1998). Among 83 presented skills, educators also perceived nine management skills as the most important for senior logistics executives in this study, which confirms the earlier ascertain that logistics executives should first be proficient in management skill set. Using the same BLM framework, Murphy and Poist (2006) also found that management skills are most important

for both senior- and entry-level managers, followed in order by logistics and business skills, although there was a high degree of difference across the two groups. The BLM framework was also validated in the Asian context as evidenced in the study by Razzaque and Sirat (2001). It is also found from this study that business and government skill received high score which perhaps reflect the great influence of the local government policies and legislature and concern for society in the respective study countries.

Although the research has brought attention to the changing role of logistics managers, researchers such as Razzaque and Sirat (2001) suggest that the focus on ‘the skills and attributes that make a good logistician, has been rather scant’. Similarly, Gammelgaard and Larson (2001) add that overall ‘little has been written on these new logistics skills and competencies’. Although the BLM framework has so far been used as a common tool to evaluate skills and knowledge of logisticians, it has been validated mostly in the American context. Furthermore, it is also important to take into account factors that affect and change business environments, i.e. globalisation, outsourcing, technology developments, climate change and the increasing emphasis on risk management which may impact the preference for skills and competencies of logisticians. For example, a recent study conducted in the context of the new European Union environment found that skill preference will be given to international business expertise or skill levels in a relevant foreign language (Poist, Scheraga and Semeijn, 2001). With the exception of the recent United States based study by Murphy and Poist (2006), the amount of interest in the knowledge and skill sets for logistics managers appears to have somewhat subsided.

3. Methodology

3.1 Research question

This study aims to examine the questions of what skills and knowledge are necessary for logistics professionals to be successful in their job and how these skills and knowledge profiles may change in the future. It also looks at the perceived importance of these skills and knowledge and the implication to educational providers in preparing students embarking on a logistics career.

3.2 Methods of data collection

Triangulation is utilised in this study. Triangulation is strongly suggested in transportation and logistics research literature as an effective and useful technique to achieve the width and depth of research issues (Cunningham et al. 2000). The type of triangulation technique employed in this paper is the methodological triangulation, in which the author used and combined qualitative and quantitative methods to obtain a comprehensive understanding and a wide and deep picture of the research question. The methods of data collection and interpretation used in this study are exploratory in-depth interviews to provide more inputs for the follow-up survey method (by using mail questionnaires).

3.3 Sampling design

The exploratory phase of this research involves seven in-depth interviews with senior logistics executives who are members of the Chartered Institute of Logistics and Transport in Australia (CILTA). Due to the elite nature of the interview population which is required to be those in senior designations of logistics profession, interviewee sample for this research was selected on convenient basis, i.e. from the authors' contact database. Given the target population being logistics professionals with their skills and knowledge as the unit of analysis in this research, the sampling frame for the questionnaire survey is constructed from the member directory of CILTA with the total sampling approach taken. A list of 1,300 members of CILTA is thus

used as the mailing list. By the cut-off date, 147 questionnaires were returned, representing a 11.3% overall response rate.

3.4 Design of research instruments

During the interviews, a response card consisting of a brief description of the three groups of business, logistics and management skills was given to interviewees asking them about the suitability of these skill groups for logistics professionals as well as their rankings. Interviewees were also asked to indicate any new skill and knowledge that they would think important to be included, as well as any possible difference of requirements for logistics professionals at the entry and management levels. For the questionnaire survey, both fixed-alternative and open-ended response questions were utilised. Skills and knowledge required by logistics professionals were explored by asking respondents to rank the perceived current and future importance (in 10 years time) of 68 skills and knowledge on the scale with 1 indicating 'not important' and 5 denoting 'most important'. Table 1 presents the 68 skills and knowledge used in this study and their associated codes. Respondents were also asked to indicate whether they currently have the relevant skill and knowledge. The 68 skills and knowledge used for this research are mainly derived from the BLM framework of 33 business, 18 logistics and 32 management skills. However, they were thoroughly reviewed and scrutinised to ensure their relevant meaning and avoid repetition. This led to the rewording as well as deletion of some skills and knowledge in the original BLM framework. In addition, some other new skills and knowledge were added on the basis of findings from the in-depth interviews specifically on the aspect of how changes in the business environment would affect logistics professionals in terms of requirements of skills and knowledge necessary to perform their jobs successfully. As a result, in the business-related group, 13 skills were deleted, two of them were combined, and seven new skills were added making up

25 skills and knowledge in this group. In the logistics-related group, 20 skills and knowledge in the original framework were retained with some modification in wording to make them more user-friendly. Three new skills and knowledge were also added following the findings from the in-depth interviews. In the management-related group, 12 deletions were made from the original 32 skills and knowledge on the basis of review of repetition in semantic meaning as well as in other skill groups. The above revision is reflected in Table 2.

Insert Table 2 about here.

3.4 Administering research instruments

Prior to the interviews, a list of prospective interviewees in various organisations was drawn up, and each of these interviewees was contacted by telephone inviting their participation in the interviews. The interviews were conducted on a one-to-one basis and averaged approximately sixty minutes. A tape recorder was used to record the whole interview with the prior consent of the interviewees. The survey questionnaire was pre-tested with a group of 10 organisations. Once this was completed and all feedback was incorporated in a revised questionnaire, the finalised version was mailed, together with a cover letter and a self-addressed envelope, to the Secretariat of CILT for further forwarding to their members.

4. Findings and discussion

4.1 Measurement scale reliability analysis

In this study, the statistical norm concerning the internal consistency adopted is above ± 2.0 , and the accepted value level of reliability (Chronbach's alpha value) is above 0.60 for the scale. Table 3 shows the item-total correlation analysis and Chronbach's alpha value of the scale measuring perceptions of 68 skills/knowledge. Since all the values in the 'Corrected item-total correlation' column, which shows the internal consistency of the whole scale, are

above ± 2.0 (the lowest item has an item-total correlation of 0.38), it is decided that no variable is dropped from the scale, as each is considered a reliable skill/knowledge necessary for logistics professionals. Even when the variable with the lowest item-total correlation is dropped from the scale, the scale's alpha is still very high (0.972). The overall alpha value for the questionnaire is 0.972, which indicates that the survey instrument is very reliable.

Insert Table 3 about here

4.2 General perception of proposed skills and knowledge for logistics professionals

Table 4 presents the descriptive statistical results of the proposed 68 skills and knowledge which deem necessary for logistics professionals in the current and future states. Mean and standard deviation were computed to derive the descriptive profile of variables. Based on the mean scores, conclusion could be drawn on respondents' perception of the perceived importance of each skill and knowledge. Ranking of skills and knowledge in terms of importance could also be established based on their mean scores and standard deviation. Specifically, as the midpoint of the scale is 3 (neutral), those variables having a mean score greater than 3 would indicate that their importance is supported by the survey respondents, while those with mean score less than 2 (little important) should be eliminated from the original model. The change in ranks of each variable from the current to future state is also computed using mean score differences. In addition, the test of significant at 95% confidence level using z test (Zikmund 2003) was also conducted to examine the generalisability of all variables involved.

Insert Table 4 about here

As can be seen from Table 4, no skill and knowledge in the proposed set has the mean response lower than 2 both in current and future states, which indicate that they are all

accepted by respondents as necessary skills and knowledge for logistics professionals. However, in terms of perceived importance, four skills/knowledge (*managing returned products*, *packaging*, *salvage and scrap disposal*, and *knowing two or more languages*) were seen as least important to logistics professional in the current state, although *managing returned products* would be of moderate importance in the future. This, to some extent, demonstrate the increasing importance of reverse logistics in the future as logistics professionals would be entrusted to take care of all related operations and processes of the product's lifecycle, i.e. "from cradle to grave". However, the finding that *salvage and scrap disposal* was rated least importantly must be interpreted with caution, since this may be industry specific rather than a universal outcome. For instance, this skill is important in the electronics but might be less likely so in the trucking industry. The finding that *knowing two or more languages* was not seen as of great importance reflects the context where respondents are operating in, i.e. English speaking as the mother tongue, nevertheless this is also seen as of increasing importance in the future given the international exposure of logistics and supply chain operations.

In terms of ranking, the five most important skills and knowledge (in order) as currently perceived by respondents are *personal integrity*, *managing client relationships*, *problem-solving ability*, *cost control* and *ability to plan*. All these skills/knowledge have mean scores greater than 4 denoting that they are seen as greatly important skill sets that logistics professionals must possess. In the future state, these skills and knowledge are also seen of most important magnitude since they are still in the top five most important. However, rankings of individual skill/knowledge have changed slightly. While *personal integrity* and *problem-solving ability* remain their ranks as the most and third most important skill and knowledge necessary for logistics professionals, *ability to plan* has become the second most

important in the future (from the 5th rank), the importance of *managing client relationship* has been downgraded from second to fourth rank, while the same is observed for *cost control* (from the 4th to 5th rank). What can be induced from the above is that planning capability is seen as critical for logistics professionals operating in an increasingly complex business environment with many uncertainties. At the same time, logistics professionals will need to remain their personal integrity as an important virtue for business success, while also being vigilant in solving any problem that may arise in their operations.

Compared between the current and future states, several skills and knowledge in the proposed set of skills and knowledge for logistics professionals have their ranks changed substantially. This is reflected in the last column in Table 4 which shows the gap score of ranks for each skill and knowledge between current and future states. A positive score indicates an increase in ranking from the current to the future state which means the perceived importance of a specific skill/knowledge has been decreased, and vice versa. It can be seen from Table 4 that those skills and knowledge which have biggest positive scores (decreased perceived magnitude of importance of eight, seven and five ranks respectively) are *understanding logistics terminologies*, *ability to delegate*, *traffic/transport management*, *effective supervision of staff*, *occupational health and safety*, among others. On the other hand, those skills and knowledge which have biggest negative scores (increased perceived magnitude of importance) are *use of logistics specialised softwares* (13 ranks difference), *strategic management* (11 ranks difference), *risk management* (8 ranks difference), *impact of climate change* (7 ranks difference), among others. The above findings signify that those skills and knowledge at the basic operational level are decreasing their importance, while logistics professionals in Australia emphasised the increasing importance in the future of those skills and knowledge relating to the capability at the strategic level such as strategically managing

the overall logistics processes as well as risks. It is also interesting to note the increasing concern of logistics professionals on the capability to understand and mitigate climate change's impact on logistics operations, which in turns can be interpreted into logistics-related skill and knowledge such as the capability to design, operate and manage environmentally friendly logistics operations processes ("green logistics").

Majority of the five least important skills and knowledge for logistics professionals are those related to logistics skill and knowledge group (*packaging, managing returned products, and salvage and scrap disposal*). The other least important skills and knowledge are business-related (*international business regulations*) and management-related (*knowing two or more languages*). As discussed earlier, this may be induced as context-constrained where English is the mother tongue of respondents and Australia as a continent is geographically separated from the rest. However, the latter must be interpreted with much caution given the connectivity in terms of logistics operations between Australia and the rest of the world. The finding that respondents give a lesser extent of importance to logistics-related skills and knowledge is in line with other findings in the literature where logistics professionals need to be managers first, not logistician. This can be seen clearer when skills and knowledge are classified into business, logistics and management groups with statistical results summarised in Table 5. It is also worth noticing that the perceived importance of each skill and knowledge group in the future state is increased compared to the current state.

Insert Table 5 about here

Table 6 depicts the current skill and knowledge profile of the Australian logistics professionals. As can be seen from this table, 86% of respondents in this study currently have management-related skill and knowledge set while the percentage for business- and logistics-

related ones are 71% and 52% respectively. What can be deduced from this result is that, from the training and education perspective, respondents are quite proficient in terms of management and business areas, but it is quite alarming that just about half of them currently possess logistics-related skill and knowledge set. This might be partly because many respondents have been concentrated their daily work on some specific areas but not the overall picture of the logistics and supply chain. Given the finding that logistics-related skills and knowledge are seen as important and necessary for the success of logistics professionals in Australia, educational and training institutions will need to act on this accordingly.

Insert Table 6 about here

4.3 Respondents' perception by demographic variables

Statistical tests were conducted to explore whether there is a significant difference in respondents' perception of the proposed skills and knowledge at present and future, and whether their perception is dependent on other demographic variables such as their designation and work experience. First, a paired sample t-test was conducted to investigate whether there is any particular skill and knowledge in which their respective perceived present and future importance is significantly different from each other. As can be seen from Table 7, there are 11 skills and knowledge which perceived present and future importance are significantly different from each other (p value <0.05), in that respondents perceived that these skills and knowledge would be significantly more important to possess in the future so that logistics professionals can fulfil their job successfully. On the business side, respondents emphasised the future importance of knowledge on local and international business regulations (skills 1, 8), impact of globalisation and climate change (skills 7, 19), and information system management (skill 22). On the logistics side, respondents also emphasised the future importance of application of ICT in logistics such as the use of specialised logistics

softwares (skill 28), minimising the effect of demand uncertainty (skill 29), logistics personnel recruitment (skill 37), global logistics operations (skill 39), as well as developing environmentally sustainable logistics systems (skill 48), which are in line with ongoing trends on technological application in business and increasing awareness for the environmental sustainability. On the management side, there was not much difference in respondents' perception of current and future importance of the proposed skills and knowledge, except that the knowledge of two or more languages in the future was specifically emphasised (skill 68). This finding is quite expected in the context of Australian logistics professionals given the social context of an English speaking nation.

Insert Table 7 about here

Based on description of job title, respondents were classified into two main groups: 99 respondents at senior level (with designations such as CEO, director, deputy director, general manager, manager, etc.) and 48 at entry level (for all other designations). Table 8 presents the statistical summary of the findings. As can be seen from this table, in terms of current importance there are 11 skills and knowledge in which the difference in perception of respondents at the entry and senior levels is significant. Specifically, senior level respondents rated significantly more important than do respondents at the entry level in the skills and knowledge of *analysing statistical data, the impact of globalisation, marketing, human resource management, strategic management, understanding economic principles, engineering logistics, ability to organise, expertise in interpersonal relations, and ability to train subordinates*. The higher emphasis by senior level respondents on some skills such as strategic management, knowledge of impact of globalisation, ability to train subordinates, etc. is quite expected given the respondents' designation profile. Entry level respondents, however, rated significantly more important than do respondents at the senior level on the

knowledge of two or more languages. This is also understandable as entry-level respondents are those directly involved in logistics business at the operational level. As far as future importance of skills and knowledge is concerned, there are five skills and knowledge in which respondents at the entry level rated significantly more important than do those at the senior level, namely, *business regulations*, *modelling of operations systems*, *infrastructure planning and management*, *understanding transport regulations*, and *salvage and scrap disposal*. At the aggregate level, there is no significant difference in the perception of respondents at the senior level towards current and future importance of business, logistics and management skills and knowledge. However, those at the entry level rated these three skills and knowledge groups significantly more important in the future compared to the current state. This is reflected in Table 9.

Insert Tables 8 and 9 about here

Respondents were also classified into three groups according to their levels of experience. As two-third of respondents hold senior positions, they have also correspondingly spent many years working in the industry. The average number of years of work experience is 26, and for this reason respondents were grouped into those of having ≤ 15 years (35 respondents), > 15 and < 25 years (23 respondents), and those of > 25 years (89 respondents). One-way ANOVA tests and multiple comparisons among groups (posthoc test) using the Tukey test procedure were conducted to examine whether there is any significant difference in respondents' perception of the current and future importance of skills and knowledge by their levels of work experience. The statistical results are summarized in Table 10 and Table 11. It can be seen from Table 10 that there are 14 skills and knowledge in which the difference in perception of the three respondent groups is significant (based on the p value). Specifically, respondents with more than 25 years of experience rated *general business administration*

significantly more important than do those with more than 15 and less than 25 years. Those with more than 25 years of experience also rated *human resource management* and *ability to plan* significantly more important than those with less than 15 years. This is expected given that these skills are at the management level. In terms of *effective written communication*, there are significant differences between respondents with 25 years of experience and those with less than 15 years, as well as between those with more than 15 and less than 25 years and those with 15 years, in which the former rated this skill significantly more important than the latter. Another common observation is that respondents with 25 years of work experience placed more importance on the skills of *self-motivation*, *individual time management*, *enthusiasm*, and *effective verbal communication* than do those with the least experience (less than 15 years). The difference between these two respondent groups is particularly reflected in the current perceived importance of the management-related skills and knowledge group, in that respondents with more than 25 years of experience rated this group significantly more important than do those with less than 15 years. This is summarised in Table 12.

Insert Tables 10, 11 and 12 about here

With regards to the perceived future importance of skills and knowledge by work experience, there is no but one significant difference between three respondent groups toward the knowledge on the *impact of climate change*. In this respect, it is interesting to note that respondents with less than 15 years of work experience rated this knowledge significantly more important than do those with more than 25 years, as well as those having more than 15 but less than 25 years of experience. This finding is unexpected given the earlier observation that respondents with more work experience were often in favour of skills and knowledge in terms of perceived importance than do those with less experience, and that experienced respondents normally rated knowledge on trends impacting on logistics operations, such as

climate change, more importantly than do those with less experience. Nevertheless, this finding does not necessarily mean that experienced respondents did not appreciate the importance on the knowledge of how climate change might impact logistics operations and professionals (since mean scores are 3.22 and 3.28 respectively), but implies the increasing awareness of other less experienced respondents on this knowledge in the future. The above finding is summarised in Tables 13 and 14.

Insert Tables 13 and 14 about here

4.4 Educational programs for the future

This section explores how educational providers are implicated from the results of this study. In the survey questionnaire, respondents were asked to indicate the educational programs that they would need to undertake in the next 10 years to prepare and perform their job as a logistics professional. The result is summarised in Table 15. It can be seen from this table that a majority number of respondents favoured to have some professional development courses in the future to prepare themselves as a logistics professional. This is also in inline with responses in the ‘other’ selection category, in that respondents indicated *skill sets, management training, certificate of competency, IT courses, specific target short courses*, and *cultural awareness of foreign country business* as the most popular training programs in the future. This is also aligned with the earlier finding that logistics-related skills and knowledge need further attention from educators and trainers for the current workforce. Interestingly, the second most desired training program is postgraduate qualifications, only followed by undergraduate degree and diploma qualifications. This can be partly explained by looking at the respondents’ profile, in that 76% currently hold logistics or business-related qualifications. It is understood from this finding that some professional short courses or in-depth knowledge

courses (postgraduate courses) would be the preferred choice, given the respondents' existing professional qualification background.

Insert Table 15 about here

In response to the question of how education programs to prepare logistics professionals for the next 10 years should be developed and conducted, the majority of responses indicated that the industry should be involved in this process. In other words, universities should develop and conduct these programs in consultation with logistics associations. In addition, it was also suggested by respondents that such a development and conduct of logistics education programs be supported by other business associations, while international universities should also be involved to provide reference of necessary educational programs. This result supports the earlier finding that respondents would prefer professional development courses in that educators and trainers provide skills and knowledge that are in line with the needs of industry professionals. All in all, universities designing and conducting educational program on their own is not a preferred choice. The above findings are presented in Table 16.

Insert Table 16 about here

5. Academic and managerial implications

This research has several academic implications. First of all, it helps to enrich the contemporary literature on logistics knowledge and skill set for logistics professionals, which is currently rather scant. Secondly, although this study was designed on the BLM framework, it has gone further to elaborate the framework and incorporated a number of additional skills and knowledge which are considered to be critical in the contemporary business environment, while refining several other existing variables in the current framework. Findings from this research also indicate the consistency in findings from several earlier studies in the field,

whilst also discover that new skills and knowledge which are critical for logistics professionals should be continuously explored and empirically validated along with changes in the logistics business environment.

This study is also of benefits to managers in logistics firms as they can identify important skills and knowledge to improve on, while policy makers and educational and training bodies can also use the findings from this research to design and implement courses which are necessary to facilitate skill and knowledge development for logistics workforce. On the one hand, as management-related skills and knowledge were rated the most important group, it is paramount that educator and trainers continue to focus their curriculum development and teaching designs on areas which are perceived as critical to logistics professionals such as customer relationship management and problem solving and decision making. Meanwhile, more emphasis should also be placed on areas of increasing concern such as logistics cost control and management, and ability to plan business processes effectively. These skills and knowledge can be imparted as part of the overall tailor-made curriculum development in strategic management in logistics and supply chain, which also includes topical aspects such as risk management and environmental management. Some necessary teaching tools can be developed accordingly such as business strategy games in which learners need to employ their knowledge on various aspects of planning, cost management, customer service management, etc. to achieve business performance objectives within the given constraints. On the other hand, the finding that nearly half of the current logistics workforce has not possessed necessary logistics-related skills and knowledge requires further attention of educators and trainers. While many logistics professionals have learnt their logistics skills and knowledge on the job, these might be too constrained within their daily job scope and thus logistics and supply chain management education programs to provide holistic logistics knowledge are

desired to fill up this knowledge gap. This should not be the job of only training institutions but collaboration with professionals in the logistics and supply chain industry is also required.

6. Conclusion

This research aims to build and empirically validate a model of skills and knowledge which are necessary for logistics professionals to perform their job successfully based on the existing BLM framework with substantial refinement based on critical screening and analysis of changes that may impact logistics business environment. It has been found from this study that all proposed skills and knowledge in the model are empirically validated, while findings on the relative importance of business, logistics and management skill and knowledge sets are consistent with earlier research. In addition, logistics-related skill and knowledge set was found to be the area that educational and training institution should particularly aim at to further equip logistics workforce with substantial skills and knowledge to perform their job successfully in the future.

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| Skill/knowledge | Code |
|--|-------------|
| Business regulations | Skill 1 |
| Modelling of operations systems | Skill 2 |
| Knowledge of client's systems | Skill 3 |
| Financial management | Skill 4 |
| Public relations | Skill 5 |
| Analysing statistical data | Skill 6 |
| The impact of globalisation | Skill 7 |
| International business regulations | Skill 8 |
| Cost control | Skill 9 |
| Marketing | Skill 10 |
| Managing client relationships | Skill 11 |
| General business administration | Skill 12 |
| Managing corporate knowledge | Skill 13 |
| Human resource management | Skill 14 |
| Managing organisational culture | Skill 15 |
| Risk management | Skill 16 |
| Ethical behaviour | Skill 17 |
| Being a good corporate citizen | Skill 18 |
| Impact of climate change | Skill 19 |
| Strategic management | Skill 20 |
| Understanding economic principles | Skill 21 |
| Information system management | Skill 22 |
| Industrial relations | Skill 23 |
| Occupational health and safety | Skill 24 |
| Infrastructure planning and management | Skill 25 |
| Planning the location of facilities | Skill 26 |
| Contract management | Skill 27 |
| Use of logistics specialised softwares | Skill 28 |
| Product demand forecasting | Skill 29 |
| Spare parts support | Skill 30 |
| Understanding transport regulation | Skill 31 |
| Order processing | Skill 32 |
| Traffic/transport management | Skill 33 |
| Distribution communications | Skill 34 |
| Purchasing | Skill 35 |
| Materials handling | Skill 36 |
| Recruiting logistics personnel | Skill 37 |
| Packaging | Skill 38 |
| International logistics | Skill 39 |
| Inventory control | Skill 40 |
| Managing returned products | Skill 41 |
| Salvage and scrap disposal | Skill 42 |
| Production planning | Skill 43 |
| Understanding logistics terminology | Skill 44 |
| Customer service | Skill 45 |
| Engineering logistics | Skill 46 |
| Warehousing | Skill 47 |

| | |
|--|----------|
| Developing environmentally sustainable logistics systems | Skill 48 |
| Ability to plan | Skill 49 |
| Effective written communication | Skill 50 |
| Self-confidence | Skill 51 |
| Effective supervision of staff | Skill 52 |
| Negotiation skills | Skill 53 |
| Ability to delegate | Skill 54 |
| Problem-solving ability | Skill 55 |
| Self-motivation | Skill 56 |
| Individual time management | Skill 57 |
| Ability to motivate staff | Skill 58 |
| Enthusiasm | Skill 59 |
| Personal integrity | Skill 60 |
| Adapting to organisational change | Skill 61 |
| Effective verbal communication | Skill 62 |
| Ability to organise | Skill 63 |
| Expertise in interpersonal relations | Skill 64 |
| Knowledge of operations | Skill 65 |
| Ability to train subordinates | Skill 66 |
| Identifying opportunities and threats | Skill 67 |
| Knowing two or more languages | Skill 68 |

Table 1: List of skills & knowledge and associated codes

| Original BLM framework BUSINESS (33 SKILLS) | Framework in this study BUSINESS (33 – 13 deletions – 2 combinations + 7 additions = 25 SKILLS) |
|--|--|
| General business administration | General business administration |
| Marketing management | Marketing |
| Human resource management | Human resource management |
| Public relations | Public relations |
| Business strategy | Strategic management |
| Transport & logistics | Deleted, to be in traffic/transport management in Logistics-related group |
| Business ethics | Ethical behavior |
| Accounting | Cost control |
| Business writing | Deleted, to be part of effective written communication in Management-related group |
| Financial management | Financial management |
| Labor relations | Industrial relations |
| Microeconomics | Understanding economic principles |
| Macroeconomics | Understanding economic principles |
| Quantitative methods | Modeling of operations systems |
| Procurement | Deleted, to be in Purchasing in Logistics-related group |
| Organizational psychology | Managing corporate knowledge |
| Production management | Deleted, to be included in Strategic management |
| Computer science | Information system management |
| Information system | Information system management |

| | |
|----------------------------------|--|
| management | |
| Statistics | Analysis statistical data |
| Industrial engineer | Deleted, combined with civil engineering to become engineering logistics in Logistics-related group |
| Business & government | Australian business regulations |
| Business law | International business regulations |
| Business & society | Being a good corporate citizen |
| Transport engineer | Deleted, combined with industrial engineering to become engineering logistics in Logistics-related group |
| Industrial sociology | Deleted |
| International business | International business regulations |
| Business history | Deleted |
| Economic geography | Deleted |
| Insurance & real estates | Deleted |
| Speech communication | Deleted, to be part of effective verbal communication in Management-related group |
| Regional planning | Infrastructure planning & management |
| Foreign languages | Deleted, to be covered in Knowing two or more languages in Management-related group |
| | NEW: knowledge of client's systems |
| | NEW: the impact of globalization |
| | NEW: managing client relationships |
| | NEW: managing organizational culture |
| | NEW: risk management |
| | NEW: impact of climate change |
| | NEW: occupational health & safety |
| LOGISTICS (18 SKILLS) | LOGISTICS (20 SKILLS WITH MODIFICATION + 3 additions = 23 SKILLS) |
| Customer service | Customer service |
| International logistics | International logistics |
| Inventory management | Inventory control |
| Materials handling | Materials handling |
| Order management | Order processing |
| Production scheduling | Production planning |
| Packaging | Packaging |
| Purchasing | Purchasing |
| Salvage & scrap disposal | Salvage & scrap disposal |
| Transport and traffic management | Transport/traffic management |
| Warehousing management | Warehousing |
| Logistics-related regulations | Understanding transport regulations |
| Facilities location | Planning the location of facilities |
| Forecasting | Product demand forecasting |
| Parts & service support | Spare parts support |
| Personnel movement | Recruiting logistics personnel |
| Return goods handling | Managing returned products |
| Logistics information management | Use of logistics specialized softwares |
| | NEW: understanding logistics terminology |

| | |
|--|---|
| | NEW: engineering logistics (combined industrial engineering & civil engineering) |
| | NEW: developing an environmentally sustainable logistics systems |
| MANAGEMENT (32 SKILLS) | MANAGEMENT (32 – 12 deletions = 20 SKILLS) |
| Written communication | Effective written communication |
| Interpersonal relations | Expertise in interpersonal relations |
| Plan | Ability to plan |
| Organize | Ability to organize |
| Decision making ability | Problem-solving ability |
| Train/mentor | Ability to train subordinates |
| Personal integrity | Personal integrity |
| Self-motivation | Self-motivation |
| Self-confidence | Self-confidence |
| Enthusiasm | Enthusiasm |
| Motivate others | Ability to motivate staff |
| Managerial control | Deleted, to be part of effective supervision of staff |
| Oral communication | Effective verbal communication |
| Supervise others | Effective supervision of staff |
| Delegate | Ability to delegate |
| Time management | Individual time management |
| Negotiate | Negotiation skills |
| Adapt to change | Adapting to organizational change |
| Persuasion | Deleted, to be part of negotiation skills |
| System concept | Deleted, to be part of managing corporate knowledge in Business-related group |
| Listen and empathize | Deleted, to be part of expertise in interpersonal relations |
| Analytic reasoning | Deleted, to be part of problem-solving ability |
| Operational logistics tasks | Knowledge of operations |
| Assertiveness | Deleted, to be part of expertise in interpersonal relations |
| Personal grooming | Deleted, to be part of personal integrity |
| Personal dress | Deleted, to be part of personal integrity |
| Statesmanship | Deleted, to be part of expertise in interpersonal relations |
| Visualize future threats/opportunities | Identifying opportunities and threats |
| Quantitative expertise | Deleted, to be part of modeling operations systems in Business-related |
| Outgoing personality | Deleted, not considered as part of management skills |
| Computer expertise | Deleted, to be part of information system management in Business-related group |
| Foreign languages | Knowing two or more languages |

Table 2: Changes from the BLM framework to this study

| Alpha = 0.972 | | | | |
|----------------------|---------------------------------------|---|--|---|
| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item- Total Correlation | Cronbach's Alpha if Item Deleted |

| | | | | |
|---------|--------|---------|------|-------|
| skill1 | 248.82 | 1758.48 | 0.39 | 0.972 |
| skill2 | 248.71 | 1739.51 | 0.51 | 0.972 |
| skill3 | 248.73 | 1744.09 | 0.46 | 0.972 |
| skill4 | 248.14 | 1756.99 | 0.42 | 0.972 |
| skill5 | 248.97 | 1746.11 | 0.40 | 0.972 |
| skill6 | 248.56 | 1745.48 | 0.55 | 0.972 |
| skill7 | 248.98 | 1741.86 | 0.45 | 0.972 |
| skill8 | 249.37 | 1726.24 | 0.61 | 0.972 |
| skill9 | 248.08 | 1749.50 | 0.57 | 0.972 |
| skill10 | 248.91 | 1736.79 | 0.56 | 0.972 |
| skill11 | 248.05 | 1749.67 | 0.54 | 0.972 |
| skill12 | 248.50 | 1753.10 | 0.45 | 0.972 |
| skill13 | 248.57 | 1746.25 | 0.56 | 0.972 |
| skill14 | 248.44 | 1736.73 | 0.59 | 0.972 |
| skill15 | 248.46 | 1741.73 | 0.58 | 0.972 |
| skill16 | 248.36 | 1748.83 | 0.54 | 0.972 |
| skill17 | 248.15 | 1757.36 | 0.43 | 0.972 |
| skill18 | 248.54 | 1736.83 | 0.61 | 0.972 |
| skill19 | 249.30 | 1744.44 | 0.48 | 0.972 |
| skill20 | 248.35 | 1743.46 | 0.60 | 0.972 |
| skill21 | 248.79 | 1740.52 | 0.56 | 0.972 |
| skill22 | 248.57 | 1746.58 | 0.53 | 0.972 |
| skill23 | 248.70 | 1731.53 | 0.65 | 0.971 |
| skill24 | 248.27 | 1741.77 | 0.57 | 0.972 |
| skill25 | 248.67 | 1733.65 | 0.64 | 0.971 |
| skill26 | 248.89 | 1721.10 | 0.72 | 0.971 |
| skill27 | 248.58 | 1736.14 | 0.58 | 0.972 |
| skill28 | 249.09 | 1729.00 | 0.59 | 0.972 |
| skill29 | 248.97 | 1724.02 | 0.67 | 0.971 |
| skill30 | 249.24 | 1722.84 | 0.56 | 0.972 |
| skill31 | 248.65 | 1729.53 | 0.64 | 0.971 |
| skill32 | 249.25 | 1725.82 | 0.65 | 0.971 |
| skill33 | 248.85 | 1723.68 | 0.68 | 0.971 |
| skill34 | 249.08 | 1715.17 | 0.75 | 0.971 |
| skill35 | 248.99 | 1732.37 | 0.63 | 0.972 |
| skill36 | 249.04 | 1713.07 | 0.78 | 0.971 |
| skill37 | 248.93 | 1721.64 | 0.68 | 0.971 |
| skill38 | 249.50 | 1719.09 | 0.64 | 0.971 |
| skill39 | 249.18 | 1718.43 | 0.66 | 0.971 |
| skill40 | 248.86 | 1717.24 | 0.71 | 0.971 |
| skill41 | 249.41 | 1716.53 | 0.66 | 0.971 |
| skill42 | 249.63 | 1719.77 | 0.62 | 0.972 |
| skill43 | 249.20 | 1715.19 | 0.66 | 0.971 |
| skill44 | 248.85 | 1738.83 | 0.53 | 0.972 |
| skill45 | 248.22 | 1731.02 | 0.60 | 0.972 |

| | | | | |
|---------|--------|---------|------|-------|
| skill46 | 249.35 | 1730.02 | 0.55 | 0.972 |
| skill47 | 249.03 | 1720.99 | 0.67 | 0.971 |
| skill48 | 249.19 | 1719.39 | 0.70 | 0.971 |
| skill49 | 248.08 | 1752.06 | 0.51 | 0.972 |
| skill50 | 248.13 | 1762.32 | 0.38 | 0.972 |
| skill51 | 248.26 | 1761.59 | 0.35 | 0.972 |
| skill52 | 248.22 | 1745.79 | 0.52 | 0.972 |
| skill53 | 248.24 | 1738.95 | 0.67 | 0.971 |
| skill54 | 248.33 | 1749.22 | 0.51 | 0.972 |
| skill55 | 248.07 | 1760.02 | 0.43 | 0.972 |
| skill56 | 248.14 | 1742.36 | 0.56 | 0.972 |
| skill57 | 248.28 | 1743.74 | 0.61 | 0.972 |
| skill58 | 248.38 | 1733.74 | 0.60 | 0.972 |
| skill59 | 248.29 | 1752.41 | 0.44 | 0.972 |
| skill60 | 247.88 | 1751.71 | 0.47 | 0.972 |
| skill61 | 248.41 | 1744.83 | 0.54 | 0.972 |
| skill62 | 248.16 | 1743.53 | 0.60 | 0.972 |
| skill63 | 248.34 | 1739.18 | 0.66 | 0.971 |
| skill64 | 248.47 | 1743.89 | 0.59 | 0.972 |
| skill65 | 248.33 | 1735.07 | 0.67 | 0.971 |
| skill66 | 248.68 | 1727.75 | 0.73 | 0.971 |
| skill67 | 248.35 | 1738.60 | 0.63 | 0.972 |
| skill68 | 249.93 | 1738.55 | 0.50 | 0.972 |

Table 3: Reliability analysis of scale measuring necessary skill/knowledge of logistics professionals

| Skills | Current importance | | | | | Future importance | | | | | Gap |
|---------|--------------------|------|------|--------|-------|-------------------|------|------|--------|-------|-----|
| | M | STD | Rank | z stat | z obs | M | STD | Rank | z stat | z obs | |
| skill60 | 4.51 | 0.93 | 1 | 1.96 | 19.65 | 4.44 | 1.18 | 1 | 1.96 | 14.72 | 0 |
| skill11 | 4.33 | 0.85 | 2 | 1.96 | 18.91 | 4.28 | 1.16 | 4 | 1.96 | 13.33 | 2 |
| skill55 | 4.32 | 0.78 | 3 | 1.96 | 20.61 | 4.29 | 1.05 | 3 | 1.96 | 14.86 | 0 |
| skill9 | 4.31 | 0.81 | 4 | 1.96 | 19.61 | 4.27 | 1.09 | 5 | 1.96 | 14.11 | 1 |
| skill49 | 4.31 | 0.85 | 5 | 1.96 | 18.65 | 4.33 | 1.12 | 2 | 1.96 | 14.37 | -3 |
| skill50 | 4.26 | 0.82 | 6 | 1.96 | 18.61 | 4.22 | 1.07 | 7 | 1.96 | 13.86 | 1 |
| skill56 | 4.24 | 0.98 | 7 | 1.96 | 15.46 | 4.19 | 1.21 | 11 | 1.96 | 11.90 | 4 |
| skill4 | 4.24 | 0.89 | 8 | 1.96 | 16.99 | 4.18 | 1.14 | 12 | 1.96 | 12.46 | 4 |
| skill17 | 4.24 | 0.85 | 9 | 1.96 | 17.56 | 4.26 | 1.06 | 6 | 1.96 | 14.39 | -3 |
| skill62 | 4.23 | 0.89 | 10 | 1.96 | 16.74 | 4.20 | 1.11 | 9 | 1.96 | 13.03 | -1 |
| skill52 | 4.16 | 0.97 | 11 | 1.96 | 14.61 | 4.16 | 1.14 | 16 | 1.96 | 12.25 | 5 |
| skill45 | 4.16 | 1.14 | 12 | 1.96 | 12.36 | 4.16 | 1.32 | 13 | 1.96 | 10.69 | 1 |
| skill53 | 4.14 | 0.88 | 13 | 1.96 | 15.68 | 4.20 | 1.11 | 8 | 1.96 | 13.10 | -5 |
| skill51 | 4.13 | 0.89 | 14 | 1.96 | 15.32 | 4.10 | 1.14 | 18 | 1.96 | 11.73 | 4 |
| skill24 | 4.12 | 0.96 | 15 | 1.96 | 14.11 | 4.07 | 1.15 | 20 | 1.96 | 11.30 | 5 |
| skill57 | 4.11 | 0.87 | 16 | 1.96 | 15.47 | 4.15 | 1.12 | 17 | 1.96 | 12.39 | 1 |

| | | | | | | | | | | | |
|---------|------|------|----|------|-------|------|------|----|------|-------|-----|
| skill59 | 4.10 | 0.96 | 17 | 1.96 | 13.83 | 4.08 | 1.18 | 19 | 1.96 | 11.14 | 2 |
| skill54 | 4.06 | 0.92 | 18 | 1.96 | 14.05 | 4.01 | 1.11 | 26 | 1.96 | 11.07 | 8 |
| skill65 | 4.05 | 0.95 | 19 | 1.96 | 13.47 | 4.04 | 1.15 | 23 | 1.96 | 11.01 | 4 |
| skill63 | 4.05 | 0.89 | 20 | 1.96 | 14.21 | 4.05 | 1.13 | 22 | 1.96 | 11.34 | 2 |
| skill20 | 4.04 | 0.90 | 21 | 1.96 | 14.05 | 4.19 | 1.13 | 10 | 1.96 | 12.77 | -11 |
| skill67 | 4.03 | 0.94 | 22 | 1.96 | 13.35 | 4.16 | 1.14 | 14 | 1.96 | 12.43 | -8 |
| skill16 | 4.03 | 0.88 | 23 | 1.96 | 14.23 | 4.16 | 1.08 | 15 | 1.96 | 12.94 | -8 |
| skill58 | 4.01 | 1.08 | 24 | 1.96 | 11.28 | 4.03 | 1.29 | 25 | 1.96 | 9.72 | 1 |
| skill61 | 3.98 | 0.96 | 25 | 1.96 | 12.35 | 4.05 | 1.18 | 21 | 1.96 | 10.83 | -4 |
| skill14 | 3.95 | 1.04 | 26 | 1.96 | 11.15 | 4.03 | 1.16 | 24 | 1.96 | 10.80 | -2 |
| skill15 | 3.93 | 0.95 | 27 | 1.96 | 11.91 | 4.01 | 1.14 | 27 | 1.96 | 10.73 | 0 |
| skill64 | 3.92 | 0.90 | 28 | 1.96 | 12.44 | 3.94 | 1.10 | 29 | 1.96 | 10.35 | 1 |
| skill12 | 3.89 | 0.93 | 29 | 1.96 | 11.62 | 3.85 | 1.11 | 34 | 1.96 | 9.27 | 5 |
| skill18 | 3.84 | 1.00 | 30 | 1.96 | 10.18 | 3.90 | 1.18 | 32 | 1.96 | 9.22 | 2 |
| skill6 | 3.82 | 0.93 | 31 | 1.96 | 10.68 | 3.82 | 1.11 | 35 | 1.96 | 8.91 | 4 |
| skill13 | 3.82 | 0.89 | 32 | 1.96 | 11.10 | 3.92 | 1.13 | 30 | 1.96 | 9.89 | -2 |
| skill22 | 3.82 | 0.93 | 33 | 1.96 | 10.65 | 4.00 | 1.14 | 28 | 1.96 | 10.63 | -5 |
| skill27 | 3.81 | 1.07 | 34 | 1.96 | 9.13 | 3.90 | 1.22 | 31 | 1.96 | 8.96 | -3 |
| skill31 | 3.73 | 1.10 | 35 | 1.96 | 8.10 | 3.77 | 1.23 | 37 | 1.96 | 7.56 | 2 |
| skill25 | 3.71 | 1.02 | 36 | 1.96 | 8.49 | 3.86 | 1.19 | 33 | 1.96 | 8.75 | -3 |
| skill66 | 3.71 | 0.99 | 37 | 1.96 | 8.62 | 3.78 | 1.18 | 36 | 1.96 | 8.00 | -1 |
| skill23 | 3.69 | 1.05 | 38 | 1.96 | 7.97 | 3.72 | 1.22 | 41 | 1.96 | 7.16 | 3 |
| skill2 | 3.68 | 1.14 | 39 | 1.96 | 7.23 | 3.75 | 1.30 | 39 | 1.96 | 6.99 | 0 |
| skill3 | 3.65 | 1.14 | 40 | 1.96 | 6.92 | 3.75 | 1.37 | 38 | 1.96 | 6.63 | -2 |
| skill21 | 3.60 | 1.02 | 41 | 1.96 | 7.13 | 3.67 | 1.16 | 42 | 1.96 | 7.04 | 1 |
| skill1 | 3.57 | 0.91 | 42 | 1.96 | 7.58 | 3.73 | 1.11 | 40 | 1.96 | 8.05 | -2 |
| skill33 | 3.54 | 1.14 | 43 | 1.96 | 5.73 | 3.59 | 1.29 | 50 | 1.96 | 5.56 | 7 |
| skill44 | 3.54 | 1.11 | 44 | 1.96 | 5.86 | 3.55 | 1.26 | 52 | 1.96 | 5.32 | 8 |
| skill40 | 3.52 | 1.20 | 45 | 1.96 | 5.29 | 3.60 | 1.37 | 49 | 1.96 | 5.30 | 4 |
| skill26 | 3.50 | 1.12 | 46 | 1.96 | 5.38 | 3.61 | 1.34 | 47 | 1.96 | 5.53 | 1 |
| skill10 | 3.48 | 1.09 | 47 | 1.96 | 5.31 | 3.62 | 1.29 | 45 | 1.96 | 5.80 | -2 |
| skill37 | 3.46 | 1.17 | 48 | 1.96 | 4.72 | 3.63 | 1.29 | 44 | 1.96 | 5.86 | -4 |
| skill29 | 3.42 | 1.15 | 49 | 1.96 | 4.46 | 3.61 | 1.31 | 48 | 1.96 | 5.60 | -1 |
| skill5 | 3.41 | 1.25 | 50 | 1.96 | 4.03 | 3.52 | 1.30 | 53 | 1.96 | 4.89 | 3 |
| skill7 | 3.41 | 1.23 | 51 | 1.96 | 4.04 | 3.61 | 1.44 | 46 | 1.96 | 5.17 | -5 |
| skill35 | 3.40 | 1.06 | 52 | 1.96 | 4.57 | 3.48 | 1.26 | 54 | 1.96 | 4.59 | 2 |
| skill47 | 3.35 | 1.20 | 53 | 1.96 | 3.58 | 3.42 | 1.39 | 58 | 1.96 | 3.68 | 5 |
| skill36 | 3.35 | 1.16 | 54 | 1.96 | 3.64 | 3.43 | 1.30 | 56 | 1.96 | 4.00 | 2 |
| skill34 | 3.31 | 1.17 | 55 | 1.96 | 3.18 | 3.40 | 1.34 | 59 | 1.96 | 3.62 | 4 |
| skill28 | 3.30 | 1.20 | 56 | 1.96 | 3.03 | 3.63 | 1.40 | 43 | 1.96 | 5.46 | -13 |
| skill39 | 3.21 | 1.27 | 57 | 1.96 | 2.02 | 3.42 | 1.49 | 57 | 1.96 | 3.42 | 0 |
| skill48 | 3.20 | 1.18 | 58 | 1.96 | 2.03 | 3.57 | 1.43 | 51 | 1.96 | 4.83 | -7 |
| skill43 | 3.18 | 1.31 | 59 | 1.96 | 1.69 | 3.29 | 1.48 | 60 | 1.96 | 2.39 | 1 |
| skill30 | 3.14 | 1.38 | 60 | 1.96 | 1.26 | 3.22 | 1.51 | 62 | 1.96 | 1.80 | 2 |
| skill32 | 3.14 | 1.15 | 61 | 1.96 | 1.43 | 3.12 | 1.32 | 64 | 1.96 | 1.13 | 3 |

| | | | | | | | | | | | |
|---------|------|------|----|------|-------|------|------|----|------|-------|----|
| skill19 | 3.09 | 1.08 | 62 | 1.96 | 0.99 | 3.46 | 1.37 | 55 | 1.96 | 4.09 | -7 |
| skill46 | 3.03 | 1.25 | 63 | 1.96 | 0.33 | 3.15 | 1.40 | 63 | 1.96 | 1.29 | 0 |
| skill8 | 3.01 | 1.21 | 64 | 1.96 | 0.14 | 3.27 | 1.38 | 61 | 1.96 | 2.39 | -3 |
| skill41 | 2.97 | 1.29 | 65 | 1.96 | -0.26 | 3.03 | 1.41 | 65 | 1.96 | 0.29 | 0 |
| skill38 | 2.89 | 1.28 | 66 | 1.96 | -1.03 | 2.95 | 1.47 | 66 | 1.96 | -0.45 | 0 |
| skill42 | 2.76 | 1.31 | 67 | 1.96 | -2.26 | 2.88 | 1.45 | 68 | 1.96 | -1.03 | 1 |
| skill68 | 2.46 | 1.18 | 68 | 1.96 | -5.50 | 2.90 | 1.47 | 67 | 1.96 | -0.78 | -1 |

Table 4: Descriptive statistics of proposed skills/knowledge of logistics professionals

| SKILL GROUPS | Current importance | | Future importance | |
|------------------|--------------------|------|-------------------|------|
| | M | STD | M | STD |
| BUSINESS GROUP | 3.79 | 0.60 | 3.88 | 0.90 |
| LOGISTICS GROUP | 3.34 | 0.87 | 3.45 | 1.07 |
| MANAGEMENT GROUP | 4.04 | 0.67 | 4.07 | 0.97 |

Table 5: Descriptive statistics of proposed skills/knowledge of logistics professionals by groups

| SKILL GROUPS | Possession of this skill | Absence of this skill |
|------------------|--------------------------|-----------------------|
| BUSINESS GROUP | 71% | 29% |
| LOGISTICS GROUP | 52% | 48% |
| MANAGEMENT GROUP | 86% | 14% |

Table 6: Descriptive statistics of skill possession

| Skills | Current importance | | Future importance | | P value | Skills | Current importance | | Future importance | | P value |
|---------|--------------------|------|-------------------|------|--------------|---------|--------------------|------|-------------------|------|--------------|
| | M | STD | M | STD | | | M | STD | M | STD | |
| skill1 | 3.57 | 0.91 | 3.73 | 1.11 | 0.023 | skill35 | 3.40 | 1.06 | 3.48 | 1.26 | 0.356 |
| skill2 | 3.68 | 1.14 | 3.75 | 1.30 | 0.346 | skill36 | 3.35 | 1.16 | 3.43 | 1.30 | 0.250 |
| skill3 | 3.65 | 1.14 | 3.75 | 1.37 | 0.228 | skill37 | 3.46 | 1.17 | 3.63 | 1.29 | 0.027 |
| skill4 | 4.24 | 0.89 | 4.18 | 1.14 | 0.371 | skill38 | 2.89 | 1.28 | 2.95 | 1.47 | 0.396 |
| skill5 | 3.41 | 1.25 | 3.52 | 1.30 | 0.095 | skill39 | 3.21 | 1.27 | 3.42 | 1.49 | 0.007 |
| skill6 | 3.82 | 0.93 | 3.82 | 1.11 | 0.929 | skill40 | 3.52 | 1.20 | 3.60 | 1.37 | 0.369 |
| skill7 | 3.41 | 1.23 | 3.61 | 1.44 | 0.008 | skill41 | 2.97 | 1.29 | 3.03 | 1.41 | 0.319 |
| skill8 | 3.01 | 1.21 | 3.27 | 1.38 | 0.000 | skill42 | 2.76 | 1.31 | 2.88 | 1.45 | 0.095 |
| skill9 | 4.31 | 0.81 | 4.27 | 1.09 | 0.606 | skill43 | 3.18 | 1.31 | 3.29 | 1.48 | 0.117 |
| skill10 | 3.48 | 1.09 | 3.62 | 1.29 | 0.115 | skill44 | 3.54 | 1.11 | 3.55 | 1.26 | 0.848 |
| skill11 | 4.33 | 0.85 | 4.28 | 1.16 | 0.467 | skill45 | 4.16 | 1.14 | 4.16 | 1.32 | 1.000 |
| skill12 | 3.89 | 0.93 | 3.85 | 1.11 | 0.542 | skill46 | 3.03 | 1.25 | 3.15 | 1.40 | 0.119 |
| skill13 | 3.82 | 0.89 | 3.92 | 1.13 | 0.151 | skill47 | 3.35 | 1.20 | 3.42 | 1.39 | 0.346 |
| skill14 | 3.95 | 1.04 | 4.03 | 1.16 | 0.319 | skill48 | 3.20 | 1.18 | 3.57 | 1.43 | 0.000 |
| skill15 | 3.93 | 0.95 | 4.01 | 1.14 | 0.285 | skill49 | 4.31 | 0.85 | 4.33 | 1.12 | 0.756 |
| skill16 | 4.03 | 0.88 | 4.16 | 1.08 | 0.097 | skill50 | 4.26 | 0.82 | 4.22 | 1.07 | 0.645 |
| skill17 | 4.24 | 0.85 | 4.26 | 1.06 | 0.799 | skill51 | 4.13 | 0.89 | 4.10 | 1.14 | 0.699 |

| | | | | | | | | | | | |
|---------|------|------|------|------|--------------|---------|------|------|------|------|--------------|
| skill18 | 3.84 | 1.00 | 3.90 | 1.18 | 0.478 | skill52 | 4.16 | 0.97 | 4.16 | 1.14 | 0.928 |
| skill19 | 3.09 | 1.08 | 3.46 | 1.37 | 0.000 | skill53 | 4.14 | 0.88 | 4.20 | 1.11 | 0.459 |
| skill20 | 4.04 | 0.90 | 4.19 | 1.13 | 0.052 | skill54 | 4.06 | 0.92 | 4.01 | 1.11 | 0.508 |
| skill21 | 3.60 | 1.02 | 3.67 | 1.16 | 0.311 | skill55 | 4.32 | 0.78 | 4.29 | 1.05 | 0.733 |
| skill22 | 3.82 | 0.93 | 4.00 | 1.14 | 0.025 | skill56 | 4.24 | 0.98 | 4.19 | 1.21 | 0.439 |
| skill23 | 3.69 | 1.05 | 3.72 | 1.22 | 0.664 | skill57 | 4.11 | 0.87 | 4.15 | 1.12 | 0.595 |
| skill24 | 4.12 | 0.96 | 4.07 | 1.15 | 0.563 | skill58 | 4.01 | 1.08 | 4.03 | 1.29 | 0.723 |
| skill25 | 3.71 | 1.02 | 3.86 | 1.19 | 0.073 | skill59 | 4.10 | 0.96 | 4.08 | 1.18 | 0.858 |
| skill26 | 3.50 | 1.12 | 3.61 | 1.34 | 0.116 | skill60 | 4.51 | 0.93 | 4.44 | 1.18 | 0.319 |
| skill27 | 3.81 | 1.07 | 3.90 | 1.22 | 0.202 | skill61 | 3.98 | 0.96 | 4.05 | 1.18 | 0.327 |
| skill28 | 3.30 | 1.20 | 3.63 | 1.40 | 0.000 | skill62 | 4.23 | 0.89 | 4.20 | 1.11 | 0.637 |
| skill29 | 3.42 | 1.15 | 3.61 | 1.31 | 0.024 | skill63 | 4.05 | 0.89 | 4.05 | 1.13 | 0.922 |
| skill30 | 3.14 | 1.38 | 3.22 | 1.51 | 0.283 | skill64 | 3.92 | 0.90 | 3.94 | 1.10 | 0.781 |
| skill31 | 3.73 | 1.10 | 3.77 | 1.23 | 0.651 | skill65 | 4.05 | 0.95 | 4.04 | 1.15 | 0.856 |
| skill32 | 3.14 | 1.15 | 3.12 | 1.32 | 0.851 | skill66 | 3.71 | 0.99 | 3.78 | 1.18 | 0.403 |
| skill33 | 3.54 | 1.14 | 3.59 | 1.29 | 0.485 | skill67 | 4.03 | 0.94 | 4.16 | 1.14 | 0.089 |
| skill34 | 3.31 | 1.17 | 3.40 | 1.34 | 0.187 | skill68 | 2.46 | 1.18 | 2.90 | 1.47 | 0.000 |

Table 7: Respondents' perception of current and future skills and knowledge

| Skills | Current importance | | | | | Future importance | | | | |
|---------|--------------------|------|--------------|------|--------------|-------------------|------|--------------|------|--------------|
| | Entry level | | Senior level | | p value | Entry level | | Senior level | | p value |
| | M | STD | M | STD | | M | STD | M | STD | |
| skill1 | 3.67 | 0.91 | 3.53 | 0.92 | 0.789 | 3.98 | 0.89 | 3.62 | 1.18 | 0.013 |
| skill2 | 3.77 | 1.21 | 3.64 | 1.11 | 0.856 | 3.98 | 1.14 | 3.64 | 1.36 | 0.029 |
| skill3 | 3.50 | 1.30 | 3.73 | 1.06 | 0.095 | 3.85 | 1.41 | 3.70 | 1.35 | 0.732 |
| skill4 | 4.29 | 0.94 | 4.22 | 0.86 | 0.975 | 4.40 | 0.94 | 4.07 | 1.22 | 0.387 |
| skill5 | 3.33 | 1.45 | 3.45 | 1.15 | 0.133 | 3.56 | 1.35 | 3.51 | 1.28 | 0.761 |
| skill6 | 3.71 | 1.09 | 3.88 | 0.85 | 0.028 | 3.90 | 1.10 | 3.78 | 1.12 | 0.702 |
| skill7 | 3.19 | 1.50 | 3.52 | 1.06 | 0.013 | 3.56 | 1.60 | 3.64 | 1.36 | 0.110 |
| skill8 | 3.08 | 1.25 | 2.98 | 1.20 | 0.559 | 3.50 | 1.27 | 3.16 | 1.42 | 0.472 |
| skill9 | 4.27 | 0.94 | 4.32 | 0.74 | 0.330 | 4.33 | 0.97 | 4.23 | 1.14 | 0.786 |
| skill10 | 3.21 | 1.32 | 3.61 | 0.93 | 0.023 | 3.58 | 1.46 | 3.64 | 1.22 | 0.093 |
| skill11 | 4.10 | 1.04 | 4.44 | 0.73 | 0.156 | 4.15 | 1.15 | 4.34 | 1.17 | 0.877 |
| skill12 | 3.79 | 1.11 | 3.94 | 0.83 | 0.088 | 3.96 | 0.99 | 3.80 | 1.17 | 0.228 |
| skill13 | 3.85 | 1.01 | 3.80 | 0.83 | 0.940 | 4.13 | 0.94 | 3.82 | 1.20 | 0.075 |
| skill14 | 3.67 | 1.26 | 4.09 | 0.88 | 0.003 | 4.10 | 1.10 | 4.00 | 1.20 | 0.916 |
| skill15 | 3.85 | 1.07 | 3.97 | 0.89 | 0.365 | 4.00 | 1.05 | 4.01 | 1.18 | 0.545 |
| skill16 | 3.98 | 0.98 | 4.05 | 0.83 | 0.692 | 4.31 | 0.90 | 4.08 | 1.16 | 0.464 |
| skill17 | 4.08 | 1.01 | 4.31 | 0.76 | 0.413 | 4.29 | 0.87 | 4.24 | 1.14 | 0.236 |
| skill18 | 3.81 | 1.07 | 3.86 | 0.98 | 0.570 | 4.02 | 1.02 | 3.84 | 1.25 | 0.146 |
| skill19 | 3.02 | 1.28 | 3.12 | 0.98 | 0.136 | 3.56 | 1.40 | 3.41 | 1.36 | 0.788 |
| skill20 | 4.02 | 1.16 | 4.05 | 0.75 | 0.027 | 4.25 | 1.10 | 4.16 | 1.15 | 0.645 |
| skill21 | 3.56 | 1.27 | 3.62 | 0.88 | 0.024 | 3.75 | 1.18 | 3.64 | 1.16 | 0.708 |
| skill22 | 3.83 | 1.08 | 3.81 | 0.85 | 0.604 | 4.10 | 1.08 | 3.95 | 1.17 | 0.542 |

| | | | | | | | | | | |
|---------|------|------|------|------|--------------|------|------|------|------|--------------|
| skill23 | 3.63 | 1.20 | 3.72 | 0.97 | 0.097 | 3.90 | 1.08 | 3.64 | 1.28 | 0.234 |
| skill24 | 4.02 | 1.10 | 4.17 | 0.89 | 0.937 | 4.17 | 1.00 | 4.03 | 1.22 | 0.246 |
| skill25 | 3.81 | 1.10 | 3.67 | 0.98 | 0.900 | 4.13 | 0.98 | 3.73 | 1.26 | 0.029 |
| skill26 | 3.46 | 1.13 | 3.52 | 1.12 | 0.594 | 3.79 | 1.22 | 3.53 | 1.39 | 0.121 |
| skill27 | 3.98 | 1.08 | 3.73 | 1.07 | 0.753 | 4.21 | 1.03 | 3.76 | 1.29 | 0.262 |
| skill28 | 3.42 | 1.38 | 3.24 | 1.10 | 0.284 | 3.85 | 1.53 | 3.52 | 1.33 | 0.869 |
| skill29 | 3.48 | 1.34 | 3.39 | 1.05 | 0.119 | 3.77 | 1.28 | 3.53 | 1.33 | 0.418 |
| skill30 | 3.02 | 1.49 | 3.20 | 1.32 | 0.452 | 3.27 | 1.50 | 3.20 | 1.53 | 0.636 |
| skill31 | 3.79 | 1.18 | 3.71 | 1.06 | 0.701 | 4.02 | 1.04 | 3.65 | 1.30 | 0.019 |
| skill32 | 2.98 | 1.21 | 3.21 | 1.12 | 0.766 | 3.15 | 1.22 | 3.11 | 1.37 | 0.211 |
| skill33 | 3.58 | 1.18 | 3.52 | 1.12 | 0.777 | 3.81 | 1.23 | 3.48 | 1.31 | 0.147 |
| skill34 | 3.29 | 1.30 | 3.31 | 1.10 | 0.602 | 3.54 | 1.34 | 3.33 | 1.35 | 0.430 |
| skill35 | 3.50 | 1.11 | 3.35 | 1.04 | 0.865 | 3.73 | 1.12 | 3.35 | 1.30 | 0.119 |
| skill36 | 3.35 | 1.23 | 3.34 | 1.13 | 0.978 | 3.60 | 1.18 | 3.34 | 1.35 | 0.086 |
| skill37 | 3.38 | 1.35 | 3.49 | 1.08 | 0.215 | 3.69 | 1.19 | 3.60 | 1.35 | 0.192 |
| skill38 | 2.88 | 1.41 | 2.90 | 1.22 | 0.249 | 3.08 | 1.53 | 2.88 | 1.44 | 0.513 |
| skill39 | 3.33 | 1.43 | 3.15 | 1.18 | 0.166 | 3.69 | 1.53 | 3.29 | 1.47 | 0.883 |
| skill40 | 3.63 | 1.21 | 3.47 | 1.20 | 0.714 | 3.79 | 1.27 | 3.51 | 1.41 | 0.156 |
| skill41 | 3.02 | 1.38 | 2.95 | 1.25 | 0.534 | 3.21 | 1.35 | 2.95 | 1.43 | 0.664 |
| skill42 | 2.71 | 1.27 | 2.78 | 1.34 | 0.557 | 2.98 | 1.26 | 2.83 | 1.53 | 0.013 |
| skill43 | 3.27 | 1.25 | 3.14 | 1.35 | 0.356 | 3.52 | 1.30 | 3.18 | 1.55 | 0.052 |
| skill44 | 3.56 | 1.18 | 3.53 | 1.08 | 0.947 | 3.75 | 1.19 | 3.45 | 1.28 | 0.301 |
| skill45 | 4.10 | 1.34 | 4.19 | 1.04 | 0.485 | 4.23 | 1.26 | 4.13 | 1.35 | 0.432 |
| skill46 | 2.83 | 1.55 | 3.13 | 1.08 | 0.001 | 3.17 | 1.60 | 3.14 | 1.30 | 0.050 |
| skill47 | 3.35 | 1.26 | 3.35 | 1.17 | 0.919 | 3.46 | 1.35 | 3.40 | 1.41 | 0.534 |
| skill48 | 3.21 | 1.34 | 3.19 | 1.10 | 0.256 | 3.69 | 1.45 | 3.52 | 1.43 | 0.952 |
| skill49 | 4.21 | 1.03 | 4.35 | 0.75 | 0.075 | 4.52 | 0.90 | 4.24 | 1.21 | 0.339 |
| skill50 | 4.15 | 0.99 | 4.31 | 0.72 | 0.266 | 4.29 | 0.90 | 4.19 | 1.15 | 0.467 |
| skill51 | 4.08 | 1.11 | 4.15 | 0.77 | 0.250 | 4.19 | 1.12 | 4.06 | 1.15 | 0.798 |
| skill52 | 4.04 | 1.20 | 4.22 | 0.83 | 0.123 | 4.31 | 0.97 | 4.08 | 1.22 | 0.428 |
| skill53 | 4.06 | 1.08 | 4.18 | 0.77 | 0.791 | 4.27 | 1.05 | 4.16 | 1.14 | 0.690 |
| skill54 | 3.83 | 1.10 | 4.17 | 0.80 | 0.141 | 3.98 | 0.96 | 4.03 | 1.18 | 0.225 |
| skill55 | 4.25 | 0.93 | 4.35 | 0.69 | 0.341 | 4.33 | 0.86 | 4.27 | 1.14 | 0.317 |
| skill56 | 4.15 | 1.13 | 4.29 | 0.90 | 0.401 | 4.23 | 1.13 | 4.17 | 1.25 | 0.597 |
| skill57 | 4.04 | 1.09 | 4.14 | 0.74 | 0.265 | 4.29 | 1.07 | 4.08 | 1.15 | 0.917 |
| skill58 | 3.83 | 1.23 | 4.09 | 1.00 | 0.182 | 4.15 | 1.18 | 3.98 | 1.34 | 0.650 |
| skill59 | 3.96 | 1.09 | 4.16 | 0.89 | 0.338 | 4.11 | 1.13 | 4.07 | 1.21 | 0.861 |
| skill60 | 4.46 | 1.11 | 4.54 | 0.84 | 0.248 | 4.52 | 1.07 | 4.39 | 1.24 | 0.414 |
| skill61 | 3.92 | 1.05 | 4.01 | 0.92 | 0.695 | 4.06 | 1.02 | 4.05 | 1.26 | 0.149 |
| skill62 | 4.08 | 1.15 | 4.30 | 0.73 | 0.128 | 4.23 | 1.06 | 4.18 | 1.15 | 0.643 |
| skill63 | 3.88 | 1.21 | 4.13 | 0.68 | 0.024 | 4.02 | 1.19 | 4.07 | 1.10 | 0.840 |
| skill64 | 3.73 | 1.12 | 4.01 | 0.75 | 0.017 | 3.92 | 1.05 | 3.95 | 1.13 | 0.622 |
| skill65 | 3.98 | 1.19 | 4.09 | 0.81 | 0.262 | 4.08 | 1.13 | 4.02 | 1.16 | 0.966 |
| skill66 | 3.54 | 1.18 | 3.79 | 0.88 | 0.037 | 3.83 | 1.15 | 3.75 | 1.19 | 0.877 |
| skill67 | 3.88 | 1.10 | 4.11 | 0.84 | 0.466 | 4.10 | 1.08 | 4.19 | 1.17 | 0.457 |

| | | | | | | | | | | |
|---------|------|------|------|------|--------------|------|------|------|------|-------|
| skill68 | 2.58 | 1.38 | 2.40 | 1.08 | 0.022 | 3.08 | 1.51 | 2.82 | 1.45 | 0.741 |
|---------|------|------|------|------|--------------|------|------|------|------|-------|

Table 8: Respondents' perception of current and future skills and knowledge by designation

| Entry level | | | | | |
|-------------|--------------------|------|-------------------|------|--------------|
| Skill group | current importance | | future importance | | p value |
| | M | STD | M | STD | |
| BUS | 3.72 | 0.76 | 3.98 | 0.72 | 0.000 |
| LOG | 3.35 | 0.96 | 3.61 | 0.93 | 0.000 |
| MAN | 3.93 | 0.85 | 4.13 | 0.82 | 0.001 |

Table 9: Entry-level respondents' perception of current and future skills and knowledge

| Skills | ≤ 15 | | > 15 & < 25 | | ≥ 25 | | F | Sig. |
|---------|------|------|-------------|------|------|------|-------|--------------|
| | M | STD | M | STD | M | STD | | |
| skill1 | 3.57 | 0.74 | 3.26 | 1.05 | 3.65 | 0.93 | 1.686 | 0.189 |
| skill2 | 3.77 | 1.06 | 3.43 | 1.08 | 3.71 | 1.19 | 0.667 | 0.515 |
| skill3 | 3.57 | 1.09 | 3.30 | 1.11 | 3.78 | 1.17 | 1.679 | 0.190 |
| skill4 | 4.14 | 0.94 | 4.22 | 0.95 | 4.29 | 0.86 | 0.365 | 0.695 |
| skill5 | 3.23 | 1.21 | 3.43 | 1.31 | 3.48 | 1.25 | 0.522 | 0.594 |
| skill6 | 3.69 | 0.96 | 3.74 | 0.96 | 3.90 | 0.92 | 0.762 | 0.469 |
| skill7 | 3.49 | 1.27 | 3.26 | 1.01 | 3.42 | 1.27 | 0.235 | 0.791 |
| skill8 | 2.89 | 1.05 | 2.87 | 1.32 | 3.10 | 1.24 | 0.587 | 0.557 |
| skill9 | 4.23 | 0.65 | 4.17 | 0.94 | 4.37 | 0.83 | 0.752 | 0.473 |
| skill10 | 3.20 | 1.02 | 3.43 | 0.84 | 3.60 | 1.16 | 1.697 | 0.187 |
| skill11 | 4.14 | 0.88 | 4.13 | 1.06 | 4.46 | 0.77 | 2.558 | 0.081 |
| skill12 | 3.66 | 0.97 | 3.52 | 1.12 | 4.08 | 0.81 | 4.991 | 0.008 |
| skill13 | 3.63 | 0.88 | 3.78 | 0.90 | 3.90 | 0.89 | 1.177 | 0.311 |
| skill14 | 3.60 | 1.01 | 3.91 | 1.16 | 4.10 | 0.99 | 3.042 | 0.051 |
| skill15 | 3.94 | 0.87 | 3.87 | 1.10 | 3.94 | 0.95 | 0.058 | 0.943 |
| skill16 | 3.91 | 0.74 | 4.04 | 1.02 | 4.07 | 0.89 | 0.386 | 0.681 |
| skill17 | 4.06 | 0.76 | 4.35 | 0.88 | 4.28 | 0.88 | 1.087 | 0.340 |
| skill18 | 3.71 | 0.79 | 3.65 | 1.19 | 3.94 | 1.03 | 1.152 | 0.319 |
| skill19 | 3.26 | 1.04 | 2.91 | 1.00 | 3.07 | 1.13 | 0.738 | 0.480 |
| skill20 | 4.00 | 0.91 | 3.96 | 0.98 | 4.08 | 0.88 | 0.214 | 0.808 |
| skill21 | 3.57 | 0.88 | 3.61 | 1.12 | 3.61 | 1.05 | 0.016 | 0.984 |
| skill22 | 3.86 | 0.69 | 3.65 | 0.93 | 3.84 | 1.01 | 0.425 | 0.654 |
| skill23 | 3.66 | 0.87 | 3.52 | 1.16 | 3.74 | 1.08 | 0.419 | 0.658 |
| skill24 | 4.00 | 0.87 | 4.04 | 1.02 | 4.19 | 0.99 | 0.581 | 0.561 |
| skill25 | 3.74 | 0.85 | 3.70 | 1.11 | 3.71 | 1.07 | 0.019 | 0.981 |
| skill26 | 3.34 | 1.14 | 3.26 | 0.96 | 3.62 | 1.14 | 1.372 | 0.257 |
| skill27 | 3.77 | 0.91 | 3.57 | 1.12 | 3.89 | 1.12 | 0.849 | 0.430 |
| skill28 | 3.46 | 0.92 | 2.87 | 1.46 | 3.35 | 1.21 | 1.887 | 0.155 |
| skill29 | 3.49 | 1.29 | 3.39 | 1.03 | 3.40 | 1.13 | 0.072 | 0.931 |
| skill30 | 2.94 | 1.35 | 3.17 | 1.40 | 3.21 | 1.39 | 0.487 | 0.616 |

| | | | | | | | | |
|---------|------|------|------|------|------|------|-------|--------------|
| skill31 | 3.49 | 1.04 | 3.65 | 1.19 | 3.85 | 1.09 | 1.494 | 0.228 |
| skill32 | 3.09 | 0.98 | 2.91 | 1.16 | 3.21 | 1.21 | 0.664 | 0.516 |
| skill33 | 3.54 | 0.95 | 3.30 | 1.18 | 3.60 | 1.19 | 0.597 | 0.552 |
| skill34 | 3.14 | 1.19 | 3.09 | 1.20 | 3.43 | 1.15 | 1.227 | 0.296 |
| skill35 | 3.40 | 0.98 | 3.22 | 1.13 | 3.45 | 1.09 | 0.431 | 0.651 |
| skill36 | 3.29 | 1.05 | 3.00 | 1.28 | 3.46 | 1.16 | 1.525 | 0.221 |
| skill37 | 3.29 | 1.18 | 3.35 | 0.98 | 3.55 | 1.22 | 0.755 | 0.472 |
| skill38 | 2.69 | 1.23 | 2.96 | 1.07 | 2.96 | 1.36 | 0.586 | 0.558 |
| skill39 | 3.31 | 1.16 | 3.00 | 1.13 | 3.22 | 1.35 | 0.437 | 0.647 |
| skill40 | 3.69 | 0.93 | 3.35 | 1.30 | 3.51 | 1.27 | 0.572 | 0.566 |
| skill41 | 2.94 | 1.24 | 2.87 | 1.22 | 3.01 | 1.34 | 0.122 | 0.886 |
| skill42 | 2.69 | 1.13 | 2.57 | 1.34 | 2.83 | 1.38 | 0.437 | 0.647 |
| skill43 | 3.26 | 1.12 | 2.96 | 1.40 | 3.21 | 1.37 | 0.418 | 0.659 |
| skill44 | 3.54 | 1.04 | 3.57 | 1.12 | 3.53 | 1.15 | 0.011 | 0.989 |
| skill45 | 3.94 | 1.30 | 4.00 | 1.24 | 4.29 | 1.04 | 1.465 | 0.234 |
| skill46 | 2.91 | 1.34 | 3.17 | 1.03 | 3.04 | 1.28 | 0.304 | 0.738 |
| skill47 | 3.29 | 1.18 | 3.30 | 1.06 | 3.39 | 1.25 | 0.123 | 0.884 |
| skill48 | 3.20 | 1.16 | 3.04 | 1.11 | 3.24 | 1.22 | 0.241 | 0.786 |
| skill49 | 3.94 | 1.03 | 4.35 | 0.93 | 4.44 | 0.71 | 4.517 | 0.013 |
| skill50 | 3.89 | 1.02 | 4.43 | 0.90 | 4.36 | 0.66 | 5.094 | 0.007 |
| skill51 | 3.91 | 0.98 | 4.09 | 1.20 | 4.22 | 0.75 | 1.559 | 0.214 |
| skill52 | 3.74 | 1.15 | 4.35 | 0.98 | 4.28 | 0.84 | 4.617 | 0.011 |
| skill53 | 3.91 | 0.98 | 4.13 | 0.87 | 4.24 | 0.84 | 1.683 | 0.189 |
| skill54 | 3.54 | 1.04 | 4.17 | 0.94 | 4.24 | 0.78 | 8.123 | 0.000 |
| skill55 | 3.97 | 0.95 | 4.35 | 0.93 | 4.45 | 0.60 | 5.046 | 0.008 |
| skill56 | 3.86 | 1.19 | 4.35 | 0.98 | 4.37 | 0.84 | 3.765 | 0.025 |
| skill57 | 3.74 | 0.92 | 4.13 | 0.92 | 4.25 | 0.80 | 4.438 | 0.013 |
| skill58 | 3.74 | 1.09 | 4.00 | 0.90 | 4.11 | 1.11 | 1.474 | 0.232 |
| skill59 | 3.63 | 1.09 | 4.26 | 0.92 | 4.24 | 0.87 | 5.785 | 0.004 |
| skill60 | 4.29 | 0.99 | 4.61 | 0.89 | 4.57 | 0.92 | 1.353 | 0.262 |
| skill61 | 3.77 | 0.94 | 3.96 | 0.98 | 4.07 | 0.96 | 1.202 | 0.304 |
| skill62 | 3.86 | 1.03 | 4.30 | 0.88 | 4.36 | 0.80 | 4.259 | 0.016 |
| skill63 | 3.71 | 0.96 | 4.17 | 0.83 | 4.15 | 0.86 | 3.304 | 0.040 |
| skill64 | 3.49 | 1.07 | 3.87 | 0.76 | 4.10 | 0.80 | 6.419 | 0.002 |
| skill65 | 3.86 | 1.12 | 4.04 | 0.93 | 4.13 | 0.88 | 1.078 | 0.343 |
| skill66 | 3.23 | 1.03 | 3.83 | 0.98 | 3.87 | 0.93 | 5.682 | 0.004 |
| skill67 | 3.77 | 0.97 | 4.04 | 1.07 | 4.13 | 0.88 | 1.905 | 0.153 |
| skill68 | 2.54 | 1.22 | 2.39 | 1.23 | 2.45 | 1.17 | 0.126 | 0.882 |

Table 10: ANOVA test – Current importance of skills/knowledge by work experience

| Factor | Experience groups | | Sig. | Factor | Experience groups | | Sig. |
|---------|-------------------------|-------------------------|------|---------|-------------------------|-------------------------|-------------|
| skill12 | ≤ 15 | $> 15 \text{ \& } < 25$ | 0.84 | skill56 | ≤ 15 | $> 15 \text{ \& } < 25$ | 0.14 |
| | | ≥ 25 | 0.05 | | | ≥ 25 | 0.02 |
| | $> 15 \text{ \& } < 25$ | ≤ 15 | 0.84 | | $> 15 \text{ \& } < 25$ | ≤ 15 | 0.14 |

| | | | | | | | |
|---------|-------------------------|-------------------------|-------------|---------|-------------------------|-------------------------|-------------|
| | | ≥ 25 | 0.03 | | | ≥ 25 | 0.99 |
| | ≥ 25 | ≤ 15 | 0.05 | | ≥ 25 | ≤ 15 | 0.02 |
| | | $> 15 \text{ \& } < 25$ | 0.03 | | | $> 15 \text{ \& } < 25$ | 0.99 |
| skill14 | ≤ 15 | $> 15 \text{ \& } < 25$ | 0.49 | skill57 | ≤ 15 | $> 15 \text{ \& } < 25$ | 0.21 |
| | | ≥ 25 | 0.04 | | | ≥ 25 | 0.01 |
| | $> 15 \text{ \& } < 25$ | ≤ 15 | 0.49 | | $> 15 \text{ \& } < 25$ | ≤ 15 | 0.21 |
| | | ≥ 25 | 0.71 | | | ≥ 25 | 0.83 |
| | ≥ 25 | ≤ 15 | 0.04 | | ≥ 25 | ≤ 15 | 0.01 |
| | | $> 15 \text{ \& } < 25$ | 0.71 | | | $> 15 \text{ \& } < 25$ | 0.83 |
| skill49 | ≤ 15 | $> 15 \text{ \& } < 25$ | 0.17 | skill59 | ≤ 15 | $> 15 \text{ \& } < 25$ | 0.03 |
| | | ≥ 25 | 0.01 | | | ≥ 25 | 0.00 |
| | $> 15 \text{ \& } < 25$ | ≤ 15 | 0.17 | | $> 15 \text{ \& } < 25$ | ≤ 15 | 0.03 |
| | | ≥ 25 | 0.89 | | | ≥ 25 | 0.99 |
| | ≥ 25 | ≤ 15 | 0.01 | | ≥ 25 | ≤ 15 | 0.00 |
| | | $> 15 \text{ \& } < 25$ | 0.89 | | | $> 15 \text{ \& } < 25$ | 0.99 |
| skill50 | ≤ 15 | $> 15 \text{ \& } < 25$ | 0.03 | skill62 | ≤ 15 | $> 15 \text{ \& } < 25$ | 0.14 |
| | | ≥ 25 | 0.01 | | | ≥ 25 | 0.01 |
| | $> 15 \text{ \& } < 25$ | ≤ 15 | 0.03 | | $> 15 \text{ \& } < 25$ | ≤ 15 | 0.14 |
| | | ≥ 25 | 0.91 | | | ≥ 25 | 0.96 |
| | ≥ 25 | ≤ 15 | 0.01 | | ≥ 25 | ≤ 15 | 0.01 |
| | | $> 15 \text{ \& } < 25$ | 0.91 | | | $> 15 \text{ \& } < 25$ | 0.96 |
| skill52 | ≤ 15 | $> 15 \text{ \& } < 25$ | 0.05 | skill63 | ≤ 15 | $> 15 \text{ \& } < 25$ | 0.13 |
| | | ≥ 25 | 0.01 | | | ≥ 25 | 0.04 |
| | $> 15 \text{ \& } < 25$ | ≤ 15 | 0.05 | | $> 15 \text{ \& } < 25$ | ≤ 15 | 0.13 |
| | | ≥ 25 | 0.95 | | | ≥ 25 | 0.99 |
| | ≥ 25 | ≤ 15 | 0.01 | | ≥ 25 | ≤ 15 | 0.04 |
| | | $> 15 \text{ \& } < 25$ | 0.95 | | | $> 15 \text{ \& } < 25$ | 0.99 |
| skill54 | ≤ 15 | $> 15 \text{ \& } < 25$ | 0.02 | skill64 | ≤ 15 | $> 15 \text{ \& } < 25$ | 0.23 |
| | | ≥ 25 | 0.00 | | | ≥ 25 | 0.00 |
| | $> 15 \text{ \& } < 25$ | ≤ 15 | 0.02 | | $> 15 \text{ \& } < 25$ | ≤ 15 | 0.23 |
| | | ≥ 25 | 0.95 | | | ≥ 25 | 0.49 |
| | ≥ 25 | ≤ 15 | 0.00 | | ≥ 25 | ≤ 15 | 0.00 |
| | | $> 15 \text{ \& } < 25$ | 0.95 | | | $> 15 \text{ \& } < 25$ | 0.49 |
| skill55 | ≤ 15 | $> 15 \text{ \& } < 25$ | 0.16 | skill66 | ≤ 15 | $> 15 \text{ \& } < 25$ | 0.06 |
| | | ≥ 25 | 0.01 | | | ≥ 25 | 0.00 |
| | $> 15 \text{ \& } < 25$ | ≤ 15 | 0.16 | | $> 15 \text{ \& } < 25$ | ≤ 15 | 0.06 |
| | | ≥ 25 | 0.83 | | | ≥ 25 | 0.98 |
| | ≥ 25 | ≤ 15 | 0.01 | | ≥ 25 | ≤ 15 | 0.00 |
| | | $> 15 \text{ \& } < 25$ | 0.83 | | | $> 15 \text{ \& } < 25$ | 0.98 |

Table 11: Posthoc test – Current importance of skills/knowledge by work experience

| ANOVA | ≤ 15 | | $> 15 \text{ \& } < 25$ | | ≥ 25 | | F | Sig. |
|----------|-----------|------|-------------------------|------|-----------|------|-------|-------|
| | M | STD | M | STD | M | STD | | |
| BUSINESS | 3.70 | 0.43 | 3.67 | 0.63 | 3.85 | 0.65 | 1.315 | 0.272 |

| | | | | | | | | |
|---|--------------------------|-------------|------------------------|-------------|------|------|-------|--------------|
| GROUP | | | | | | | | |
| LOGISTICS GROUP | 3.29 | 0.79 | 3.20 | 0.85 | 3.40 | 0.91 | 0.589 | 0.556 |
| MANAGEMENT GROUP | 3.72 | 0.82 | 4.09 | 0.77 | 4.15 | 0.54 | 5.541 | 0.005 |
| Multiple Comparisons (Tykey HSD) | | | | | | | | |
| Factor | Experience groups | | Mean Difference | Sig. | | | | |
| MANAGEMENT GROUP | ≤ 15 | > 15 & < 25 | -0.37 | 0.09 | | | | |
| | | ≥ 25 | -0.43 | 0.00 | | | | |
| | > 15 & < 25 | ≤ 15 | 0.37 | 0.09 | | | | |
| | | ≥ 25 | -0.06 | 0.92 | | | | |
| | ≥ 25 | ≤ 15 | 0.43 | 0.00 | | | | |
| | | > 15 & < 25 | 0.06 | 0.92 | | | | |

Table 12: Current importance of management-related skill group by work experience

| Skills | ≤ 15 | | > 15 & < 25 | | ≥ 25 | | F | Sig. |
|--------|------|------|-------------|------|------|------|------|-------------|
| | M | STD | M | STD | M | STD | | |
| skil1 | 3.97 | 0.66 | 3.43 | 1.24 | 3.72 | 1.20 | 1.67 | 0.19 |
| skil2 | 3.91 | 1.20 | 3.74 | 1.10 | 3.69 | 1.39 | 0.39 | 0.68 |
| skil3 | 3.86 | 1.19 | 3.35 | 1.23 | 3.81 | 1.46 | 1.18 | 0.31 |
| skil4 | 4.09 | 0.95 | 4.04 | 1.19 | 4.25 | 1.21 | 0.43 | 0.65 |
| skil5 | 3.51 | 0.98 | 3.43 | 1.50 | 3.55 | 1.37 | 0.07 | 0.93 |
| skil6 | 4.00 | 0.84 | 3.70 | 1.11 | 3.78 | 1.20 | 0.67 | 0.51 |
| skil7 | 3.94 | 1.28 | 3.43 | 1.24 | 3.53 | 1.53 | 1.26 | 0.29 |
| skil8 | 3.49 | 1.09 | 3.09 | 1.41 | 3.24 | 1.47 | 0.66 | 0.52 |
| skil9 | 4.31 | 0.72 | 4.13 | 1.10 | 4.28 | 1.21 | 0.22 | 0.80 |
| skil10 | 3.46 | 1.24 | 3.70 | 1.06 | 3.66 | 1.37 | 0.36 | 0.70 |
| skil11 | 4.26 | 1.07 | 4.04 | 1.22 | 4.35 | 1.19 | 0.63 | 0.53 |
| skil12 | 3.86 | 0.81 | 3.35 | 1.27 | 3.98 | 1.15 | 3.01 | 0.05 |
| skil13 | 3.86 | 0.77 | 4.00 | 1.13 | 3.92 | 1.25 | 0.11 | 0.89 |
| skil14 | 4.11 | 0.68 | 3.91 | 1.24 | 4.03 | 1.29 | 0.21 | 0.81 |
| skil15 | 4.09 | 0.78 | 3.96 | 1.15 | 3.99 | 1.26 | 0.12 | 0.89 |
| skil16 | 4.31 | 0.63 | 4.09 | 1.04 | 4.11 | 1.23 | 0.49 | 0.61 |
| skil17 | 4.34 | 0.59 | 4.35 | 1.03 | 4.20 | 1.21 | 0.31 | 0.73 |
| skil18 | 3.91 | 0.78 | 3.87 | 1.22 | 3.90 | 1.31 | 0.01 | 0.99 |
| skil19 | 4.09 | 0.95 | 3.22 | 1.28 | 3.28 | 1.47 | 5.02 | 0.01 |
| skil20 | 4.40 | 0.69 | 4.13 | 1.25 | 4.12 | 1.23 | 0.79 | 0.46 |
| skil21 | 3.89 | 0.63 | 3.61 | 1.20 | 3.61 | 1.30 | 0.77 | 0.47 |
| skil22 | 4.29 | 0.62 | 3.74 | 1.14 | 3.96 | 1.28 | 1.79 | 0.17 |
| skil23 | 3.91 | 0.78 | 3.65 | 1.23 | 3.66 | 1.36 | 0.57 | 0.57 |
| skil24 | 4.20 | 0.80 | 4.04 | 1.11 | 4.03 | 1.28 | 0.27 | 0.76 |

| | | | | | | | | |
|--------|------|------|------|------|------|------|------|------|
| skil25 | 4.23 | 0.60 | 3.78 | 1.04 | 3.73 | 1.36 | 2.30 | 0.10 |
| skil26 | 3.54 | 1.22 | 3.57 | 1.20 | 3.65 | 1.43 | 0.10 | 0.91 |
| skil27 | 4.06 | 0.87 | 3.61 | 1.31 | 3.92 | 1.32 | 0.95 | 0.39 |
| skil28 | 4.00 | 1.06 | 3.23 | 1.38 | 3.58 | 1.50 | 2.22 | 0.11 |
| skil29 | 3.80 | 1.21 | 3.65 | 1.27 | 3.52 | 1.37 | 0.60 | 0.55 |
| skil30 | 3.17 | 1.46 | 3.30 | 1.33 | 3.22 | 1.59 | 0.05 | 0.95 |
| skil31 | 3.89 | 0.76 | 3.48 | 1.27 | 3.80 | 1.37 | 0.82 | 0.44 |
| skil32 | 3.37 | 1.14 | 2.87 | 1.25 | 3.09 | 1.40 | 1.08 | 0.34 |
| skil33 | 3.77 | 1.03 | 3.39 | 1.23 | 3.57 | 1.40 | 0.62 | 0.54 |
| skil34 | 3.51 | 1.27 | 3.17 | 1.37 | 3.42 | 1.37 | 0.46 | 0.64 |
| skil35 | 3.71 | 1.07 | 3.13 | 1.29 | 3.47 | 1.31 | 1.51 | 0.22 |
| skil36 | 3.66 | 1.08 | 3.09 | 1.31 | 3.43 | 1.36 | 1.35 | 0.26 |
| skil37 | 3.80 | 1.08 | 3.57 | 1.12 | 3.57 | 1.41 | 0.41 | 0.66 |
| skil38 | 2.94 | 1.47 | 3.04 | 1.33 | 2.92 | 1.51 | 0.06 | 0.94 |
| skil39 | 3.89 | 1.30 | 3.17 | 1.30 | 3.30 | 1.58 | 2.33 | 0.10 |
| skil40 | 3.91 | 1.15 | 3.48 | 1.34 | 3.51 | 1.45 | 1.23 | 0.30 |
| skil41 | 3.20 | 1.30 | 2.91 | 1.28 | 3.00 | 1.48 | 0.35 | 0.70 |
| skil42 | 2.97 | 1.25 | 2.74 | 1.39 | 2.88 | 1.54 | 0.18 | 0.84 |
| skil43 | 3.57 | 1.27 | 3.09 | 1.53 | 3.24 | 1.54 | 0.91 | 0.41 |
| skil44 | 3.74 | 1.04 | 3.57 | 1.08 | 3.47 | 1.37 | 0.58 | 0.56 |
| skil45 | 4.26 | 1.20 | 3.96 | 1.36 | 4.18 | 1.36 | 0.37 | 0.69 |
| skil46 | 3.29 | 1.36 | 3.39 | 1.12 | 3.03 | 1.48 | 0.81 | 0.45 |
| skil47 | 3.51 | 1.36 | 3.43 | 1.12 | 3.38 | 1.47 | 0.11 | 0.89 |
| skil48 | 4.03 | 1.18 | 3.22 | 1.24 | 3.48 | 1.54 | 2.71 | 0.07 |
| skil49 | 4.43 | 1.01 | 4.30 | 1.15 | 4.30 | 1.17 | 0.16 | 0.85 |
| skil50 | 4.14 | 0.97 | 4.26 | 1.14 | 4.25 | 1.10 | 0.13 | 0.88 |
| skil51 | 4.06 | 1.03 | 4.00 | 1.38 | 4.15 | 1.12 | 0.18 | 0.83 |
| skil52 | 4.11 | 0.93 | 4.26 | 1.18 | 4.15 | 1.22 | 0.12 | 0.89 |
| skil53 | 4.23 | 0.94 | 4.04 | 1.07 | 4.22 | 1.18 | 0.26 | 0.77 |
| skil54 | 3.83 | 0.92 | 4.17 | 1.15 | 4.04 | 1.17 | 0.76 | 0.47 |
| skil55 | 4.20 | 0.93 | 4.22 | 1.13 | 4.35 | 1.09 | 0.31 | 0.73 |
| skil56 | 3.94 | 1.21 | 4.26 | 1.21 | 4.27 | 1.21 | 0.96 | 0.39 |
| skil57 | 4.06 | 0.97 | 4.09 | 1.16 | 4.20 | 1.18 | 0.25 | 0.78 |
| skil58 | 4.20 | 0.99 | 3.87 | 1.10 | 4.01 | 1.43 | 0.49 | 0.62 |
| skil59 | 3.85 | 1.18 | 4.09 | 1.12 | 4.17 | 1.19 | 0.88 | 0.42 |
| skil60 | 4.40 | 0.98 | 4.43 | 1.16 | 4.45 | 1.27 | 0.02 | 0.98 |
| skil61 | 4.06 | 0.94 | 4.04 | 1.15 | 4.06 | 1.28 | 0.00 | 1.00 |
| skil62 | 4.06 | 0.97 | 4.13 | 1.10 | 4.27 | 1.18 | 0.50 | 0.61 |
| skil63 | 4.03 | 0.92 | 4.04 | 1.07 | 4.07 | 1.22 | 0.02 | 0.98 |
| skil64 | 3.80 | 1.05 | 3.87 | 1.01 | 4.01 | 1.14 | 0.51 | 0.60 |
| skil65 | 4.00 | 1.03 | 3.91 | 1.16 | 4.09 | 1.19 | 0.24 | 0.78 |
| skil66 | 3.60 | 1.06 | 3.83 | 1.15 | 3.83 | 1.23 | 0.51 | 0.60 |
| skil67 | 4.11 | 0.96 | 4.13 | 1.18 | 4.19 | 1.20 | 0.07 | 0.93 |
| skil68 | 3.20 | 1.41 | 2.96 | 1.55 | 2.78 | 1.48 | 1.06 | 0.35 |

Table 13: ANOVA test – Future importance of skills/knowledge by work experience

| Factor | Experience groups | | Mean Difference | Sig. |
|---------------|--------------------------|-------------------------|------------------------|-------------|
| skill19 | ≤ 15 | $> 15 \text{ \& } < 25$ | 0.87 | 0.04 |
| | | ≥ 25 | 0.80 | 0.01 |
| | $> 15 \text{ \& } < 25$ | ≤ 15 | -0.87 | 0.04 |
| | | ≥ 25 | -0.06 | 0.98 |
| | ≥ 25 | ≤ 15 | -0.80 | 0.01 |
| | | $> 15 \text{ \& } < 25$ | 0.06 | 0.98 |

Table 14: Posthoc test – Future importance of skills/knowledge by work experience

| Educational programs | Number of responses |
|----------------------------------|----------------------------|
| Professional development courses | 90 |
| Postgraduate qualifications | 38 |
| Undergraduate courses | 13 |
| Diploma | 4 |
| Others | 2 |

Table 15: Educational programs needed for next 10 years

| How should education programs be developed | Number of responses |
|---|----------------------------|
| In consultation with logistics associations | 121 |
| In consultation with other business associations | 98 |
| In consultation with international universities | 77 |
| Design and conduct training programs on their own | 21 |
| Others | 11 |

Table 16: How universities should design and develop educational programs