

INTERMODAL EDUCATION IN COMPARATIVE PERSPECTIVE

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The New Science of Intermodalism.

Intermodalism, in its simplest notion, involves the transport of both people and goods from origin to destination, be that within the same city or across the globe. Implicitly, however, it also involves the interface of multiple modes of transportation, and the interchange of people and goods between them. Some have come to refer to it as *multimodalism*. Yet, it is greater than *multi-*, it is *intermodalism*, involving the linkage and integration of existing transportation modes such that they become a seamless conveyance and distribution system from origin to destination. Such a system offers the potential of using each mode to its best advantage to generate -safe, physically secure, energy efficient, environmentally benign and economically sustainable mobility. There is no simple definition for intermodalism, nor sadly, is there a

the world's economic "hinterland", with more expensive goods, less favorable trade and lower income. Now, such economies need not only catch up to the present, but even more they need to advance to the ever new and changing intermodalism, else the game is lost.

This is a tall order, even for a deep pocket in economic terms. Conceptually, it is even taller. It has been told that a scientist, once asked to define "electricity," replied, "I can't tell you exactly what it is, but I can tell you how it works." Fifty years later, the "new science of intermodalism" shares the same state of mind. This article explores the current state of intermodal education and suggests steps to advance the state of the discipline.

Overview of the Study.

In January 2000, the Asia Pacific Economic Cooperation (APEC) awarded a contract to researchers at the University of Denver and the University of Calgary, in Alberta, Canada, to identify needed intermodal skills, and to assess the degree to which educational and training programs supply such skills to the workforce within the APEC member economies.² The resulting study, of which this is a summary, was presented to the Transportation Working Group of APEC at its October 2000 meeting in Miyazaki, Japan. The study itself is a "case of first impression," for in reviewing the literature we found that no similar trails have been blazed before. There have been several efforts to identify and enumerate specific intermodal skills required of the industry workforce, and while there have been some efforts to identify courses, degree and training programs in individual national contexts, we found none to have undertaken to do so comparatively across national and economic boundaries.³

The study has two major foci, which we pursue broadly in the context of supply and demand. The first, the demand side, delves beneath the process of intermodalism, to identify whether there are any particular skills or knowledge needed of the intermodal workforce, and to *identify the skill sets involved*. The second is to *identify degree and training programs* that are in place, and which supply the skills identified.

The remainder of this paper will summarize the four major steps that we followed in prosecuting the study: (I) Literature Review, (II) Data Collection (Demand for Skills v. Supply of Training Programs), (III) an Analysis of Training Gaps Identified in Steps II and III, where supply and demand do not meet, and (IV) General Conclusions.

I. Literature Review.

The study began with an extensive survey of all the existing activities relating to intermodal education ranging from workshops and conferences to published reports and articles. These could be divided into four general groups – those dealing explicitly with intermodal education, those dealing with logistics education, those focusing on intelligent transportation systems, and those concerned with transportation education in general.

² APEC was established in 1989, in response to the growing interdependence among Asia-Pacific economies, and has since become the primary regional vehicle for promoting open trade and practical economic cooperation [<http://www.apecsec.org.sg>]. The current member economies of APEC, in alphabetical order, are as follows: Australia, Brunei Darussalam, Canada, Chile, People's Republic of China, Hong Kong, China, Indonesia, Japan, Republic of Korea, Malaysia, Mexico, New Zealand, Papua New Guinea, Peru, Republic of the Philippines, Russia, Singapore, Chinese Taipei, Thailand, United States and Vietnam.

³ Throughout this report, the term "economy" is used. For our purposes, it is interchangeable in meaning and content with the term "nation," or "country." For political and diplomatic reasons, APEC – the organization commissioning this study – refers to its constituent members as "economies." We necessarily follow.

IA. Intermodal Education

The first category -- dealing with intermodal education directly -- was very limited, and of quite recent vintage. A search of the literature revealed just five publications, only one of which -- the 1998 Transportation Research Board (TRB) Report discussed below -- was less than 15 years old and directly relevant to our concerns. This report summarized the results of a workshop that we had attended. It was the fifth in a series sponsored by the TRB focusing on intermodalism explicitly and the only one that dealt directly with issues of education and training. The proceedings were published as "Intermodal Transportation Education and Training, TRB Conference Proceedings #17, 1998." The Workshop concluded the following:

- Many transportation professionals are not graduates of university transportation programs.
- Existing core business curricula do not adequately incorporate logistics and intermodal transportation courses.
- Given the nature of the intermodal industry, educators must become familiar with real life experiences.
- Education must include the articulation and dissemination of an "intermodal vision."
- Intermodal education and training requires participation by the public and private sectors.
- Continuing education and lifelong learning are essential elements.
- Professionals must learn to manage technology and innovation.

Of all the papers presented, the most germane to our concerns was the report by L. Pignataro and L. Hoel entitled "*College and University Transportation and Logistics Programs*, (pp. 60-63), focusing on the extent to which intermodalism had been incorporated into transportation education. The authors concluded that most programs were located in engineering departments, that interdisciplinary cooperation was not always adequate, and that administrative support for interdisciplinary programs was "sporadic." Altogether, 28% of the institutions surveyed stated that they had "always incorporated" intermodalism in their program, another 43% had recently made course additions, and 29% had made no changes at all. This study may well have overestimated the degree to which intermodalism has been incorporated into educational programs, because the authors assumed that courses dealing with subjects such as "systems," "policy," "management," and "logistics" reflected an intermodal focus.

Two recent surveys of intermodal education are also relevant. The first was carried out by the United States Merchant Marine Academy, in order to assess the industry's perspective on intermodal education and training needs. In their sample of 43 respondent organizations, responses were tabulated with the following results:

- Existing academic programs were not viewed as providing the kind of education that an intermodal work force requires. When asked to rank the programs' performance on a scale of one to five (very poorly to very well), the responses placed the existing programs below the midpoint, at 2.1.
- The most important subjects identified for entry-level personnel (obtained at the undergraduate level) were logistics (13%), modal/intermodal operations (%), financial and characteristics (9%), and financial management, marketing, business management, with 5-6% each.
- Mid level personnel also required advanced (graduate level) training in logistics (15%), financial management and information technology (9% each), followed by labor relations, modal/intermodal characteristics and operations, and terminal operations.
- The two areas of training of most interest to the responding firms were logistics and modal/intermodal characteristics and operations (10% each), intermodal marketing (8%), and such topics as transportation economics, information technology, software applications, and international transportation (6% each).

The Intermodal Transportation Institute, University of Denver, carried out the second major study of intermodal education needs in preparation for its new Master of Science in Intermodal Transportation

Annual Forum on Transportation Education and Training: Responding to the Changing Needs of the Profession,” TRB Circular # 495, January 2000, the Forum sought answers to the following questions: (1) What factors are affecting transportation and changing education needs? (2) What actions are being taken to respond to the changing environment? And, (3) What do tomorrow’s professionals need to know? The Forum concluded:

- Needs are diverse, include many levels and careers, and are changing rapidly.
- Graduate degree programs for entry-level professionals should consist of a core and electives.
- Graduate certification programs should be developed for mid-level professionals.
- Skills can roughly be divided into technical and non-technical categories.

A follow-up workshop, in which we also participated, was held in the summer of 1999 at the University of Minnesota in cooperation with the Council of University Transportation Centers. Various presentations were made, the most important of which -- from our perspective -- involved a report of the top needs based on 200 interviews. These were essentially the ones identified by the ITS research and included Systems Integration, Organization/Institutional Change, Systems Analysis and Design Applications, Managing Contractors, Financing, Communications (including Wiring Specifications), Planning and Integrating Regional Systems, Coalition Building, Data Analysis and Management.

Notably, the Groups also concluded that: (1) professional degrees, such as MBAs and MPAs are available, but they are not adequately oriented towards transportation needs, and (2) mid-career training is deficient. In short, there is an urgent need to expand peoples’ horizons.

Another important conference we attended was held at the University of Washington, July 15-16, 1999. Entitled “Educating the 21st Century Transportation Professional,” the focus was on using technologies in transportation education.⁴

The Second Annual Forum on Transportation Education and Training was held in conjunction with the January 2000 TRB meeting. A number of experts gave reports on various aspects of the topic. On the basis of our participation, we found the following points to be particularly relevant:

- It is essential to consider that people will be dealing with very different systems than those that exist today. They will be more complex and diverse, and will require different managerial and people skills.
- Education should be differentiated from training in that the incumbent pays for the former and the employer pays for the latter.
- New approaches, such as course modules and web-based learning are essential.
- Industry today is at a real crossroads and the actions taken now will shape developments for the next 20 years.
- Management skills must expand beyond traditional “business” to include ethics, customer service, and strategic partnerships.
- Transportation management, organizational structures, and institutional arrangements need to be revamped.
- Faculties still teach the “Old Transportation.” New textbooks and curricula materials are required, as well as the integration of new disciplines and topics such as technology transfer.
- There are two general categories – professional staff and operating staff – each with its own skill requirements. There is also a need for visionaries – people who understand the “Big Picture”-- and the nature and rate of change that is impacting transportation.

ID. Other Relevant Publications.

⁴ The report is available at the following website:

A number of other publications also deserve mention. “Innovative Practices for Multimodal Transportation Planning for Freight and Passengers,” NCHRP Report #404, 1998, provides a useful survey of innovative approaches to planning that suggest that new skills will be required by intermodal planners. These include systems management, measurement ability, financing, and public engagement. Descriptions of various educational programs and projects are also to be found in the Jan/Feb 1999 issue of TR News (#200), entitled “Preparing Tomorrow’s Transportation Workforce.” Finally, “National Transportation Science and Technology Strategy,” National Science and Technology Council, April 1999, further emphasized the following points:

- The need to understand technology and technological developments.
- The importance of organizational transformation.
- The impact of globalization on transportation.

Of additional interest are the “Millennium Reports,” prepared by the numerous TRB Committees. Although many mention education, three are particularly significant: (1) “Urban Freight Movement,” by R. Czerniak, J. Lahsene and A. Chaterjee, emphasizing the importance of developing not only new skills, but also new attitudes – if the problems of urban f

- Understanding Ethical Principles
- Systems Analysis Skills
- Managerial Skills
- Environmental Analysis
- Knowledge of Computer Applications
- Knowledge of Technologies
- Communications Skills
- Knowledge of Different Modes of Transportation
- Knowledge of Planning

These competencies group into four separate categories of skills: Foundational, Analytical, Technical and Interpersonal, and within these categories of competency, a total of 32 separate skills were identified.⁵ In the research methodology, these 32 skills constituted the industry skill demand, against which the supply of educational and training programs would be measured.

IIB. Data Collection – Inventory of Supply of Educational and Training Programs.

We inventoried educational programs offered by universities and training institutions, both in North America and in Asia. Criteria of selection were that the training program be a recurring program of instruction, that it have identifiable intermodal content, and that it be listed and described on an internet web page in the English language, the official language of APEC. For those courses and programs that appeared on our “scopes,” we ascertained the level of study (undergraduate/MA/PhD/diploma or certificate program), the program course requirements, and identification of any intermodal courses. Courses identified in the latter two categories were matched against the 32 skill requirements, to determine on an aggregate and regional basis, the degree to which available programs met identified industry skill needs.

We noted that, in North America, some 13 educational institutions provide training in some fashion, 10% offering certificate programs, 30% bachelor’s degree programs, 40% master’s programs, and 20% doctoral programs. While many of the courses are offered within the context of a larger transportation program, few actually provide course work dealing with IM skills.

No programs were identified within the Latin American economies. That is not to suggest that none exist, but rather that we could not detect them among the information networks that yielded curricular information on all other APEC regions. Among the Asian economies, we identified 101 separate programs of instruction: 10% short courses, 12% certificate programs, 26% bachelor’s degree programs, 27% master’s programs, and 9% doctoral programs. Two-thirds of these program opportunities were offered in only three economies: Australia (34%), Singapore (19%) and Hong Kong (14%).

IIC. Integration of IM Skills Demand and Educational Program Supply.

Several general observations stem from our analysis thus far. Integrating the demand for IM skills in the workforce and the supply of educational programs, the following points emerge:

- Persons applying for positions in the IM industry may develop a wide range of skills through a number of different avenues. Entry-level educational requirements range from secondary school or

⁵ *Foundational Knowledge*: Government Regulations & Policies, Available Transport Technology, Global Business Environment, General Business Environment, Labor Relations, Various Transportation Modes, How Modes Interface, Identification & Understanding of Legal Issues. *Analytical Skills*: Environmental Impact Analysis (Geographic and Human), Economic & Financial Analysis, Policy Analysis, Strategic Planning, Forecasting Skills, Futures Analysis, Systems Analysis, and Ethical Analysis. *Interpersonal Skills*: General Managerial Skills, Customer Service Skills, Communications Skills, Listening Skills, Sales Skills, Coalition Building Skills, Teambuilding Skills, Conflict Management and Negotiation Skills, Leadership Skills. *Technical Skills*: Computer Applications, Technology Management, Modeling Skills, Logistics and Supply Chain Processes, Data Gathering Analysis and Manipulation Skills, Marketing Skills, Transportation Experience.

equivalent or even job-specific skills – such as Aircraft & Powerplant license or a commercial driver’s license – to MBA or Master’s level skills. Skills expected of persons at lower or entry-

Figure 1

III. Analysis of Training Gaps.

It became apparent that the supply of programs did not meet the demand for skills in any comprehensive or meaningful manner. In short, there are gaps, which we next sought to identify and explore. An overview of these gaps appears below:

Intermodal Skill Categories	Widespread Opportunities	Limited Opportunities	Few Opportunities
<i>Foundational</i>		X	
<i>Analytical</i>		X	
<i>Technical</i>		X	
<i>Interpersonal</i>			X

Table 1

Acquisition of intermodal skills, in the aggregate, is at best limited. If the goal of intermodal skills development is to meet demand with supply, then integrated programs should be provided in locations where individuals have need of training. That is, workers should be able to learn without quitting their employment, and students should be able to gain a complete set of IM skills in one program or course of study in a single location. Unfortunately this condition exists only in a few places. The only locations where a person could probably get all the training needed, without relocating for an extended period of time would be New York, Charleston, Denver, Seattle, Hong Kong, Singapore, Sydney or New Zealand. In some of these locations, well-developed degree programs are complemented by industry-based and commercial training courses, designed to address specialized and often customized, skills development needs.

Despite that, within these centers, even programs that focus explicitly on intermodalism vary in scope and content, and no single university or training program in any APEC economy provides all the necessary skills. While the Report itself considers these matters both on an aggregated and on a regional basis, for present purposes, aggregated data will make the point. Considering 10 of the APEC economies, we identified 121 training programs. The following table shows the availability of training programs by type within the APEC economies.

	PhD	MA	BS	Diploma	Certificate	Short Courses	Distance Learning	Total	%
U.S.	4	8	6	-	2	-	-	20	17%
Australia	1	8	1	9	11	2	2	34	27%
New Zealand	1	3	1	2	-	1	-	8	7%
Taipei	1	1	1	-	-	-	-	3	2%
Japan	1	1	1	-	-	-	-	3	2%
Korea	-	-	-	-	-	1	-	1	1%
Malaysia	2	3	2	-	-	-	-	7	6%
P.R. China	1	4	1	-	-	-	-	6	5%
Hong Kong	-	1	2	6	1	3	1	14	12%
Singapore	1	4	2	9	-	2	1	19	16%
Thailand	1	2	2	-	-	1	-	6	5%
Total	13	35	19	26	14	10	4	121	
%	11%	29%	16%	21%	12%	8%	3%	-	-

Table 2

Within the 121 training programs, we identified a total of 440 courses that had intermodal content – that is, the course title or description was such that we could ascribe it as addressing the 32 IM skills. The following table shows this relationship.

IM transportation is distinct from the relationship between entry-level skill needs and training availability within the traditional modal transport sector.

Consequently, *in terms of intermodal careers*, there is still a training gap for skills needed at the *entry level of intermodal transportation* – that is, when people make the leap from traditional modal transportation work to IM operations, planning, management, etc. That set of “entry level” (or “foundational”) IM skills is still in shorter supply than some of the advanced IM skills development opportunities. This state of affairs is depicted below, in Figure 2.

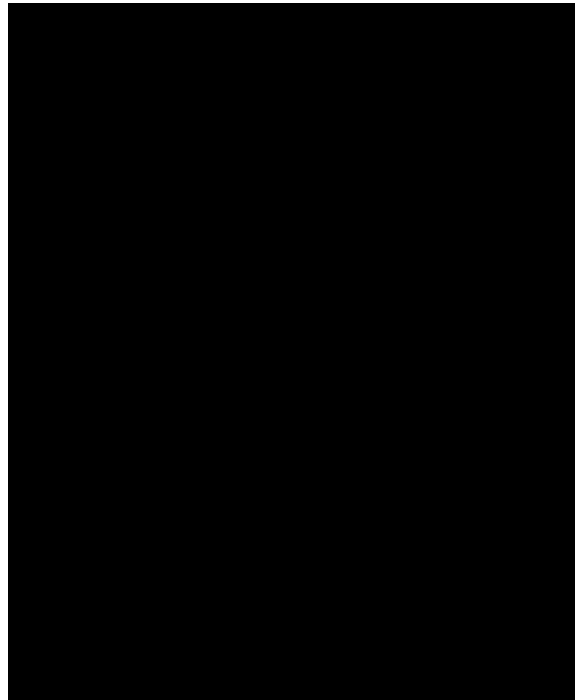


Figure 2

Additionally, Figure 2 illustrates that, while entry into the transportation industry comes through modal expertise originally, persons who are developing “entry level” IM skills generally begin receiving training through specific short courses or some type of on-the-job training. Additional training experiences are generally provided to middle and executive level personnel through college courses and degree programs.

Table 4 Availability of training experiences by degree level and by region

Degrees	Level	NA (US, Can)	LA (Mex)	Oceania (Aust NZ)	Asia- Developed (S, HK, T,J)	Asia - Developing (C,M, T, K)	TOT	%
BS and above	Exec	18		15	16	18	49	40%
Diploma	Middle			11	15	0	26	21%
Certificates	Entry	2	1	11	1	0	12	10%
Short Courses	Entry			3	5	2	10	8%

Distance Learning	Entry			2	2	0	4	3%
Total		20	1	42	39	20	122	
%		16%	1%	34%	32%	16%		

Inspection of Table 4 shows that in certain regions of APEC, there is greater availability of training programs for certain positions within organizations than with others. For example, 40% of the course offerings and programs containing those offerings are targeted towards persons who *already have an undergraduate degree*. In many economies this is the educational background required for a middle or upper level management position.

The foregoing analysis may be summarized succinctly: *It appears that the preponderance of intermodal skills training is targeted towards middle and upper middle management level, and not at the entry level professional.*

IV. Conclusions.

It should be kept in mind that the APEC member economies represent a cultural, educational, and socio-economic diversity, whereby there are no common solutions even to relatively identical problems as between economies. The best that can be offered are general guidelines that may be used in defining particular solutions within individual economies. Accordingly, the conclusions reached by the Report purport to be general guidelines, addressing both the skills needs in a complex and changing intermodal environment, and the form, format and content of programs to meet those needs.

IVa. Changing Skill Needs in the Intermodal Environment.

- General Competencies

The intermodalist is primarily concerned with integrating the dynamic process of transportation across time and space.

The general competencies required of the IM specialist are not dissimilar from those required in mode-specific jobs. However, because intermodal positions by definition include several modes, the intermodalist needs not only those general competencies, but also the ability to apply them in a more comprehensive setting.

The intermodalist integrates the dynamic process of transportation across time and space, which requires the application of managerial, analytical and interpersonal competencies in a variety of

connectivity in freight) to external constraints in tomorrow's systems (e.g., energy costs/availability, greenhouse gas limits, social equity constraints on "externalities").

- Planning and Development

The effectiveness of future intermodal systems will depend upon the ways in which new participants become engaged in planning their design and operation.

If such engagement takes the form of partnership among stakeholders who share in the economic, environmental and social benefits generated by intermodalism, then IM systems will be poised to achieve their full potential. But, if future engagement takes the form of adversarial disputes over the degree and distribution of burdens and costs associated with intermodalism, then a formidable barrier will stand in the way of achieving intermodal systems' potential. Based upon available evidence, it appears that the skills needed to solve problems arising from the mismatch between today's IM needs and existing facilities and practices will not, in themselves, create a capacity to unlock the potential of future IM designs and operations. If, for example, tomorrow's e-modal architects, planners and managers lack key skills in developing innovative financing mechanisms, in nurturing productive partnerships between public agencies and private firms, and in solving environmental problems, then the future airports, ports and other modal interchange points will cost more and deliver less. The payoff from developing future IM skills is thus a high one.

- Future Skills Needs.

As intermodal transportation systems evolve, one must upgrade the level of intermodal skills, while attending to future skills needs. If this is not done, then the skills gap will widen. Upgrade the level of intermodal skills.

Even in economies with the largest number of training opportunities, few programs provide students with the integrated and coherent experience needed to develop the skills required.

Existing educational programs meet some of the above needs to a greater or lesser degree in almost