

# The Academic Supply Chain

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## Abstract

*The commercial supply chain concept and its benefits are well understood and an area of study and implementation in industry and hot discussion and research in academia. Yet we have not transplanted this integrated material and information flow concept from industry to the halls of academia. There would be benefits to students, faculty, and administrators at multiple academic levels, if the concept were implemented to connect the secondary and collegiate stages of education.*

## INTRODUCTION

Russell and Taylor [2003, 267] define an industrial *supply chain* as:

“..the facilities, functions, and activities involved in producing and delivering a product or service from suppliers (and their suppliers) to customers (and their customers). ...(It) encompasses all activities associated with the flow and transformation of goods and services from the raw material stage through to the end user (customer), as well as the associated information flows.”

The concept and advantages of industrial supply chains are well understood by commercial firms and currently well researched by academia. The advantages of its successful use include improved product and service quality and efforts for continuous improvement; reduced operating costs (primarily through lower inventory and scrap costs); less time for inputs to be converted into the final products and services (lead time); and enhanced, real time communication and data transfer through electronic information systems [Krajewski and Ritzman, 2002].

## THE ACADEMIC SUPPLY CHAIN

As shown in Figure 1, there is a parallel between the original, industrial version of a supply chain and the concept of an academic supply chain. The academic supply chain has students entering pre-school or kindergarten and proceeding through the primary grades (stage 1), to the junior high school grades (stage 2), to high school (stage 3), on to the collegiate level (stage 4), and finally out to the world of professional employment or further graduate education. Table 1 details some of the similarities between the two types of supply chains. Thus, it is the premise here that because of their similarities with a chain-like construction, mission (dependency of quality at each stage and the finished output, cost efficiency, time constraints, etc.), and need to constantly share information and data, if the seemingly individual academic stages of education were administratively and electronically integrated similar to an industrial

supply chain, the faculty, the students, and their eventual employers could receive some or all of the benefits reported by firms who have successfully implemented commercial supply chains.

However, there are distinct differences between the two types of chains:

- The industrial supply chain is integrated in material flow, output requirements (both quality and quantity), and information flow as a system. The academic supply chain is not integrated from pre-school to college. While the educational stages may be integrated for a municipality or county from preschool to high school, there is a break in the linkage from the secondary to the collegiate level. There is insufficient feedback from colleges/universities to the high schools on the progress and shortcomings of students the high schools *supplied*. If there is communication from collegiate to high school stages, it is informal and sporadic, not formalized and consistent.
- The commercial supply chain initiates its planning by scanning and analyzing consumer needs, both current and future, and then schedules its product, service, components, and raw materials *backwards* throughout the supply chain system. The educational system does not determine how many students it needs to enter each stage of the system by surveying the employer market for current or future needs. Students simply enter the system initially by age. However, the number of students entering the academic system can be forecasted at each stage.
- Individual companies within each stage of the commercial supply chain are typically *for profit* organizations with financial responsibility to their stockholders. The academic system is not profit motivated and has no stockholders. However, each academic stage has/may have stakeholders such as parents, taxpayers, alumni, accrediting agencies, and state and federal monitoring agencies to whom the system is accountable.
- Industrial supply systems pass raw material, components, modules, etc., which do not have the ability for self-awareness or self-improvement, along the chain. Academic systems, on the other hand, transfer intelligent beings with innate knowledge, reasoning ability, emotions, self-awareness, and the ability for self-improvement outside the supply chain. Thus, these beings require *special handling*.

These differences notwithstanding it may be worthwhile to explore the potential benefits the academic supply chain could receive by incorporating some characteristics of commercial supply chains and how academia might proceed to accomplish this task.

## **WHY THE INDUSTRIAL SUPPLY CHAIN AS A MODEL**

Why use the industrial supply chain as a model to integrate academic systems? Both industrial and academic systems have some of the same objectives: high quality outputs from each stage and finished outputs which satisfy the needs of the marketplace and society; reduced cost of operating the system; reduced overall lead time from the input stage to the final output; reduced inventory and delay time at each stage; and, through effective forecasting and information transfer, the matching of supply capacity at each stage with demand. However, the industrial supply chain possesses several features lacking in the academic version - integrated output design, quality control for admission to each stage, integrated information systems, and inter-organizational relationships.

## **Integrated Output Design**

It is quite typical for each pair of sequential stages in the industrial supply chain to coordinate efforts to examine the design of the outputs of *both* stages. This is done because the company supplying the materials, components, etc. to the following stage may have suggestions and innovative ideas for the design of the materials or components it supplies or for the outputs of the company its supplies. Both actions can improve the quality of the outputs and/or reduce the time and cost of their production. While academia may have this ability for the preschool to high school stages administered within the same municipality, county, etc., it is doubtless insufficiently considered for the high school to collegiate stages. Which colleges or universities actively study and offer suggestions for improving the materials, curricula, technology, course content, or pedagogy of the high schools that supply them with entering freshmen? Which college administrators or professors frequent high schools to explore on-site the processes of education (classroom teaching) and examine the quality results? In industry this is performed to ascertain firsthand that the supplier can produce the desired material, components, or product at the required quality. In academia the average SAT scores for the entire high school and the applying students' GPA and SAT scores are perhaps the closest inspection.

## **Quality Control**

In the academic system the quality certification at each level, up to the college/university level, is performed by the stage that completed the student's education - not the next stage receiving the students. In a public K-12 system the subsequent stage receiving students cannot *reject* them. In industry, while each stage of the supply chain inspects material components, etc. before they are released to the next stage, they are/can be also inspected by the receiving company at the next stage of the supply chain. If the incoming material, components, etc., are deemed below grade, then any portion or all of the shipment can be rejected and returned to the previous stage for replacement, rework, or disposal. The trend in industry is for each stage to *certify* that all its output meets or exceeds specifications and thus, there is no need for the companies in the next stage to inspect them. This certification process reduces time, inspection cost, and storage space. The receiving company still reserves the right to inspect incoming goods, if they wish. Finally, if the supplying company (stage) has difficulty producing goods that meet acceptable standards, the receiving company or stage can terminate their business association with that firm (decertify them) or postpone further business until the producing firm can demonstrate that their outputs do indeed meet the predetermined standards. Such is not the case in academia for the primary through high school stages.

## **Integrated Information Systems**

“Information is the essential link between all supply chain processes and activities...information technology has become the most important enabler of effective supply chain management.” [Russell and Taylor, p. 271]. The industrial supply chain could not exist as it does today without the ability to integrate information and data along the chain in either direction in real time. The internet, intranets, email, FAX, and electronic data interchange [EDI] systems available make this seamless connectivity a reality. Distance, weather, time zones, languages, or personnel schedules are no longer impediments to the ability to communicate and

exchange information among the stages of *any* supply chain. Again, while academia may have this ability to connect paired stages from preschool to high school administered within the same municipality, county, etc., it is insufficiently performed for the high school to collegiate stages. Other than student transcripts and faculty letters of recommendation, very little information flows from the high schools to the colleges/universities and little to no information/data is transmitted on a routine, formalized manner in the reverse direction concerning student performance.

### **Inter-Organizational Relationships**

None of the advantages of the industrial supply chain would be possible without effective supply chain organizational relationships built upon trust, a commitment to joint planning and execution activities, efficient information sharing on a regular basis, and joint problem solving. Handfield and Nichols write:

"..without a foundation of effective supply chain organizational relationships, any efforts to manage the flow of information or materials across the supply chain are likely to be unsuccessful." [1999, 10].

Handfield and Nichols continue that industrial supply chain members are adopting the visible presence of a "co-destiny" - the belief that the futures of supply chain members are inextricably intertwined. In discussing the need for *trust* among supply chain members they write,

"As the degree of trust between the purchasing firm and its suppliers becomes firmly entrenched, a smoother flow of both materials and information between the organizations within the supply chain occurs." [Handfield and Nichols, 1999, 10].

As the information and communication exchange increases, joint planning and problem solving result [Handfield and Nichols, 1999]. However, these information and communication exchanges and joint activities are supported by an organizational climate of mutual trust, a dedication to cooperation and interaction, and the belief of a shared destiny. Interestingly the organizational relationship between the high school and college stages of the academic supply chain seem to mirror the *old attitudes* between commercial buyers and suppliers - independence, mutual distrust, little or no information sharing [demand forecasts, production plans, production costs, etc], short term relationships, continued relations based solely on achievement of the buyers' objective criteria [price, lead time, quality], no cooperation on process changes or output design, and thorough inspection of goods received from the supplier [since they cannot be trusted ]. Do high schools and colleges share a *mutual destiny*? Do they behave as though they do? Would the establishment of joint committees and task forces composed of administrators and faculty from both stages help to create a shared vision built upon mutual trust? Could these joint committees or teams more effectively address mutual problems and develop better, integrated curricula and pedagogy for its delivery?

## WHAT CAN BE DONE?

The focus here is not on the preschool to high school stages, but rather the high school to collegiate levels. Since the high school and collegiate levels can cross state and even national boundaries and be public and or private institutions, further restrictions for address are necessary. The primary thrust will be on the high school to collegiate stages that are both public institutions and within the same state. This narrows the focus to those institutions that are already related by state governance, state requirements, are geographically proximate, and, thus, should be the easiest to integrate as successive links in the academic supply chain.

While the earlier stages [preschool to high school] may be already integrated in planning and information/data sharing, the last two academic stages [high school and college] are not. Colleges/universities need to routinely [every semester] provide feedback to high schools on how their graduates are performing at the collegiate level. Feedback is needed in such areas as students' mathematical abilities, verbal and written communicative skills, computer capabilities, social/behavioral skills, and other areas all or most high school, college-bound students have commonly studied or are important to their collegiate and professional success. This input conveyed in person or more conveniently by electronic means would be helpful for both educational stages. The colleges/universities would be providing the high schools with the input they need to fine-tune their programs, courses, and pedagogies necessary to produce the necessary quality in their students. The colleges/universities would, in turn, benefit when they receive the next *wave* of students from those high schools; these next entering students would be better prepared for college work and campus life.

## A NORTH CAROLINA EXAMPLE

In the state of North Carolina a maximum of 18% of students attending state colleges/universities may be accepted from outside the state. This is to insure that the state's resources for higher education are concentrated on the students [and families] who are citizens of the state. Thus, at least 82% of the students at the state's 16 major universities are North Carolinians. The percentage of in-state students attending two-year community colleges is likely higher, since these are all commuter students. Thus, it is very much in the state's interest to integrate the high school and collegiate levels as a supply chain in order to produce the greatest academic value. Each 2 year or 4 year college or university should be required to report [annually at the very least and by semester, if possible] to each high school represented by its entering class the progress or shortcomings of the NC students enrolled. More desirable would be a report on all NC students, not just the entering class, in the undergraduate collegiate pipeline.

What would be reported? Not the academic report card for each student, but the overall glaring strengths or weaknesses of the NC students would be included in the transmission. Also the college and high school stages could meet or hold electronic discussions on the design of curricula, course content, etc. at *both* stages. As an integrated system the colleges and high schools could have a direct computer linkage similar to EDI systems in industry. With electronic communication this information/data could be conveyed immediately and be extremely cost effective.

Who would do the reporting from the collegiate level? The best source of this information/data would be directly from the individual schools, colleges, or departments within the universities and colleges with perhaps some aggregation at the dean's level.

### **A Specific Example of How the Academic Supply Chain Could Help**

A college junior who, is otherwise a good student, has terrible pronunciation and enunciation of her spoken words. Her writing skills are acceptable [thus, the oral deficiency would not be revealed by the SAT exam], but the faculty feel that this oral communication drawback, not exclusive to her, would detract from her professional success. A three-pronged approach should be launched to remedy this problem: (1) in her college business classes where she makes presentations, her verbal shortcomings should be noted and corrected (perhaps with some private conversations), (2) the faculty member who taught her college Public Speaking course (and she did successfully complete the course) and the department head of the English department responsible for offering the course should both be contacted and the problem brought to their attention, and (3) the high school the student attended should be notified that at least one of the graduates from their program has insufficient verbal communicative skills. Correcting, or at least addressing, the problem at the high school stage leaves more years to arrest the deficiency. Taking action at the collegiate junior year leaves scant time for correction before the student enters the professional world. The problem actually should have been addressed at the grammar school stage when correction of ineffective verbal traits is more easily achieved. Thus, an integrative supply chain approach with its innate attention to quality, in this case verbal communication, would have brought this problem to the attention of the high school and the English teacher(s) involved in correcting this situation. Without involving the high school (stage) in the study and correction of this situation, opportunities to prevent these shortcomings from reoccurring in the future may be lost. Correcting problems *at the source* is one tenet of total quality management that is embraced by the supply chain management concept. While the high school in this scenario is not the source of the problem, it is closer to its origin and addressing the problem adequately at this stage, while not perhaps not solving it, provides an earlier assault with correspondingly more time left to achieve a complete remedy.

There are many student skill deficiencies encountered at the collegiate level that could be prevented, or at least alleviated, if the high school and collegiate levels of academic education (at least for public institutions) were considered as a pair of successive educational stages linked along an academic chain interconnected with frequent coordination on program, course, and content design and feedback on performance, both exemplary and deficient. The industrial supply chain model would be a good prototype for such an academic version.

### **FINAL THOUGHTS**

One could argue that the inputs and products of the academic supply chain are more complex, *yet more important* than the materials, components, and goods moved along the industrial supply chain. Would not then one insist that the students of the academic supply chain need and receive even better attention (planning, processing, inspection, and correction) than inanimate industrial products? The premise here is that the academic supply chain can be improved, at least the high school and collegiate links, by studying the methods and the benefits of the industrial supply chain.

If only as much sophisticated attention could be placed on reporting the academic performance, or lack thereof, at the collegiate level to the high school stage as is the attention to scouting and reporting on athletic talent, the integrated academic supply chain would swiftly become a successful reality.

## **REFERENCES**

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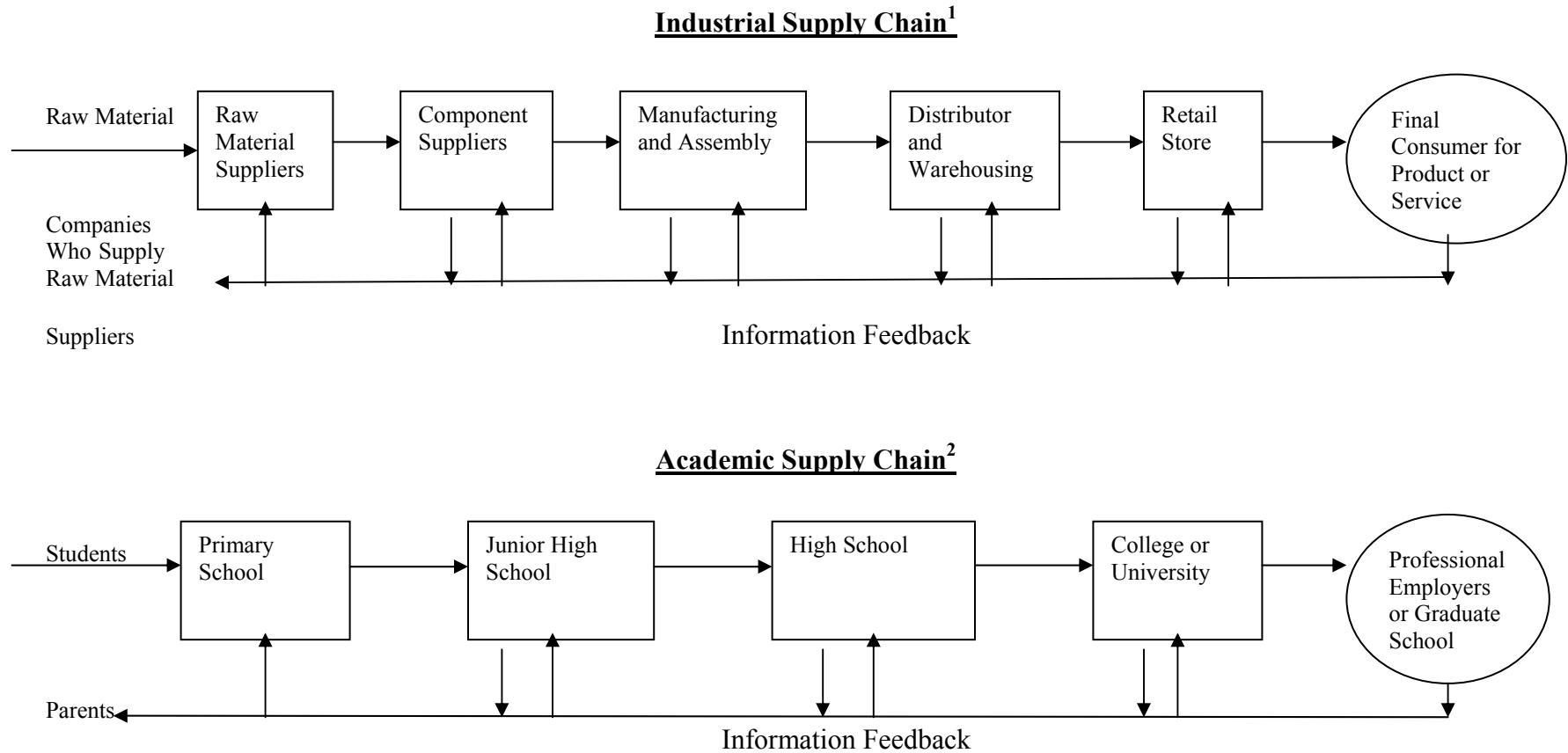
**Table 1. A Comparison of Similarities between Industrial and Academic Supply Chains**

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<u>Industrial Supply Chains</u>	<u>Academic Supply Chains</u>
Raw material, components, or modules at the start of the chain	Students at the start of the chain
Many supply chains involve services as the final consumer output; yet a chain of raw material or products (food, drugs, books, etc.) are needed as supplies.	Education is a service which needs products (texts, computers, desks, etc.) to perform effectively.
Add value to the product or service at each progressive stage	Add value (knowledge, critical reasoning, reading skills, mathematical skill, etc.) to students' at each educational stage
Depend upon the quality performance each stage for the desired final product or service result	Depend upon the quality performance of (learning) of each educational stage
Need to efficiently transmit needed information (forecast demand, quality, etc.) about the product or service from stage to stage in both directions	Need to efficiently transmit needed information (forecast demand, quality, etc.) about students from stage to stage in both directions
Entire chain and its component stages are measured and rewarded on their performance (aptness of design, quality, timeliness, etc.) at each stage and, to some degree, on the performance of the finished products or services.	Entire chain and its educational stages are/can be measured and rewarded on their performance (knowledge and ability of students, standardized test scores, percent attending college and which colleges, etc.) at each stage of the educational supply chain.
Sophisticated information systems (intranets, EDI, email, direct computer links, etc.) transmit shared information (forecasts, production plans, inventory levels, quality requirements and results, design changes, etc.) frequently among the stages.	Sophisticated information systems do or can exist among the academic stages, particularly for those stages owned by a single entity (municipality, county, etc.).
Typically no one company owns all the stages of the supply chain; however, several of the stages may be owned by a single firm.	Typically, no single entity (municipality, county, college, etc.) has ownership of all of the educational stages of the academic chain.

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**Figure 1. A Block Diagram of Industrial and Academic Supply Chains**



1. There may be multiple companies and/or multiple facilities of a single company at each stage.
2. There may be multiple schools at each stage.