ARTICULATION AGREEMENT BETWEEN

Rutgers Business School
Rutgers, The State University of New Jersey

&

New Jersey Department of Education
Covering all of the
Secondary Schools in the State of New Jersey

FOR THE

Global Logistics and Supply Chain Management Curriculum

INTRODUCTION:

The purpose of this articulation agreement is to provide an articulation process whereby a New Jersey secondary school student successfully completing the Global Logistics and Supply Chain Management (GLSCM) curriculum during secondary school, may receive general elective college credits from Rutgers Business School (RBS) upon matriculation into a degree program at RBS.

The GLSCM curriculum which was developed by the Southern Regional Education Board under the direction of, and funded by, the New Jersey Department of Education, is fully supported academically and technically by the Department of Supply Chain Management at RBS.

The goals of the articulation process are to:

a) Provide students with academic and career-technical coursework that prepares them for an industry-recognized credential, and/or a baccalaureate degree;

b) Recognize and reward students for college-level competencies achieved during high school;

c) Assist students in making a smooth transition from high school to post-secondary education;

d) Establish a continual working relationship between the faculty teaching the above mentioned program of study in New Jersey secondary schools and the Department of Supply Chain Management faculty at RBS.

College credits earned through this articulation agreement will reduce their college credit load during their enrollment at RBS.

ARTICULATION REQUIREMENTS:

Rutgers Business School and the New Jersey Department of Education agree to the following:

1) Three (3) general elective credits (011:104 – Introductory Topics in Business) will be awarded to New Jersey secondary school students successfully completing the GLSCM curriculum during secondary school, upon matriculation into a degree program at RBS. There will be no fee assessed for these articulation credits.

2) Students taking advantage of this articulation agreement are responsible for requesting an application for the articulation credits through the Department of Supply Chain Management at RBS. The application will require the signature of the New Jersey secondary school teacher or administrator of the GLSCM program at the student applicant's secondary school.

3) Candidates for college credit under this agreement must have earned a high school diploma with a minimum grade of "B" in the GLSCM program. Only students recommended by their secondary school teacher or administrator will be considered.

4) Credits may be awarded only to students who enroll at RBS within two (2) years of graduation from their secondary school.

5) Credits will be awarded after the student completes the admission process, including any remedial/developmental coursework in reading, writing, or mathematics indicated by the college's basic stills placement test(s).

6) This agreement becomes effective with the start of the RBS semester that follows the dates of the signed signatures below and shall continue uninterrupted unless suspended by either party with at least one year's advance notice.

SIGNED APPROVAL BY PARTNERS

IN WITNESS WHEREOF, the parties hereto, duly authorized, have caused these presents to be signed by their authorized lead administrators.

Jane Griesinger, Acting Division Director
Office of Career Readiness — Date: 2/14/2019

Linda Eno, Assistant Commissioner
Academics and Performance — Date: 4-1-2019

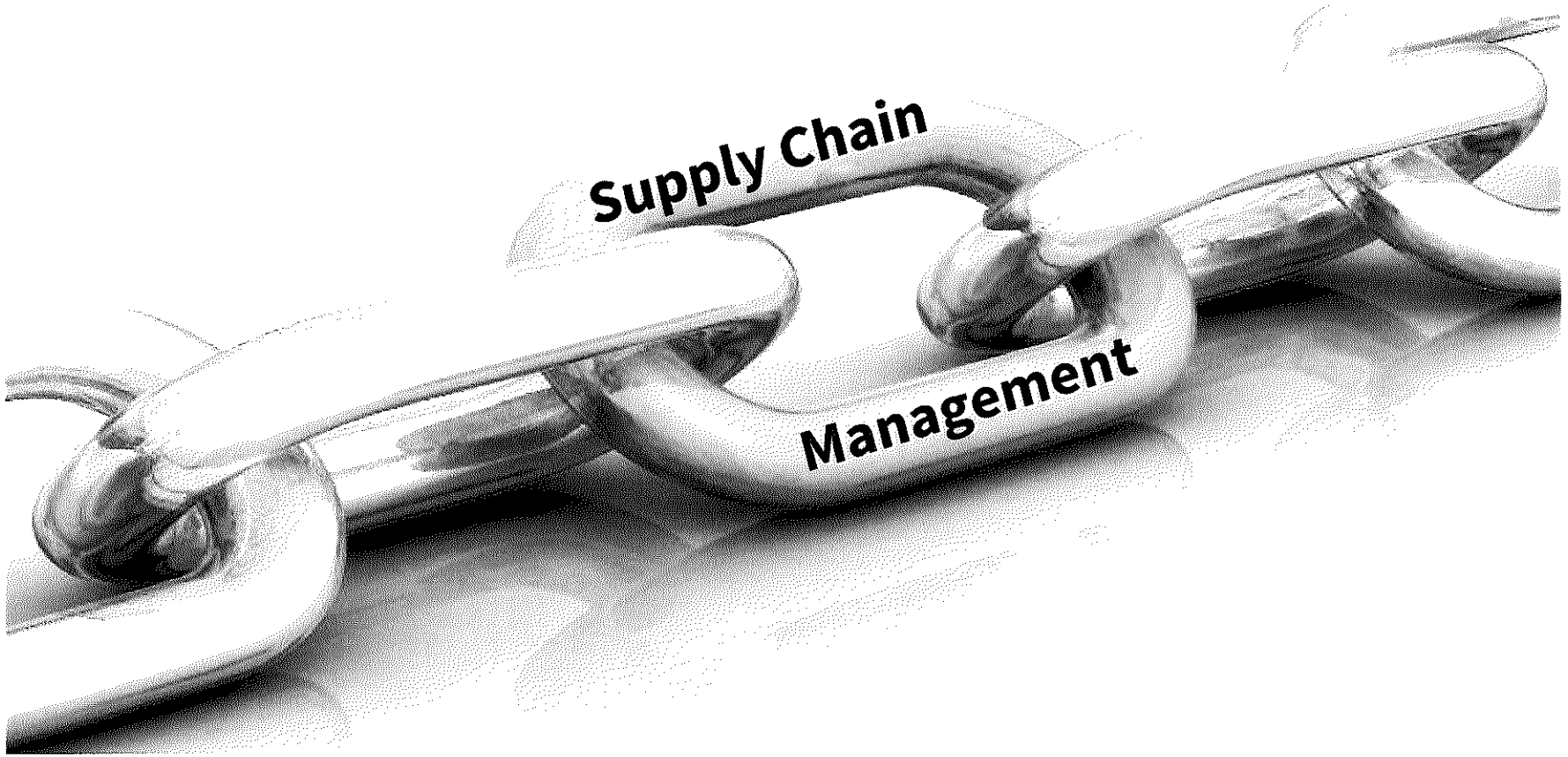
Dr. Lamont Repollet,
Commissioner of Education — Date: 4/1/19

Lei Lei, Dean — Date: 12/11/2018

Wanda Blanchett, Provost — Date: 1/7/19

Jerome Williams, Executive Vice Chancellor — Date: 12-12-18

Barbara Lee, Senior Vice President — Date: 1/29/19



Career Opportunities in Supply Chain Management

Talent Shortage in Supply Chain Management

Supply Chain Management accounts for $1.4 trillion (≈8%) of the total U.S. economy ---> **annually**.

Companies have been **expanding globally** and **speeding up** every link in the supply chain to stay competitive.

> **This has created a significant and growing shortage of supply chain talent --- which translates to JOBS !!!**

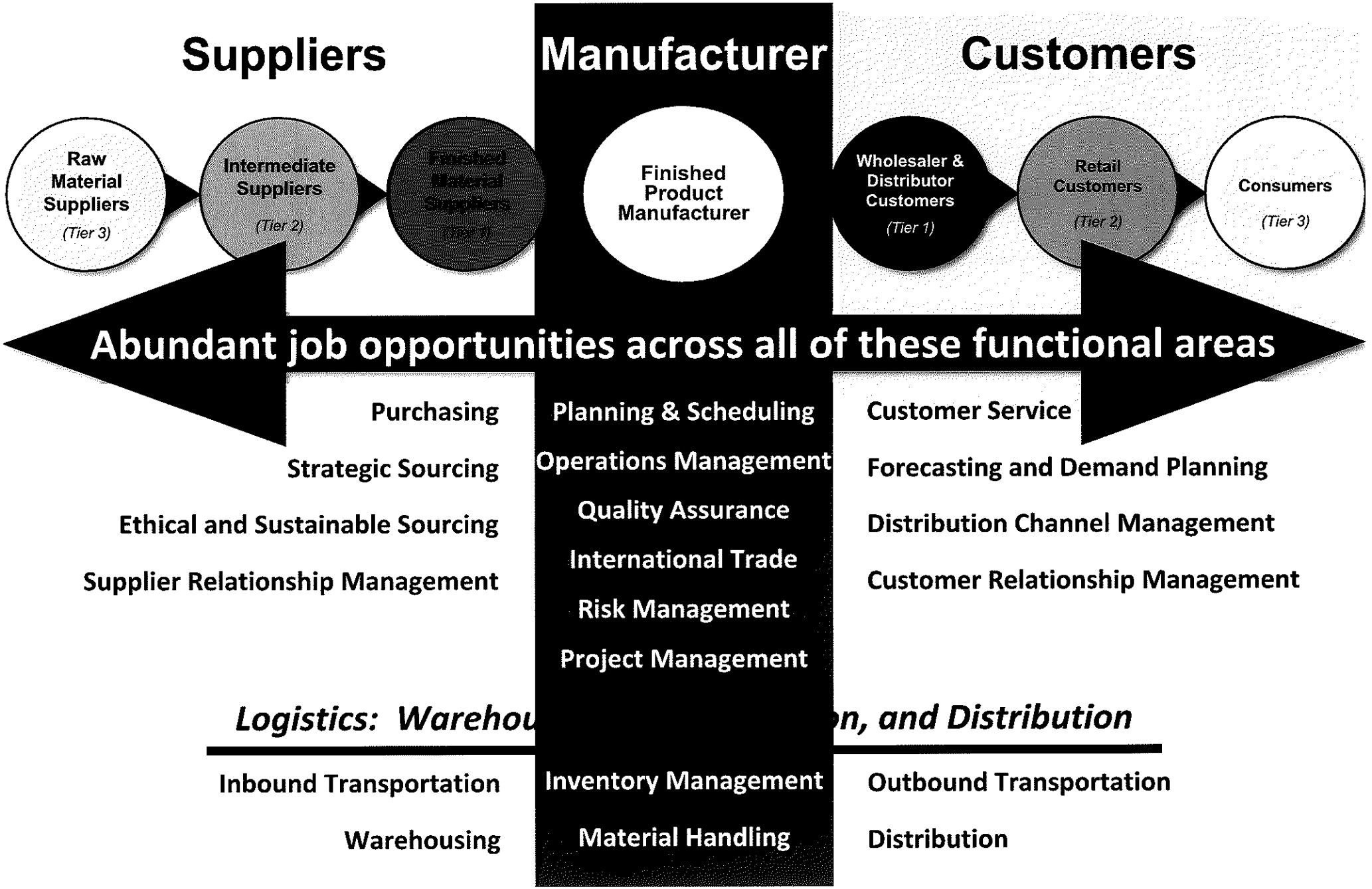
Current trends will continue to raise the bar in supply chain management, and by extension, the skills required:

- ✔ Continued and accelerated pace of **globalization**
- ✔ Expansion of **e-Commerce**
- ✔ Heightened focus on **supply chain risk**
- ✔ Widespread adoption of **new technologies** and **innovations**

Technology and Innovation

Supply Chain Management is a **skilled profession** with cutting edge technologies and major innovations happening at an accelerated pace. Just a few examples:

Typical Supply Chain Career Areas



Talent Crisis in Supply Chain Management

The U.S. is projected to create an **incremental 270,000 supply chain jobs annually** through at least 2020, however, the 8,000 postsecondary educational institutions in the U.S. offering supply chain training and education **generate only 75,000 supply chain professionals annually**.

For those who do graduate post secondary school with a degree in supply chain management, the result is:

92% are placed within 3 months of graduation, with 75% placed at or before graduation.

Average starting salary for a supply chain undergraduate is **$60,000**
(+ up to $18,325 in additional salary and signing bonus)

Average annual salary for an experienced (i.e., 3-5 years) Supply Chain Manager is **$84,232**

Careers in Supply Chain Management

Top 10 things you can expect from a **career** in Supply Chain Management

1. Job **Availability** *(entry level and advanced)*
2. Accelerated **Growth** and **Advancement** opportunities
3. Job **Security**
4. Excellent **Income** and **Compensation** packages
5. Career **Contentment** Recent survey = 79% content with their career
6. Supply chain jobs available in every **Industry** and **Worldwide**
7. Work **Location** choices. Your supply chain skills are portable!
8. **Travel** and **Relocation** opportunities
9. Opportunities to **Specialize** in supply chain **Disciplines** & **Sectors**
10. **Innovation** and cutting edge **Technologies**

Supply Chain Professional Organizations

Institute for Supply Management (ISM) **www.ism.ws**

- *ISM New Jersey Affiliate www.ismnj.org*
- *ISM New York Affiliate www.ismny.com*

Council of Supply Chain Management Professionals (CSCMP) **www.cscmp.org**

- *New Jersey Roundtable www.cscmpnj.org*
- *New York Roundtable www.cscmp-nyc.org*

American Production and Inventory Control Society (APICS) **www.apics.org**

- *Greater North Jersey Chapter www.apics-gnj.org*
- *Central Jersey Chapter www.apics-cjer.org*
- *Princeton South Jersey Chapter www.apics-prsj.org*

C – Demonstration of 21st-Century Skills Rubric

Rubric 1 - Demonstration of 21st-Century Skills

Scoring Element	Not Yet 1	Approaches Expectations 2	Meets Expectations 3	Advanced 4
Communication	Presents ideas in a manner that confuses the audience, failing to maintain audible and articulate speech or maintain eye contact. Does not address audience questions at all.	Presents ideas in a manner that sometimes challenges the audience to follow and struggles to maintain clear voice and professional body language and to answer audience questions.	Clearly explains ideas and information with smooth delivery and organization, showing only slight issues with voice or body language. Sometimes responds to audience questions with scripted answers to meet the presenter's need.	Clearly explains ideas and information with smooth delivery and organization and responds to audience questions with unique answers designed to meet their needs for information. Shows superb voice and body language.
Collaboration	Takes little to no responsibility for role within group, neglects assignments, and does not seek or offer help to others when struggling.	Takes responsibility for role within group with occasional tardiness in producing assignments while showing no effort to help others who struggle in the completion of their components.	Takes responsibility for role within the group by producing needed work, generally, on time. Sometimes may do others' work in order to complete a project.	Takes responsibility for role within the group by producing needed work which requires attendance and punctuality. Assists others with their work when they are struggling to develop their proficiency.
Creativity	Rehashes existing ideas with no combination of knowledge in ways that may or may not address the specifications of the project.	Combines existing knowledge in some new ways to create a solution that may approach the needs of the project but does not fully meet these needs.	Combines existing knowledge in new ways to create a new solution that closely meets the design needs of the project.	Combines existing and new ideas to create a novel solution that is presented clearly as the best fit for the design specifications of the project.
Critical Thinking	Struggles to follow multiple stages of a design process and particularly struggles in applying any knowledge gained during the project.	Attempts to follow a design process but struggles to do one of the following: identify what is already known, what needs to be learned, what has been learned, or show how to apply the new knowledge.	Follows a design process to analyze what is already known, what needs to be learned, what new knowledge is created, and how to apply new knowledge in the creation of a solution.	Follows a design process to analyze what is already known, what needs to be learned, what new knowledge is created, how to apply new knowledge to solve the problem, and the additional knowledge that should be learned beyond the scope of the project.
Computing and Information Literacy	Struggles to produce and use suitable data and needs constant guidance to manage all aspects of technology in the project.	Uses data from a limited variety of sources and uses technology as an addition to the project rather than incorporating it seamlessly.	Interprets data from a variety of sources and integrates results, using suggested technology with minimal guidance to report results, occasionally using technology for technology's sake.	Interprets data from a variety of sources and applies knowledge in the selection and use of appropriate technology for experiments as well as reporting that always increases productivity.
Culture of the Workplace	Assumes all other team members have the same understanding of technical content that s/he does and actively resists compromise with members of the group with diverse views or backgrounds.	Recognizes different understandings of the technical content within the team but does not consider compromise. Insists that own way is better with little consideration of the merits of others' diverse views and backgrounds.	Synthesizes understanding of the technical content within the team in a way where all members have some voice. May have individual beliefs and makes some compromises to work with members of the group with diverse ideas and backgrounds.	Construct a new team understanding of the technical content presented in the project in which all members develop shared meanings through trial and research Able to reach agreed upon values with members of the group with diverse views and backgrounds.
Career Self-Guidance	Attempts to identify the significance of the industry role presented in the project but fails to address the specific requirements and responsibilities and has little idea of how this might relate to personal goals.	Understands either the education or training requirements or responsibilities of the industry role presented in the project with little understanding of how this relates to the student personally.	Understands the education and training requirements and responsibilities of the industry role presented in the project and has some idea about personal interest in the role.	Understands the education and training requirements and responsibilities of the industry role presented in the project, from a local to a global scale, as well as how the role relates to individual interests and skills.

AC—Solution/Design Plan Rubric

Rubric 2 - AC - Solution/Design Plan

Scoring Element	Not Yet 1	Approaches Expectations 2	Meets Expectations 3	Advanced 4
Purpose	Attempts to state a purpose but is unclear. Document does not support the stated purpose or the Project Description.	States purpose somewhat clearly yet rest of the document may be at odds with the stated purpose or the Project Description.	States purpose clearly, and the rest of the document generally focuses on the stated purpose and is rooted in the Project Description.	States purpose clearly and accurately, and the rest of the document focuses on the stated purpose and is firmly rooted in the Project Description.
Scope	Identifies resources needed with little attention to quantities. Estimation is largely incorrect, and many essential items are not listed.	Identifies some of the resources and quantities needed for the project. Estimation practices are not authentic to the project, and some items are obviously missing.	Identifies the resources and quantities necessary to complete the project. Quantities represent appropriate estimation practices for the project with no obvious omissions.	Identifies the resources and quantities necessary to complete the project along with potential substitutes to compensate for potential shortages of essential items. Quantities represent appropriate estimation practices for the project with no omissions.
Goals	Establishes goals that are not related to the Project Description or are inadequate and pays no attention to the various components of the goals.	Establishes goals that approach the requirements of the Project Description. Fails to identify sub-goals that would make management of the project easier.	Establishes goals based on the requirements of the Project Description. Identifies smaller goals contained within the project goal that make management of the project easier for the team.	Establishes clear goals based on exceeding the minimum requirements of the Project Description. Deconstructs the overall goal into smaller, finite sections that make management of the project easier and more measurable.
Rationale	Provides little rationale for the decisions made or their importance for successful completion. Some decisions are unnecessary with obvious deficiencies as well.	Provides a rationale for many decisions made in the plan to demonstrate their importance, but many components have no rationale. Some listed components of the plan are likely unnecessary, and some necessary components are missing	Provides a rationale for most decisions made in the plan to demonstrate how they will facilitate successful completion of the project. Listed components of the plan are likely necessary but would benefit from additional explanation. Few steps are absent.	Provides a rationale for every decision made in the plan to demonstrate how they will facilitate successful completion of the project. Listed components of the plan are clearly necessary and are not redundant, nor are any essential steps absent from the plan.
Reading/ Research	Bases plan on assumptions with no reference to research. Citations are nonexistent.	Bases plan on some limited research about other methods for approaching the problem. Citations are generally incorrect or missing.	Bases plan on authentic research about previous methods for approaching the problem. Citations are generally correct.	Bases plan on authentic research about previous methods for approaching the problem as well as current approaches. Citations are complete and accurate.
Technical Content	Notes disciplinary content in weak and lawed descriptions, and often confuses vocabulary and concepts with erroneous explanations.	Notes disciplinary content in descriptions, but uneven use of vocabulary or errors in explanation demonstrate limited understanding	Presents accurate disciplinary content with sufficient explanation that demonstrates understanding. Makes occasional use of essential vocabulary of the project.	Integrates relevant and accurate disciplinary content with thorough explanations that demonstrate in-depth understanding, using the essential vocabulary of the industry.
Conventions	Demonstrates an uneven command of standard English conventions and cohesion with multiple significant errors that make some passages unreadable.	Demonstrates an uneven command of standard English conventions and cohesion, sometimes using inappropriate tone and language for the report with multiple errors that serve to distract the reader.	Demonstrates a command of standard English conventions and cohesion, using the appropriate tone and language for the report with few errors that distract the reader.	Demonstrates and maintains a well-developed command of standard English conventions and cohesion, using the appropriate tone and language for the report with no errors that distract the reader.

AC—Final Product Rubric

Rubric 3 - AC - Final Product Rubric

Scoring Element	Not Yet 1	Approaches Expectations 2	Meets Expectations 3	Advanced 4
Adequacy	Addresses few to none of the components of the Project Description and demonstrates little understanding of the enduring learning associated with the project.	Addresses the situation presented in the Project Description incompletely and demonstrates insufficient attention to the enduring learning presented by the Essential Question.	Addresses the situation presented in the Project Description and attends to the enduring learning presented by the Essential Question with breadth	Addresses every component of the situation presented in the Project Description and attends to the enduring learning presented in the Essential Question with breadth and depth.
Usability	Incorporates few of the practices of the industry in a generally unrecognizable way with several missing components. May contain extraneous components as well.	Incorporates some of the practices of the industry in a generally recognizable way with some expected components missing. Fails to use precision to eliminate extraneous components	Incorporates the practices of the industry in a recognizable way with attention to all of the components that would normally be expected to be part of such a solution/prototype. Uses precision that eliminates most extraneous components.	Incorporates the practices of the industry in an obvious but unique way with attention to all of the components that would normally be expected to be part of such a solution/prototype. Uses precision that eliminates any extraneous components.
Feasibility	Presents a solution with little to no basis in research and that has been determined unworkable for the identified purpose by an industry representative. Or Provides a prototype that fails to meet the stated goal or simply does not work.	Presents a solution that is partly based on research and has been determined to be unlikely for the identified purpose by an industry representative. Or Provides a prototype that approaches minimum requirements for the stated goal with significant issues with reliability.	Presents a solution that is based on research and data and has been vetted by industry representatives as a potential solution with some merit for the identified purpose. Or Provides a prototype that meets the minimum requirements of the stated goal with some issues with reliability.	Presents a solution that is based on research and data and has been vetted by industry representatives as a successful solution for the identified purpose. Or Provides a prototype that accomplishes and exceeds the minimum requirements of the stated goal with superior reliability.
Analysis	Contains no identification of limitations of the project and no analysis that might permit improvement in the future.	Attempts to identify limitations of the solution/prototype but with little substantive analysis to allow for future planning.	Identifies and attempts to justify limitations of the solution/prototype and provides analysis for potential future improvement.	Identifies and justifies limitations of the solution/prototype and provides reflective analysis of potential avenues for specific areas of future improvement.
Critical Thinking	Exhibits a solution/prototype that did not utilize the design/design process with little evidence of improvements made through research/ testing.	Exhibits a solution/prototype that attempted to utilize the design/design process with minimal evidence of improvements made through research/ testing.	Exhibits a solution/prototype that successfully used the design/design process. Suitable improvements are evident in response to issues discovered through research/ testing.	Exhibits a solution/prototype that successfully and completely used the design/design process. Substantial improvements are evident in response to any and every issue discovered through research/testing.
Execution	Demonstrates work with little to no attention to detail and which would not be passable by industry standards for such a solution/prototype.	Demonstrates work that may not demonstrate attention to detail and may lack the polish to make the solution / prototype passable by industry standards.	Demonstrates work that has been completed with attention to detail with some focus paid to the appearance of the solution/prototype so that it is passable by industry standards.	Demonstrates work that has been completed with attention to every detail with particular focus paid to the final appearance of the solution/prototype to place it at the top of industry standards for such a product.

AC—Professional Notebook Rubric

Rubric 4 - AC - Professional Notebook Rubric

Scoring Element	Not Yet 1	Approaches Expectations 2	Meets Expectations 3	Advanced 4
Design	Presents notes and findings in a random manner that does not allow for easy use of the notebook.	Presents notes organized in a way that demonstrates an attempt to create structure, but that lacks headings and other features that would make navigating the notebook easier.	Presents notes organized in a recognizable structure and makes use of various text features, including headings, subheadings, and other labels	Presents notes organized in a clear structure that is easy to follow, makes use of various text features, including headings, subheadings and other labels and includes embedded notes for cross-referencing sections and other projects.
Content	Includes little information directly related to the project and fails to demonstrate any growth in knowledge related to the Project Description.	Includes notes and data from some of the sources identified in the project and may not demonstrate a growth of knowledge related to the Project Description.	Includes notes and data from every component of the project and reflects a cumulative growth of knowledge and understanding directly related to the Project Description.	Includes notes and data from every component of the project as well as additional external considerations. Reflects a cumulative growth of knowledge and understanding directly related to the Project Description and its role in the industry.
Note-Taking	Copies all information verbatim without consideration of the larger piece or citation.	Uses some note-taking strategies inconsistently and often fails to make any note of the citation.	Demonstrates appropriate use of note-taking skills to include direct quotations, paraphrasing, and summarization, with citations for most information.	Demonstrates appropriate use of note-taking skills to include direct quotations, paraphrasing, and summarization, with citations for all information.
Connections	Notes concepts in isolation from one another. Isolates the technical content and ignores academic content.	Notes concepts learned in isolation from one another. Fails to draw connections between technical and academic content associated with the project.	Draws connections between the technical and the academic content of the project. Shows some evidence of connection to outside academic areas.	Draws connections between the technical content discovered over the course of the project and academic content learned. Demonstrates a seamless application of the common concepts and their relationship to academic classes.
Clarification	Lists notes sporadically and with no attention to the interaction of observations and research in clarifying notes.	Lists notes without discussion of how daily discoveries in the project have further clarified or refuted previous notes.	Demonstrates a flexible understanding of principles in the project that deserve clarification as new information is discovered throughout the project. Lists notes that complement earlier notations.	Demonstrates an evolving understanding of principles in the project through notations that clarify thoughts and ideas based on new information discovered through research and observation. Attempts to explain the reason for any disagreements.
Reflection	Describes opinions about the project with little or no appreciation for the value of the project to the industry.	Describes little growth or achievement within the project and exhibits little understanding of how the project fits into the course or industry or of its significance to students.	Describes growth, achievement, and significance of the project as related to the course as well as an understanding of whether the authentic role is appealing for the student.	Describes growth, achievement, and significance of the project as related to the course and the industry as well as an understanding of how the authentic role fits within the student's personal interests and skills.
Writing Mechanics	Flows awkwardly with use of incomplete thoughts and rampant spelling and grammar mistakes, making use of the notebook nearly impossible.	Flows somewhat clumsily in places with several mistakes and some incomplete thoughts, making use of the notebook difficult.	Flows easily with generally complete thoughts with minor grammar and spelling mistakes.	Flows easily as text employs complete thoughts and makes few grammar or spelling mistakes, especially in relation to the technical vocabulary of the project.

AC—Writing Rubric

Rubric 5 - AC - Writing Rubric

Scoring Element	Not Yet 1	Approaches Expectations 2	Meets Expectations 3	Advanced 4
Focus	Struggles to address the stated purpose of the project with little to no connection to the enduring learning concepts of the project.	Attempts to address the stated purpose of the project with some lapses in connecting to the Project Description and often losing sight of the enduring learning concepts.	Addresses the stated purpose of the project with consideration of the authentic role presented in the description and links it effectively to the enduring learning concepts.	Addresses the stated purpose of the project with consideration of the authentic role presented in the description. Keeps the enduring learning important in the project as the focus.
Controlling Idea	Struggles to establish a controlling idea/claim or establishes a controlling idea/claim that is not related to the project.	Establishes a controlling idea/claim that is not clear at multiple points throughout the paper and fails to fully address the requirements of the Project Description and Essential Question.	Establishes a clear controlling idea /claim that attends to the authentic task and the Essential Question from the Project Description, with few incidences that deviate from the idea.	Establishes and maintains a strong and substantive controlling idea/claim that specifically attends to the authentic task and the Essential Question from the Project Description.
Reading/ Research	Presents opinions as fact without substantiation from any sources or presents facts that are not relevant to the report.	Presents information that is sometimes not relevant to the project or uses limited sources and types of data, sometimes reflecting inaccuracy.	Presents and correctly cites information relevant to the project by integrating multiple sources and types of data. Displays disagreements among sources without discussion.	Presents and correctly cites information relevant to the project by integrating multiple sources and types of data Accurately addresses both the credibility of sources and explains situations where sources may not agree.
Development	Struggles to indicate the report's purpose or significance. Unclear arguments and multiple missing components further cloud the overall development of the report.	Attempts to indicate the report's purpose or significance but lacks a component that would help establish the overall importance of the report.	Presents explanations of the significance of the report, justifies assumptions and data used, makes conclusions based on findings, and details the consequences of the information within the report.	Presents thorough and detailed explanations of the significance of the report, justifies assumptions and data used, makes conclusions based on findings, details the consequences of the information within the report, and identifies unanswered questions the report exposes.
Organization	Uses little structure in the presentation of ideas or a structure that is simply not connected with the Project Description.	Uses an organizational structure that approximates authentic writing for the Project Description with awkward structure.	Uses an organizational structure that addresses the specific requirements of the Project Description in a generally effective way. Presents information with minor organizational issues that would not confuse a professional in the authentic role.	Maintains an organizational structure that intentionally and effectively enhances the presentation of information as required by the specific Project Description. Presents information completely in a manner resembling work of a professional in the authentic role.
Conventions	Demonstrates an uneven command of standard English conventions and cohesion with multiple significant errors that make some passages unreadable.	Demonstrates an uneven command of standard English conventions and cohesion, sometimes using inappropriate tone and language for the report, with multiple errors that serve to disrupt the reader.	Demonstrates a command of standard English conventions and cohesion, using the appropriate tone and language for the report, with few errors that disrupt the reader.	Demonstrates and maintains a well-developed command of standard English conventions and cohesion, using the appropriate tone and language for the report, with no errors that disrupt the reader.
Content Understanding	Notes disciplinary content in weak and lawed descriptions, often confuses vocabulary, and gives erroneous explanations of concepts. Makes no	Notes disciplinary content in descriptions but exhibits uneven use of vocabulary and makes errors in explanations, demonstrating limited	Presents accurate disciplinary content with sufficient explanation that demonstrates understanding. Makes occasional use of essential	Integrates relevant and accurate disciplinary content with thorough explanations that demonstrate in-depth understanding, using the essential vocabulary of the industry and

	reference to own testing.	understanding. Makes few reference to own testing.	vocabulary and some observations from own testing.	observations from own testing.

AC—Presentation Rubric

Rubric 6 - AC - Presentation Rubric

Scoring Element	Not Yet 1	Approaches Expectations 2	Meets Expectations 3	Advanced 4
Speaking	Uses substandard English language with frequent slang and maintains a voice that is generally difficult to hear or understand. Uses several filler words or uncomfortable pauses.	Uses standard English language with occasional slang and maintains a voice that is sometimes challenging to hear or understand. Uses several filler words or uncomfortable pauses.	Uses standard English language to present ideas and maintains a voice that is generally easy to hear and understand, with occasional spikes and valleys in pitch. Only uses occasional filler words.	Uses standard English language to present ideas and maintains a voice that is easily heard and understood. Refrains from use of filler words.
Body Language	Maintains poor posture and eye contact throughout presentation. Hands are generally clinched.	Maintains a mostly erect posture with sometimes poor eye contact. Uses hands distractedly or not at all.	Maintains erect posture and eye contact, perhaps concentrating on just a few members of the audience or looking away too frequently. Uses hands without distracting from presentation.	Maintains erect posture and eye contact with the various members of the audience. Uses hands expressively without distracting from presentation.
Teamwork	Interacts poorly with team members and allows one member to dominate the entire presentation.	Interacts unevenly with team members and allows one or two team members to dominate the presentation.	Interacts with team members generally evenly and allows all or most team members to participate.	Interacts with team members in a way that facilitates individual strengths and allows all team members to take part in the presentation.
Responsiveness	Answers questions from audience incorrectly or not at all.	Answers questions from audience unevenly, generally offering global answers as opposed to specific ones supported by the project.	Answers questions from audience, referring to evidence from research and observational data.	Answers questions from audience expertly, referring to evidence from research and observational data.
Content	Displays inauthentic content for the Project Description and lacks any notion of the technical vocabulary. Displays inappropriate data or no data to support claims, drawing solely on conjecture.	Displays some content that is inauthentic to the Project Description. Makes insufficient use of technical vocabulary. Displays data that is not directly tied to the Project Description or does not display enough data, drawing heavily from conjecture.	Displays content and data that is pertinent to the project with minor lapses in completeness. Draws heavily from research and some observations from testing the solution/prototype. Language could be slightly more technical in nature.	Displays content and data that is pertinent to the project and complete in every way. Draws from research to explain observations from testing the solution/ prototype. Uses the technical vocabulary of the field.
Visual Aids	Uses visual aids that are a distraction or chooses to use no visual aids at all.	Uses visual aids that serve to distract the audience or are inappropriate for the material. Colors and choice of graphics are unprofessional in appearance or there is insufficient use of visual aids.	Uses visual aids in a generally efficient manner that disseminates knowledge with occasional distraction or superfluous detail. Colors and choice of graphics are generally professional in appearance.	Uses visual aids in an efficient manner that allows for effective dissemination of knowledge without overwhelming the audience. Colors and choice of graphics are professional in appearance.
	Uses little structure in the presentation of ideas or a structure that is simply not	Uses an organizational structure that approximates authentic writing for	Uses an organizational structure that addresses the specific requirements of	Maintains an organizational structure that intentionally and

Organization	connected with the Project Description.	the Project Description with awkward structure.	the Project Description in a generally effective way. Presents information with minor organizational issues that would not confuse a professional in the authentic role.	effectively enhances the presentation of information as required by the specific Project Description. Presents information completely in a manner resembling work of a professional in the authentic role.

Suppliers

Manufacturer

Customers

PACING GUIDE - STUDENTS

A suggestion for project progression. Times may be adjusted to meet individual needs.

50 Minute Blocks				
Block 1 Read Introduction, Driving Question, Project Description and Deliverables	**Block 2** Engaging Activity	**Block 3** Complete Engaging Activity	**Block 4** Teams meet, complete the mind-mapping exercise and make research assignments.	**Block 5** Read relevant readings and watch assigned videos
Block 6 Read relevant readings and watch assigned videos Discussion as needed	**Block 7** Find definitions for Essential Vocabulary Complete Math lesson when included	**Block 8** Find definitions for Essential Vocabulary Complete Math lesson when included	**Block 9** Find definitions for Essential Vocabulary Complete Math lesson when included	**Block 10** Find definitions for Essential Vocabulary Complete Math lesson when included
Block 11 Conduct authentic research Share research findings with team members Develop a solution	**Block 12** Conduct authentic research Share research findings with team members Develop a solution	**Block 13** Conduct authentic research Share research findings with team members Develop a solution	**Block 14** Conduct authentic research Share research findings with team members Develop a solution	**Block 15** Conduct authentic research Share research findings with team members Develop a solution

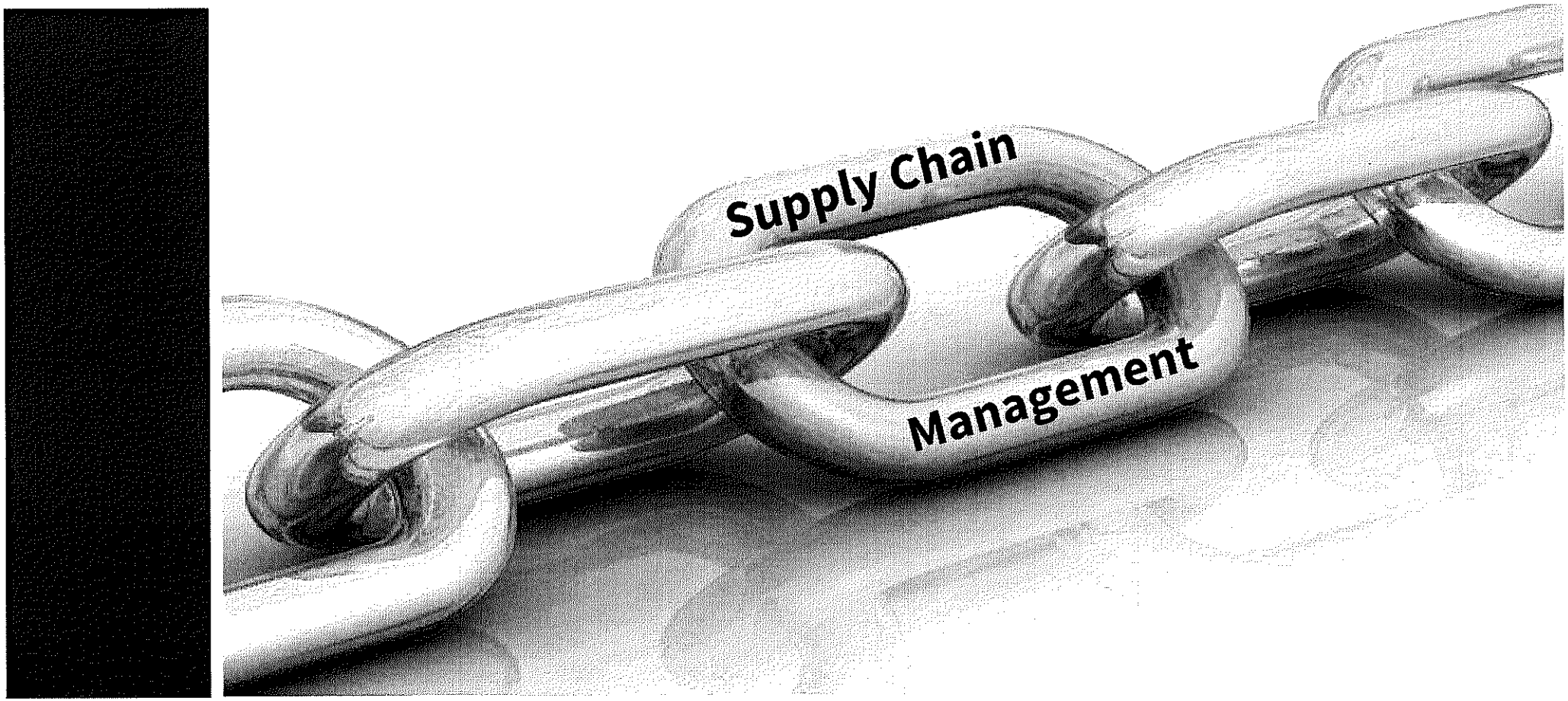
Block 16	**Block 17**	**Block 18**	**Block 19**	**Block 20**
Conduct authentic research Share research findings with team members Develop a solution	Conduct authentic research Share research findings with team members Develop a solution	Conduct authentic research Share research findings with team members Develop a solution	Conduct authentic research Share research findings with team members Develop a solution	Conduct authentic research Share research findings with team members Develop a solution
Block 21	**Block 22**	**Block 23**	**Block 24**	**Block 25**
Conduct authentic research Share research findings with team members Develop a solution	Conduct authentic research Share research findings with team members Develop a solution	Conduct authentic research Share research findings with team members Develop a solution	Present solution to an authentic audience	Revise solution and create Final Deliverable
Block 26	**Block 27**	**Block 28**	**Block 29**	**Block 30**
Revise solution and create Final Deliverable	Revise solution and create Final Deliverable	Revise solution and create Final Deliverable	Take End-of-Project Assessment	Participate in Roundtable Discussion

PACING GUIDE - TEACHERS

A suggestion for project progression. Times may be adjusted to meet individual needs.

50 Minute Blocks				
Block 1 Read Introduction, Driving Question, Project Description and Deliverables	**Block 2** Prepare props and review videos	**Block 3** Prepare props and review videos	**Block 4** Hand out team contracts (choose teams)	**Block 5** Read relevant readings and fundamental concepts
Block 6 Read relevant readings and fundamental concepts	**Block 7** Prepare Math lesson if included, Review Essential Vocabulary Definitions	**Block 8** Prepare Math lesson if included, Review Essential Vocabulary Definitions	**Block 9** Prepare Math lesson if included, Review Essential Vocabulary Definitions	**Block 10** Prepare Math lesson if included, Review Essential Vocabulary Definitions
Block 11 Monitor student progress Invite authentic audience and schedule presentations	**Block 12** Monitor student progress Invite authentic audience and schedule presentations	**Block 13** Monitor student progress Invite authentic audience and schedule presentations	**Block 14** Monitor student progress Invite authentic audience and schedule presentations	**Block 15** Monitor student progress Invite authentic audience and schedule presentations

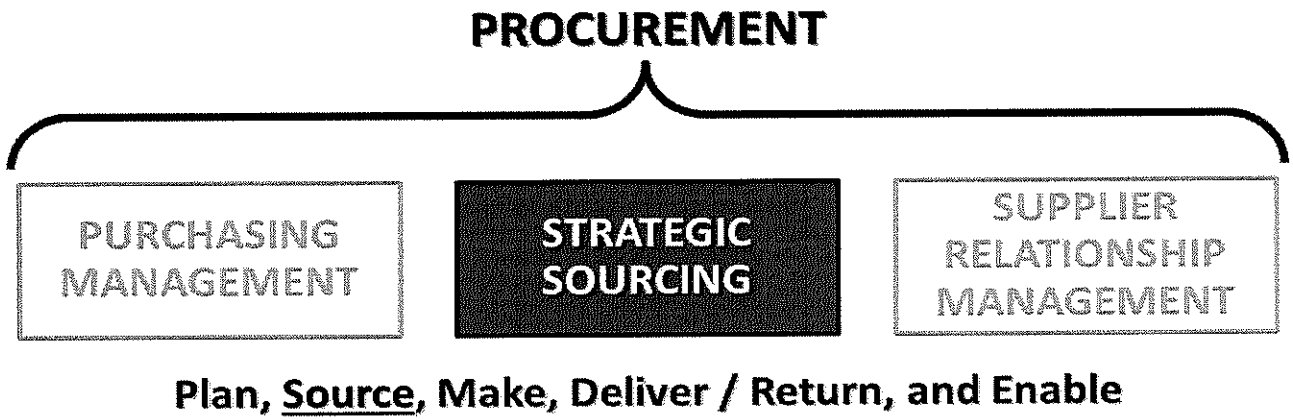
Block 16	**Block 17**	**Block 18**	**Block 19**	**Block 20**
Monitor student progress Invite authentic audience and schedule presentations	Monitor student progress Invite authentic audience and schedule presentations	Monitor student progress Invite authentic audience and schedule presentations	Monitor student progress Invite authentic audience and schedule presentations	Monitor student progress Invite authentic audience and schedule presentations
Block 21	**Block 22**	**Block 23**	**Block 24**	**Block 25**
Monitor student progress Invite authentic audience and schedule presentations	Monitor student progress Invite authentic audience and schedule presentations	Monitor student progress Invite authentic audience and schedule presentations	Observe presentation to authentic audience	Monitor student progress
Block 26	**Block 27**	**Block 28**	**Block 29**	**Block 30**
Monitor student progress	Monitor student progress	Monitor student progress	Print End-of-Project Assessment	Wrap-up



Strategic Sourcing

What Is Strategic Sourcing?

- **Sourcing** - The process of identifying a company that provides a needed good or service.
- **Strategic Sourcing** - A comprehensive approach for locating and sourcing **key suppliers**, so that an organization can leverage its consolidated purchasing power to find the best possible values in the marketplace.
  - ✔ Strategic sourcing requires analysis of what an organization buys, from whom, at what price, and at what volume.
  - ✔ Emphasis is placed on the **entire life-cycle of a product**, not just its initial purchase price.



Objectives of Strategic Sourcing

Objectives of strategic sourcing involve the reduction of cost while maintaining or improving quality:

1. **Improve the value-to-price relationship** *(i.e. achieve cost reductions while maintaining or improving quality/service)*

2. **Understand the category buying and management process**, to identify improvement opportunities

3. **Examine supplier relationships across the entire organization**. Share best practices across the organization

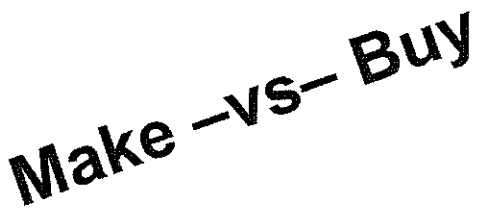
4. **Develop and implement multi-year contracts** with standardized terms and conditions across the organization

5. **Leverage the entire organization's spend**

Sourcing Strategies

Analysis and ability to make adjustments based on **price**, evaluation of **supplier performance**, and the **overall needs** of the organization.

High-level sourcing strategies include:



- **Insourcing**: Producing goods or services using a company's own internal resources.

- **Outsourcing**: The traditional definition involves purchasing an item or service externally, which had been produced using a company's own internal resources previously.
  - The term has more recently become synonymous with the concept of **buying** an item from an external source of supply regardless of whether the item had been previously produced using a company's internal resources.

Sourcing Strategies *(continued)*

- **Single-Source**: A sourcing strategy where there are multiple potential suppliers available for a product or service, however, the company **decides** to purchase from only one supplier.
  - This is in contrast to a situation where there is only one supplier for an item, i.e., **sole sourced**. Sole source is not truly a strategy as there really isn't a choice, and there is very little opportunity for a company to negotiate price or service.
- **Multi-Source**: Purchasing a good or service from more than one supplier. Companies may use multi-sourcing to create competition between suppliers in order to achieve higher quality and lower price.

A regular review of an organization's sourcing strategy is a must in order to achieve significant agreed upon results.

Sourcing Strategies *(continued)*

How many suppliers do you need? Current trends favor using fewer sources; however . . .

CAUTION: Single-source is risky.

Reasons for a Single Supplier

- To establish a good relationship
- Less quality variability
- Lower cost [100% of volume]
- Transportation economies
- Proprietary product or process
- Volume too small to split

Reasons for Multiple Suppliers

- Need more capacity
- Spread risk of supply disruption
- Create competition
- More sources of information
- Dealing with special kinds of business

Supplier Selection

Supplier Selection is typically conducted by a **cross functional team**.

The process of selecting suppliers is complex and should be based on **multiple criteria** using evaluation forms or scorecards.

The following are some commonly used criteria:

- Cost
- Quality
- Capacity
- Service
- Location
- Reliability
- Communication capability
- Order system and cycle time
- Willingness to share information
- Product and process technologies

Preferred Suppliers

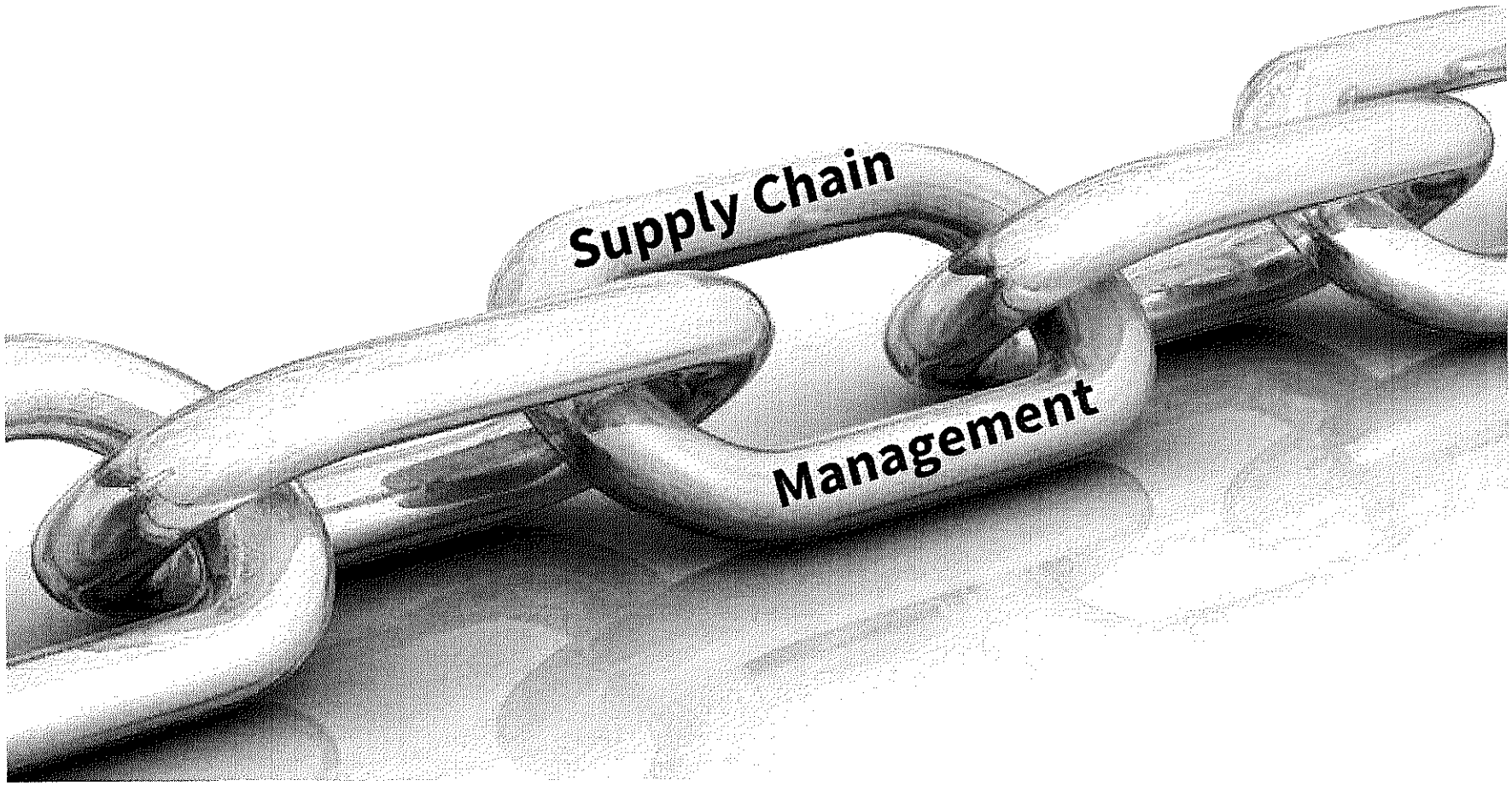
A supplier who best meets your company's overall purchasing requirements.

A supplier of choice

- Achieved a specific and exceptional **level of performance** over time as measured by a set of criteria agreed upon by both buyer and supplier.
- Typically **trusted partners** who know the buyers organization, processes, procedures, and requirements.
- Provides a **higher value** than their competitors and are characterized as **reliable**, **responsive**, **flexible**, and **cost effective**.

Preferred suppliers provide:

- Product and process technology, and expertise.
- Product development and value analysis.
- Information on latest trends in materials, processes, or designs.
- Capacity for meeting unexpected demand.
- Cost efficiency due to economies of scale.



Supplier Relationship Management

http://spendmatters.com/2017/04/19/2-strategic-ways-improve-supplier-relationship-management/

Keys to Successful Strategic Partnerships *(continued)*

Performance Metrics

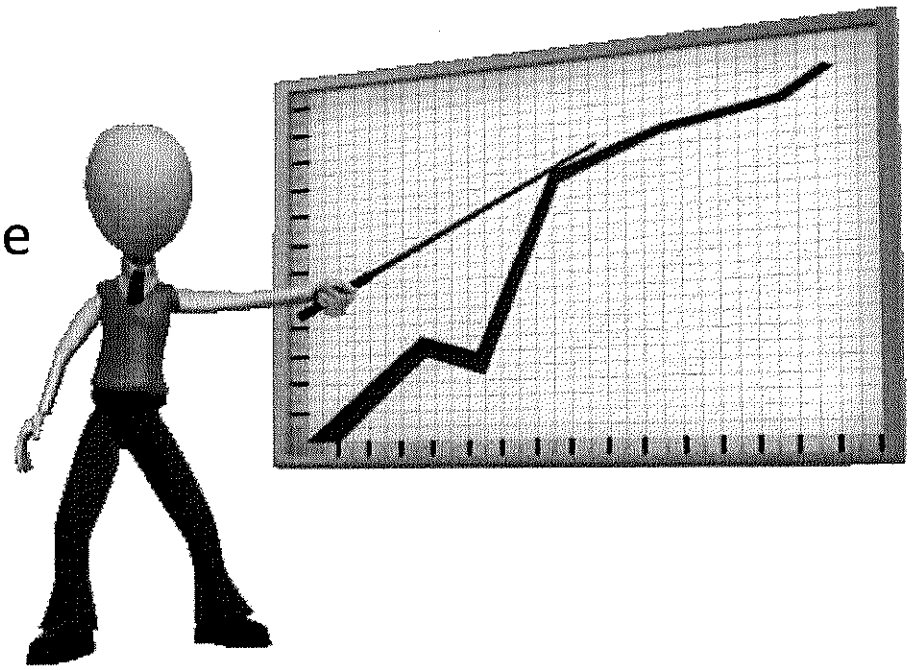
- **<u>You can't improve what you can't (or don't) measure</u>**
  - Measures related to quality, cost, delivery, and flexibility are used to evaluate suppliers.
  - Metrics should be: 1) understandable, 2) easy to measure, and 3) focused on real value-added results [S.M.A.R.T. objectives]
  - A multi-criteria approach is best **[i.e., a SCORECARD]**
- **<u>Total Cost of Ownership</u>**, is made up of all costs associated with the acquisition, use, and maintenance of a good or service

S.M.A.R.T. = <u>S</u>pecific, <u>M</u>easurable, <u>A</u>chievable, <u>R</u>elevant, <u>T</u>ime-oriented

Supplier Evaluation: Performance

It is important to actively monitor a supplier's performance and provide **visibility and feedback** on supplier performance at each stage of the evaluation process.

Some relevant metrics include:



- Supplier price and cost performance
- Product receipt quality
- Delivery performance
- Financial stability
- Contractual and standard compliance
- Participation in product development
- Cooperativeness in third-party production management
- Support of both ethics and sustainable practices

Supplier Evaluation: Weighted-Criteria

The Weighted-Criteria Evaluation System

1. Select the **key dimensions of performance** mutually acceptable to both buyer and supplier.

2. Monitor and collect **performance data**.

3. Assign **weights** to each of the dimensions.

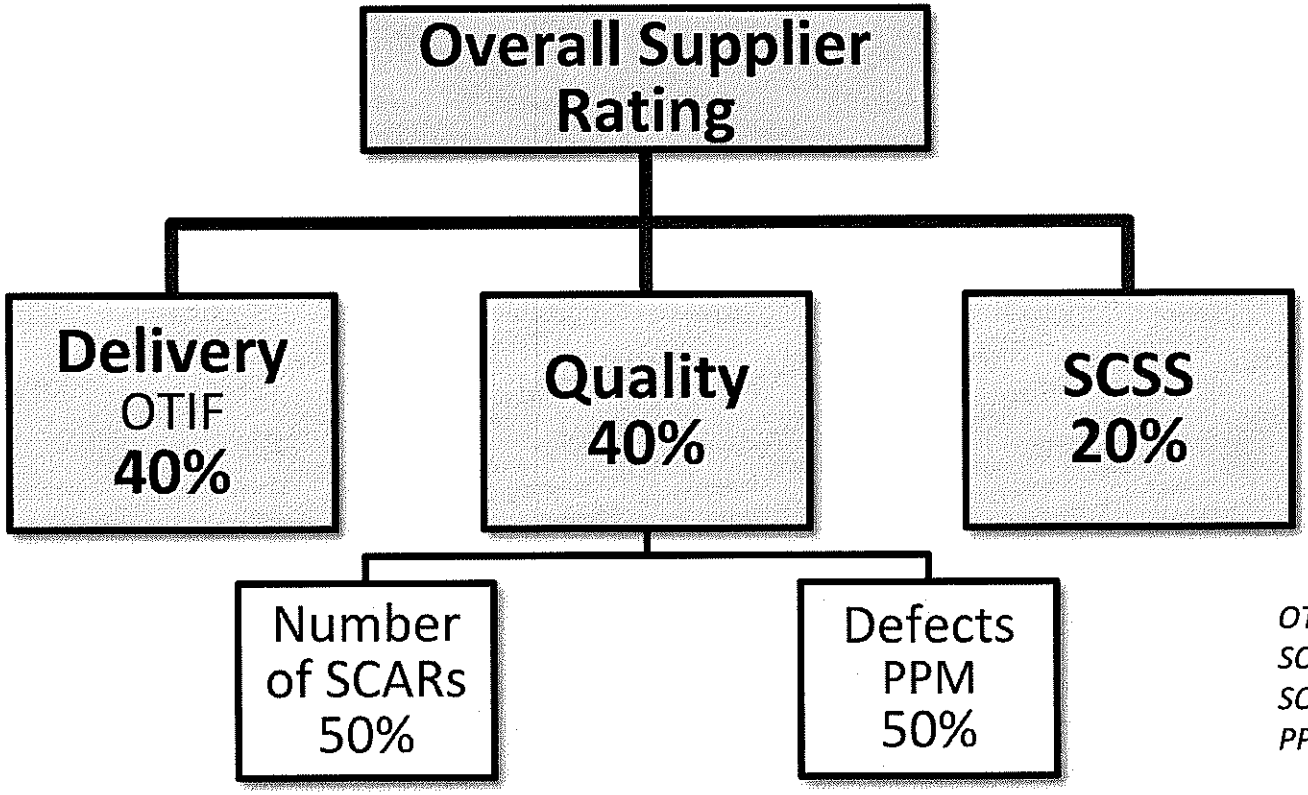
4. Evaluate **performance** measures between 0 and 100.

5. Multiply **dimension rating by weight** and sum of overall score.

6. Classify suppliers based on their overall score, e.g., **Certified**, **Preferred**, **Acceptable**, **Conditional**, **Developmental**, **Unacceptable**, etc.

7. Audit and perform **ongoing certification review**.

Weighted-Criteria Evaluation System Example



Overall Point Score:
Preferred: 90 to 100
Acceptable: 70 to 89
Developmental: 0 to 69

OTIF = On Time In Full
SCSS = Supplier Cost Savings Suggestions
SCAR = Supply Chain Action Report
PPM = Parts Per Million

A. **Preferred**: work with these suppliers in maintaining a competitive position and on new product development

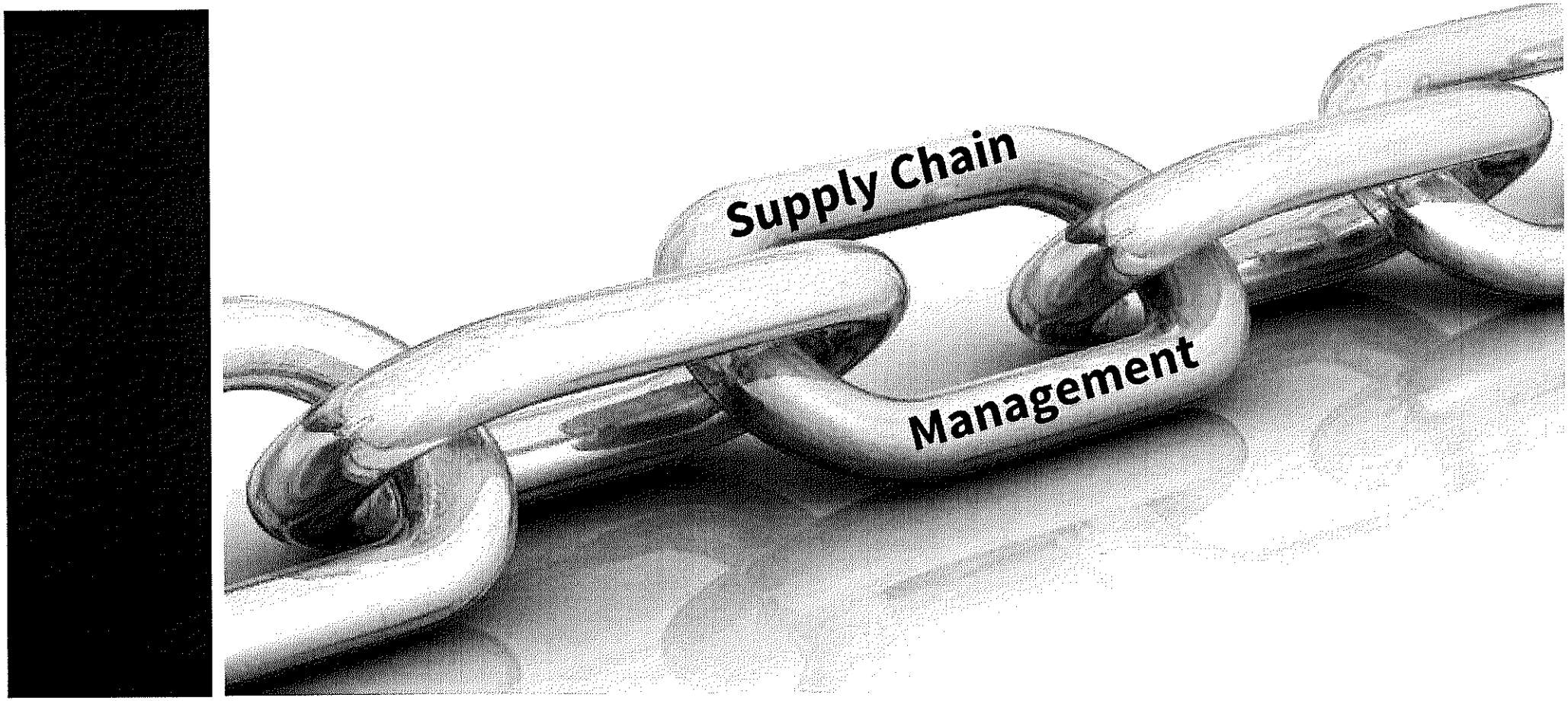
B. **Acceptable**: require a plan from these suppliers outlining how they will achieve preferred status

C. **Developmental**: require corrective actions from these suppliers on how they will achieve acceptable level. Look for alternative suppliers if these do not achieve acceptability within a fixed period of time, e.g., 3 months.

Weighted-Criteria Evaluation System Example *(cont.)*

Supplier Scorecard Used for the XYZ Company

Performance Measure	Rating	x Weight	= Final Value
Quality Defects (PPM)	90	**0.25**	22.50
Delivery OTIF	85	0.20	17.00
Cost	**80**	0.15	12.00
Responsiveness	**95**	0.10	9.50
Innovation	85	0.10	8.50
Corporate Social Responsibility	90	0.10	9.00
Customer Complaints	90	0.10	9.00
Total Score		**1.00**	**87.50**



Manufacturing

Manufacturing

To process or make **raw materials or components into a finished product**, especially by means of a large-scale industrial operation, i.e., mass production.

- Manufacturing involves the entire process of converting the raw materials or the components into a finished goods item, including; the machines used, the personnel involved, inventory handling, warehousing, etc.

Companies must develop a manufacturing strategy that suits the **type(s) of products** that they produce, their **customer's expectations**, and their **strengths**.

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Postponement Strategies

Postponement strategies provide the greatest opportunity to **minimize the risks of stock outs** or **excess inventory** by leaving the **final configuration** of a product to the **last possible moment** and moving those operations **closer to the customer**.

Postponement strategies work to **reduce the risk** of a supply chain performance issue.

- The goal of postponement is to supply **desirable products** to customers at a relatively **low cost** and in a responsive way.
- Provides more options to customers without increasing costs.

Postponement

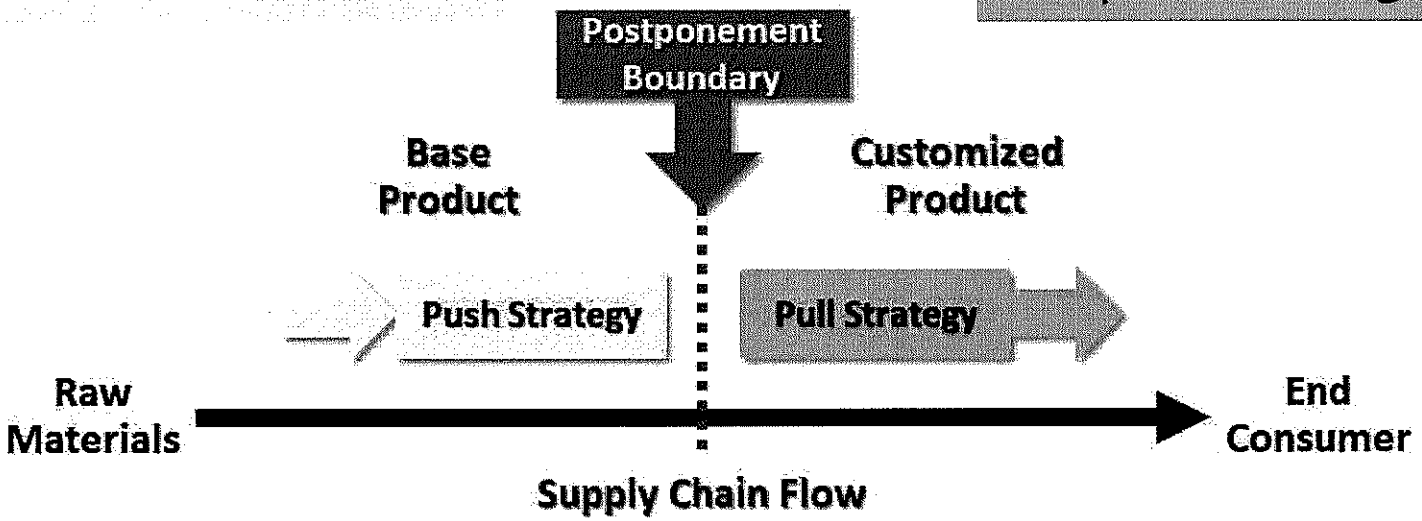
Most inventory is produced and deployed based on forecasts or planned requirements, i.e., "Push Model".

Postponement can help to **minimize wrong inventory, expedited shipping costs** and **obsolete and markdown products**.

- Postponement is a **hybrid of "Push" and "Pull" Models** designed to overcome the disadvantages of each.

Early stages of product assembly are done in a push manner

Final product assembly is done based on customer pull for specific configurations.



Postponement Strategies

Several types of postponement are common in supply chain operations:

1. **Manufacturing Postponement**
2. Assembly Postponement
3. Packaging Postponement
4. Labeling Postponement
5. Time (or Geographic) Postponement
6. Combination Postponement

Manufacturing Postponement

Where a base product is manufactured in advance of customer orders in sufficient quantities to realize economies of scale, but finalization is **delayed until after customer orders are received**.

Benefits:

- Inventories can be held at a generic level so that there will be fewer stock keeping variants and therefore less inventory in total
- Flexibility is greater – same components, modules or platforms can be embodied in a variety of end products.
- Forecasting is easier and more accurate at the generic level than it is at the finished item level

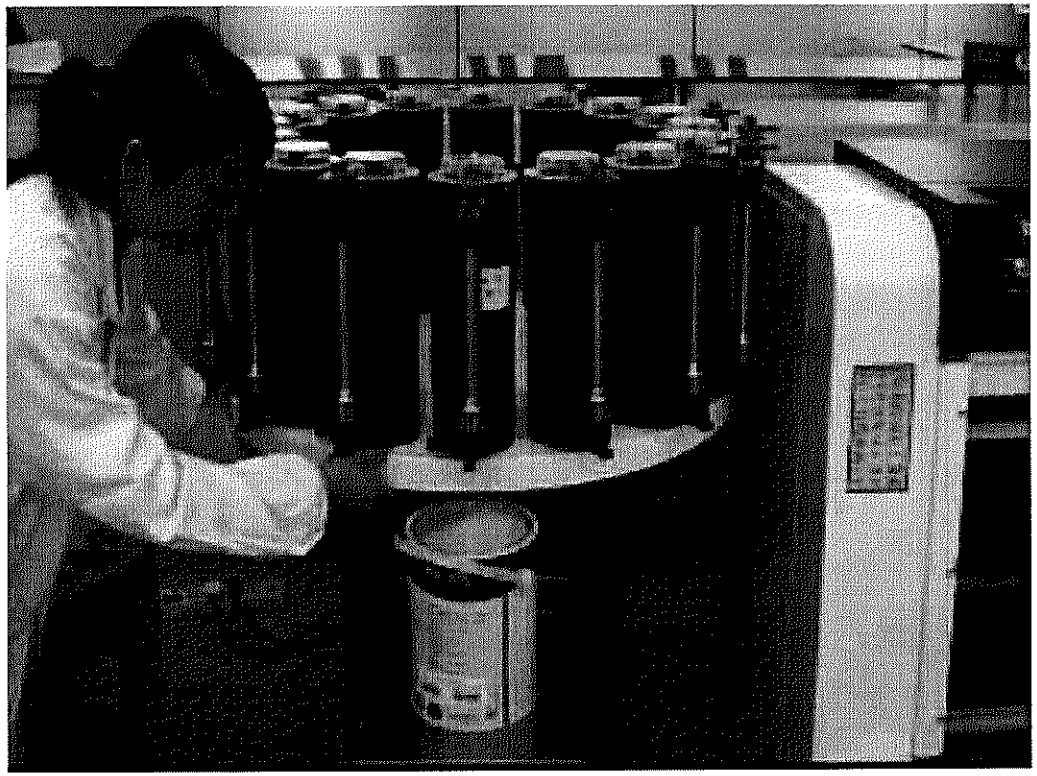
The objective is to maintain products in **an uncommitted status** as long as possible, while building a sufficient quantity of **"ready to customize"** basic units

Manufacturing Postponement Examples

One of the first commercially viable examples of manufacturing postponement was mixing paint colors at retail stores to accommodate individual customer request.

Perfecting the in-store mixing process dramatically reduced the number of stock keeping units (SKUs) required at retail paint stores.

Rather than trying to maintain inventories of premixed color paint, in every possible texture and in various volume containers, retail stores **stock a base paint and customize the color** to accommodate specific orders.

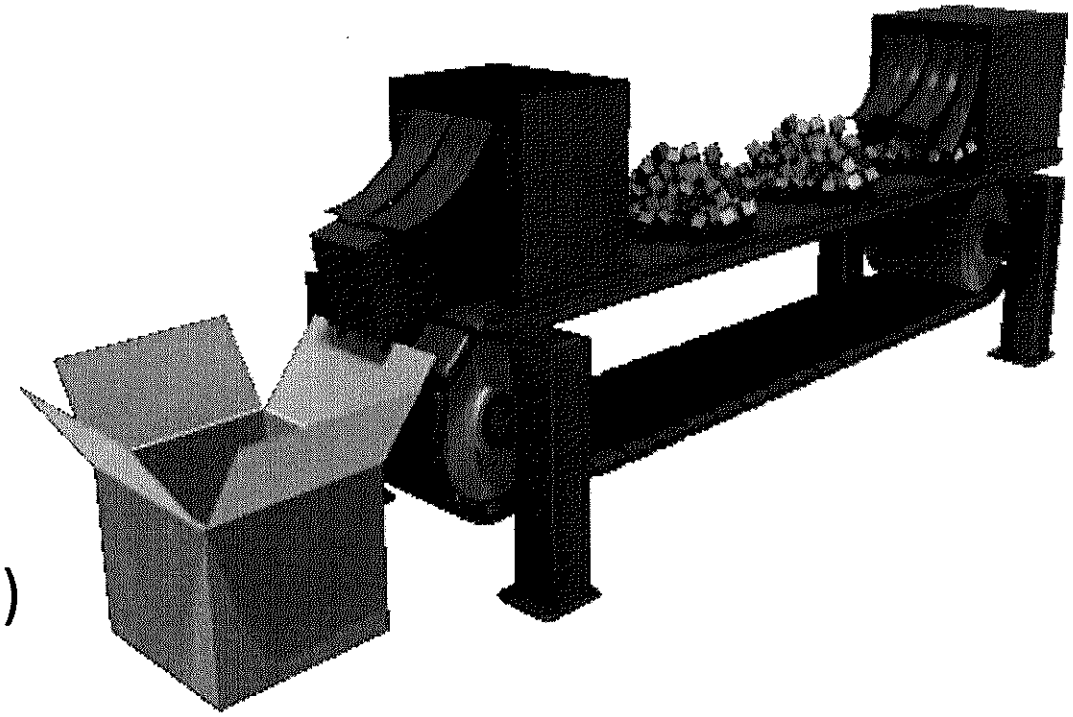


Major Manufacturing Strategies

Make-to-Stock (MTS)

Make-to-Order (MTO)

Assemble-to-Order (ATO)



Engineer-to-Order (ETO)

Make-to-Stock (MTS)

Make-to-Stock (MTS) - means to **manufacture products for stock** based on demand forecasts. Push system.

- Since accurate forecasts will prevent creating **excess inventory** and avoid **stockouts**, the critical issue is how to forecast demands accurately.

- Most daily necessities such as foods, sundries, and textiles are MTS-type products.

- The challenge of MTS is to **avoid having excess inventory**.

- Companies that operate with a MTS model tend to **hold more inventory just in case they need it**, therefore, they struggle to ensure that inventory levels don't get out of control.

Make-to-Order (MTO)

Make-to-Order (MTO) is a manufacturing strategy in which manufacturing starts only **after a customer's order is received**.

— This strategy creates additional wait time for the customer to receive the product, but allows customers to purchase products that are **customized** to their specifications.

- The MTO strategy **relieves** the problems of **excessive inventory** that is common with the Make-to-Stock strategy.

— MTO is **not appropriate for all types of products**.

- It is not appropriate for products where customers expect immediate availability/delivery. Example: Grocery items
- It is appropriate for highly configured products. Examples: aircraft, ocean vessels, bridges, or products that are very expensive to keep in inventory

Assemble-to-Order (ATO)

Assemble-to-Order (ATO) is a manufacturing strategy where products ordered by customers are produced quickly and are **customizable** to a certain extent.

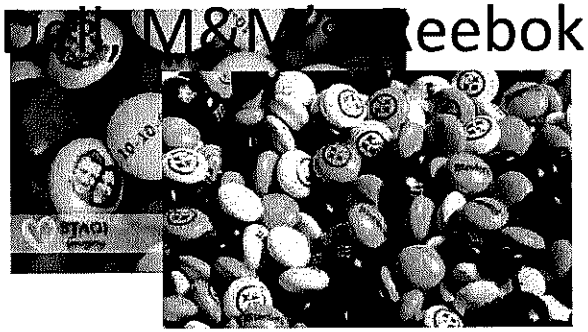
- The ATO strategy requires that the basic parts for the product are already manufactured but not yet assembled.
- Once an order is received, the parts are assembled quickly into the finished product which is then sent to the customer.
- Example: Dell Laptop Computers

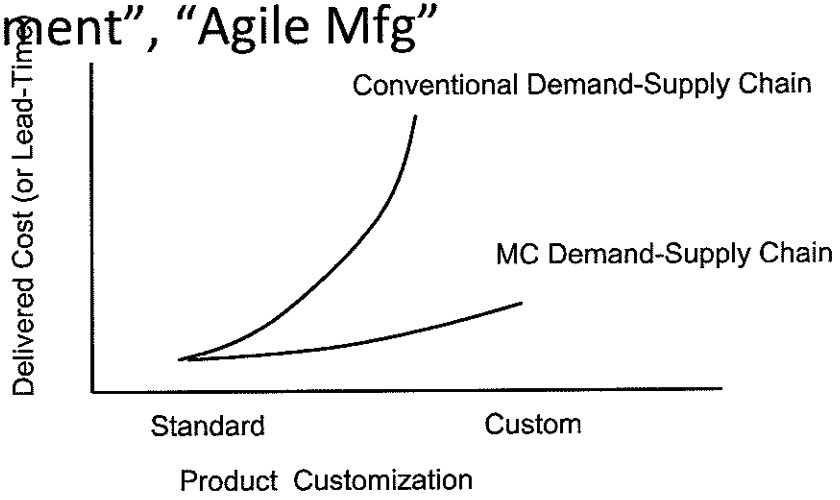
- ATO is a **hybrid strategy**, attempting to combine the benefits of both **Make-to-Stock** and **Make-to-Order** strategies, getting products into customers' hands quickly while allowing for some customization to take place.

Mass Customization: What Is It?

Individually customized products being produced at the low cost of standardized, mass produced goods.

- Mass customization produces a unique product quickly and at a **low cost** using a **high volume production process**
- Objective
  - Increase variety for customer while realizing the cost advantages of high volume continuous and line flow processes
  - "On-Demand", "To Order", "Postponement", "Agile Mfg"
- Examples: Dell, M&M's, Reebok





Mass Customization: Where Does It Work?

- Market Characteristics:
  - Sufficiently **large customer segment** that values "translatable variety"
  - Turbulent, dynamic market
  - Unpredictable demand - but not entirely unpredictable
  - Little impact of regulation or other constraints
- Product/Process Characteristics:
  - Modular or adjustable **product building blocks**
  - Predictable components/functions interactions
  - Standardized process/skill building blocks

Benefits of Mass Customization

Benefits

Profits: By providing tailored products to meet particular needs, focus shifts from price to benefits. While it is possible to manufacture at a mass produced price, you have the option to charge a premium while still retailing below the price of a custom product.

Lower Costs: Mass customization allows the ordinary person to acquire a product that has been produced to meet their own particular needs yet at a competitive price – providing exceptional value for money.

Inventory: As the concept of mass customization is for heterogeneous market, there is no extra inventory accumulation. Only required inventory is ordered in order to make customized goods, which helps in reducing inventory cost and spoilage.

Market Exploitation: Lead customers will provide a rich source of new ideas that can be exploited with other customers or with new prospects. Companies will forge close relationships with their suppliers, distributors and customer as they return again for further unique products.

Disadvantages of Mass Customization

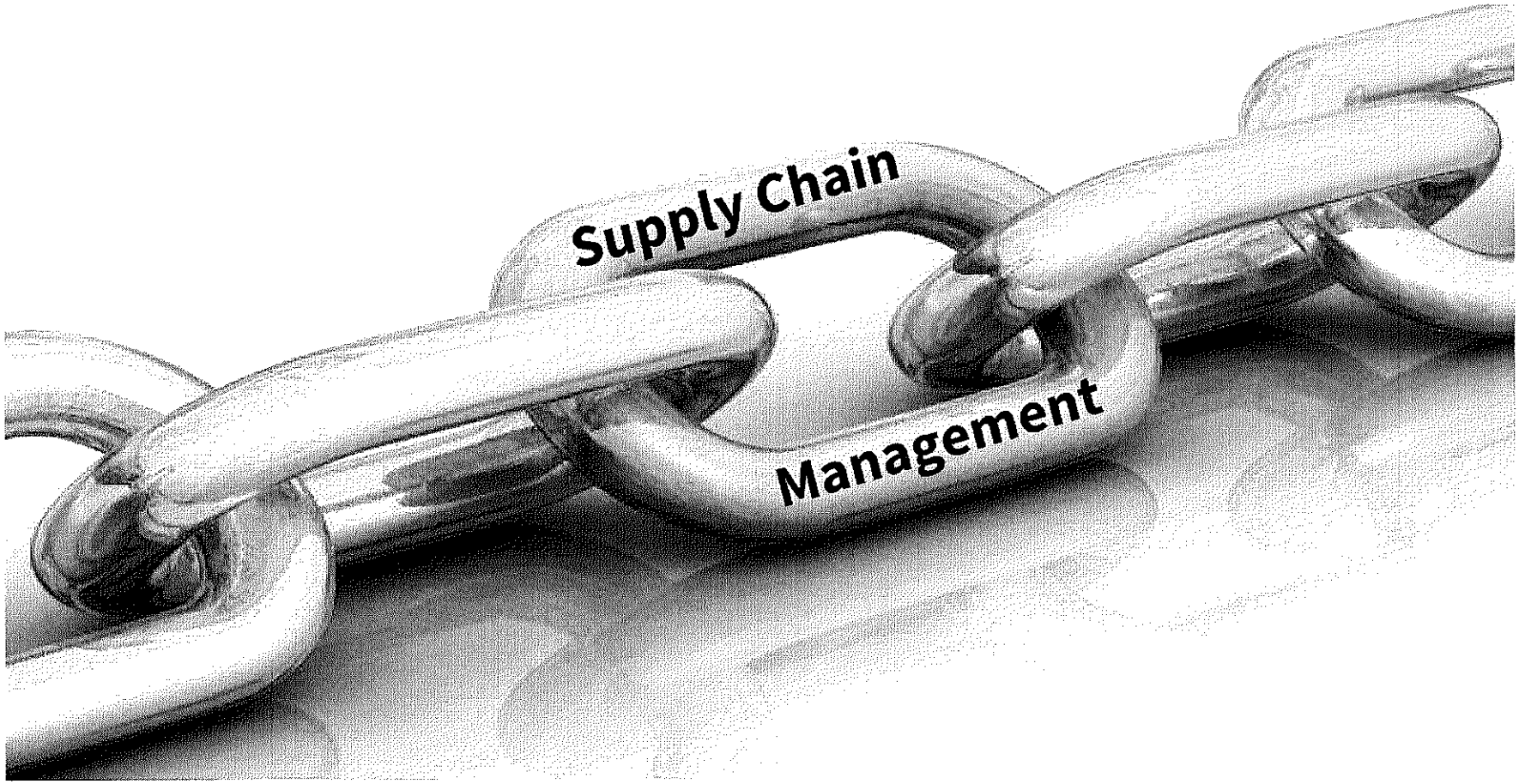
Disadvantages

Communication: Getting information from customers is not an easy job

Logistics: The logistics of distributing the right product, to the right customer, at the right time, at a reasonable price, is very difficult

Process: The production process must be flexible. Since usually only certain stages of production are flexible, only some attributes of the product can be customized.

Costs: Increase in material and manufacturing costs



Transportation

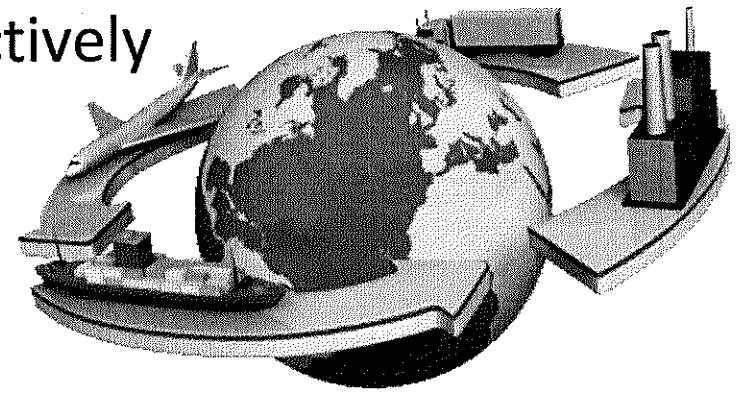
Transportation

The function of planning, scheduling, and controlling activities related to the mode, carrier, and movement of inventories into and out of an organization. *(APICS Dictionary)*

Get the right product, to the right place, at the right time by ensuring the product is moved as efficiently as possible from point-of-origin to point-of-destination.

Objectives of Transportation:

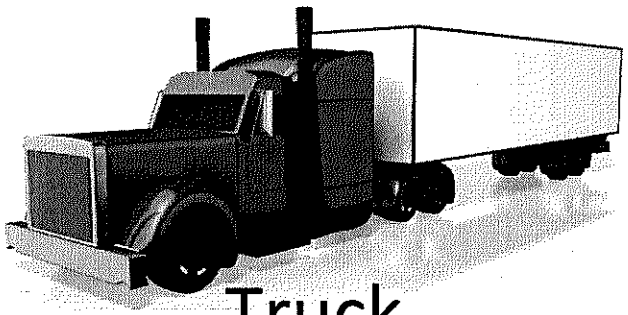
1. To maximize the value to the company through price negotiations
2. To make sure service is provided effectively
3. To satisfy customers' needs



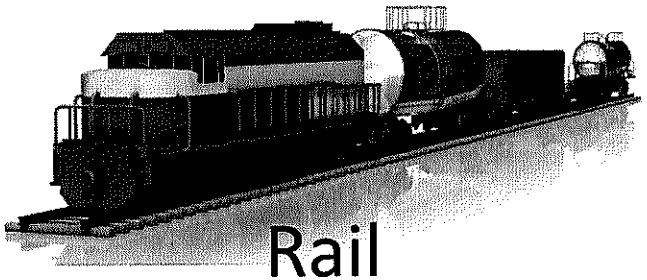
Modes of Transportation

"**Mode**" refers to the **way** in which goods are transported

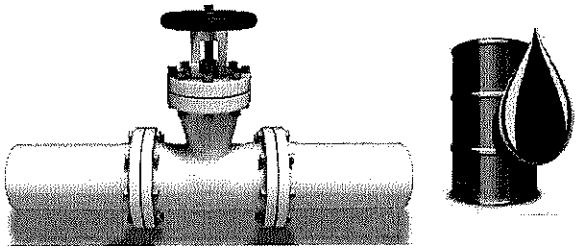
"**Carrier**" refers to the **company** that transports the goods



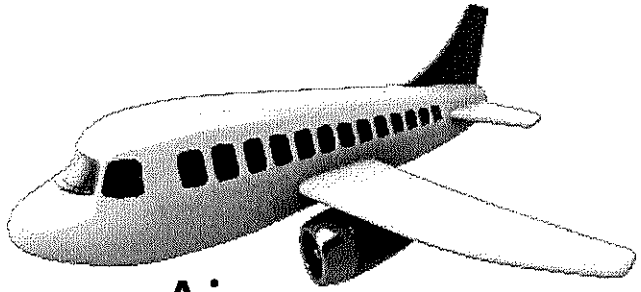
Truck



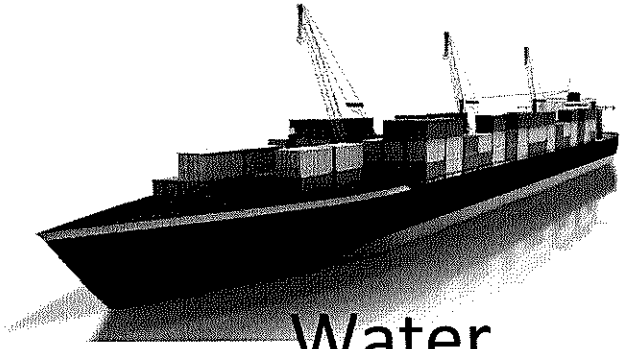
Rail



Pipeline

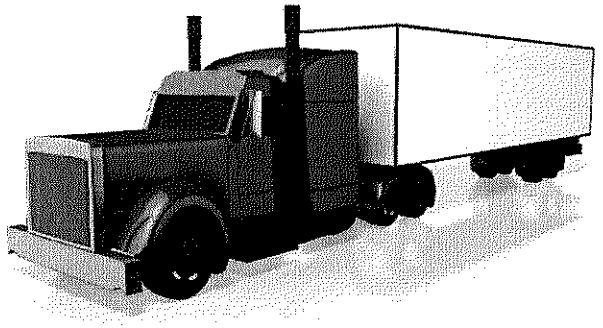


Air



Water

Modes of Transportation - Truck



- **Most flexible mode of transportation**
- **Carries > 80% of U.S. Freight**
  - Because of interaction with other transportation modes to and from ports & warehouses
- Carries nearly anything from packaged household goods, to building materials, to liquid petroleum, etc.
- Competes with Rail and Air for short-to-medium hauls.
  - **Short Haul** = 0 - 200 miles from the driver's home terminal
  - **Long Haul** = over 200 miles from the driver's home terminal
- Impacted by the truck driver shortage and Hour-of-Service rules

Modes of Transportation – Truck *(continued)*

General Freight Carriers - A trucking company which handles a wide variety of commodities in standard trailers. Freight is generally palletized.

- ✔ These can be LTL or FTL carriers. *[see next slide for definition]*
- ✔ They carry the majority of goods shipped.
- ✔ Does not require the use of specialized equipment.

Specialized Carriers - A trucking company which handles the movement of cargo that requires specialized equipment for transportation because of the shipment's size, weight and shape.

- ✔ Transport commodities like liquids, petroleum, household goods, building materials, and other specialized items.

Less-Than-Truckload (LTL)

Less-Than-Truckload (LTL) is the transportation of relatively small freight which does not require the space of an entire truck.

- Typically, freight in the range of 150 lbs. to 20,000 lbs.
- LTL carriers operate under the premise of **sharing the trailers capacity among multiple shippers**.

1. The LTL carrier collects freight from multiple shippers located along the driver's assigned route.
2. The truck then returns to the pickup terminal, where it joins with other trucks that collected freight from other shippers.
3. All the trucks are unloaded and the freight is sorted and reconfigured by destination.
4. Freight is then reloaded and delivered. Drivers will also collect more freight along the assigned route while making deliveries.

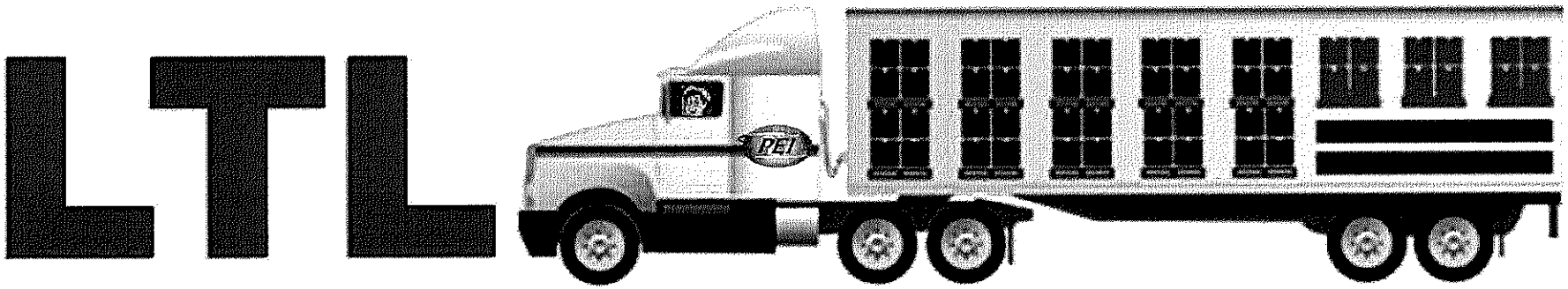
Less-Than-Truckload

Advantages:

- ✔ Can be cost effective. Don't pay for a whole truck if you don't need one.
- ✔ There are more available carrier options.
- ✔ Ideal for small businesses.

Disadvantages:

- ✔ Increased risk of theft or damage.
- ✔ Increased **shipping times and delays** as other shipper's freight will be on the same truck with your freight. Additional pick-ups and deliveries



LTL (less-than-truckload) are loaded with freight from multiple customers going to multiple destinations

Full-Truckload (FTL)

Full-Truckload (FTL) is the transport of goods that fill up a full truck, or a partial load shipment occupying an entire truck. The cargo is typically homogeneous and stays on the same vehicle from the origin to the destination

This is a "one-touch" door-to-door service, collecting freight at an origin and delivering it directly to the destination **without any intermediate stops**.

Advantages:

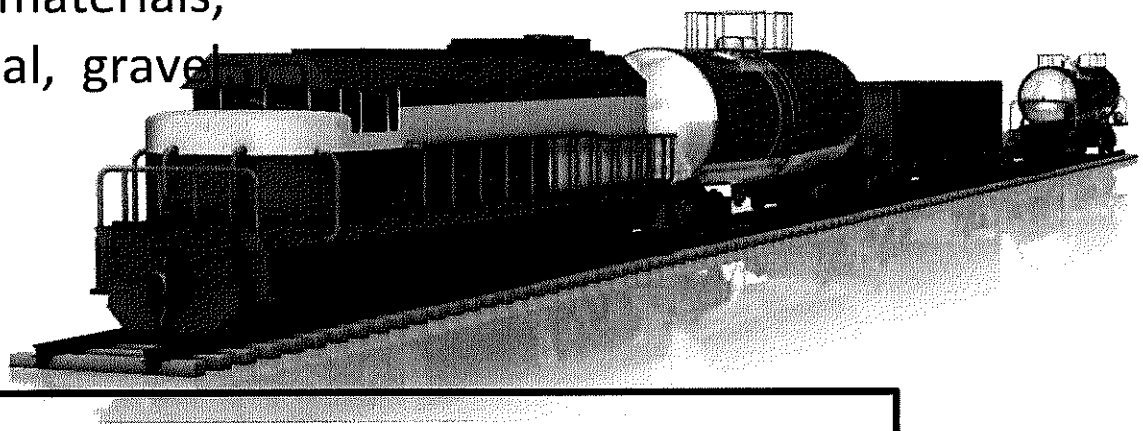
- ✔ Best way to transport large shipments.
- ✔ Ideal for high risk or delicate freight shipments.
- ✔ Considerably faster than Less-than-Truckload (LTL).

Disadvantages:

- ✔ Costs more than LTL
- ✔ Fewer options available

Modes of Transportation - Rail

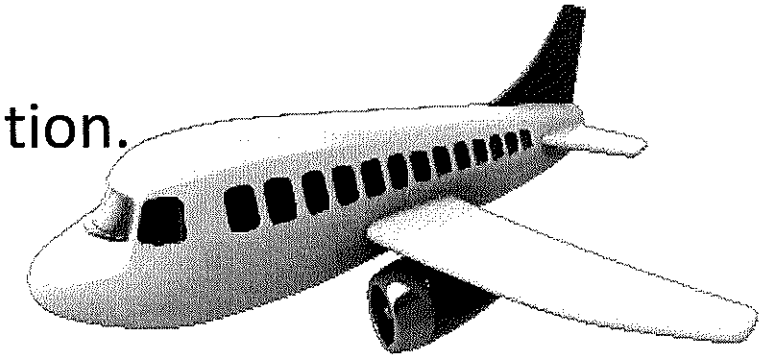
- Accounts for approximately 9% of total US freight spend.
- Competes for transportation when the **distance is long** and the shipments are **heavy or bulky**.
  - ✔ Shipments involve building materials, construction equipment, coal, gravel, sand, lumber, etc.
  - ✔ Aging infrastructure and equipment are an issue.



- **Rail is slow and inflexible but it has the most capability**
- Paired with trucks for door-to-door delivery.
  - ✔ As a result, rail carriers have begun purchasing motor carriers and can now offer point-to-point pickup and delivery service.

Modes of Transportation - Air

- Accounts for approximately 5% of total US freight spend
- Generally the **fastest** mode of transportation.
- Most **expensive** mode of transportation



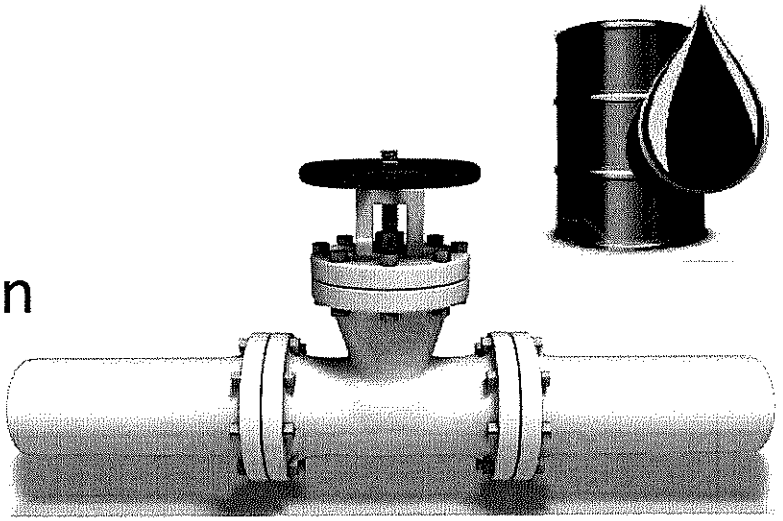
- Cannot carry extremely heavy or bulky cargo.
  Ideally, items with a **high cost to weight ratio**.

  ✔ Shipments involve very light, high-value goods that need to travel long distances quickly including; jewelry, fine wines, pharmaceuticals, racehorses, etc.

- Half of the goods transported by air are carried by freight–only airlines, e.g., FedEx. Other half in passenger planes with luggage
- Paired with trucks for door-to-door delivery

Modes of Transportation - Pipeline

- Accounts for approximately 2% of total US freight spend
- Most **reliable** form of transportation
- Lowest **per unit cost** for transportation
- Limited variety of commodities.



- Materials are transported in a **liquid or gaseous state**; petroleum, natural gas, drinking water, gasoline
- Little maintenance needed once the pipeline is running.

Modes of Transportation - Water

- Accounts for approximately 5% of total US freight spend
- Includes inland waterways, coastal and intracostal, and deep-sea cargo shipments.
- **Inexpensive**
- **Very slow and inflexible**.

- Primarily used for **heavy**, **bulky**, **low value** materials like coal, grain, sand, and petroleum.

✔ However, because transport by water is so cheap almost any item may be shipped by water including: automobiles, produce, containerized cargo, etc.

Ocean Transportation

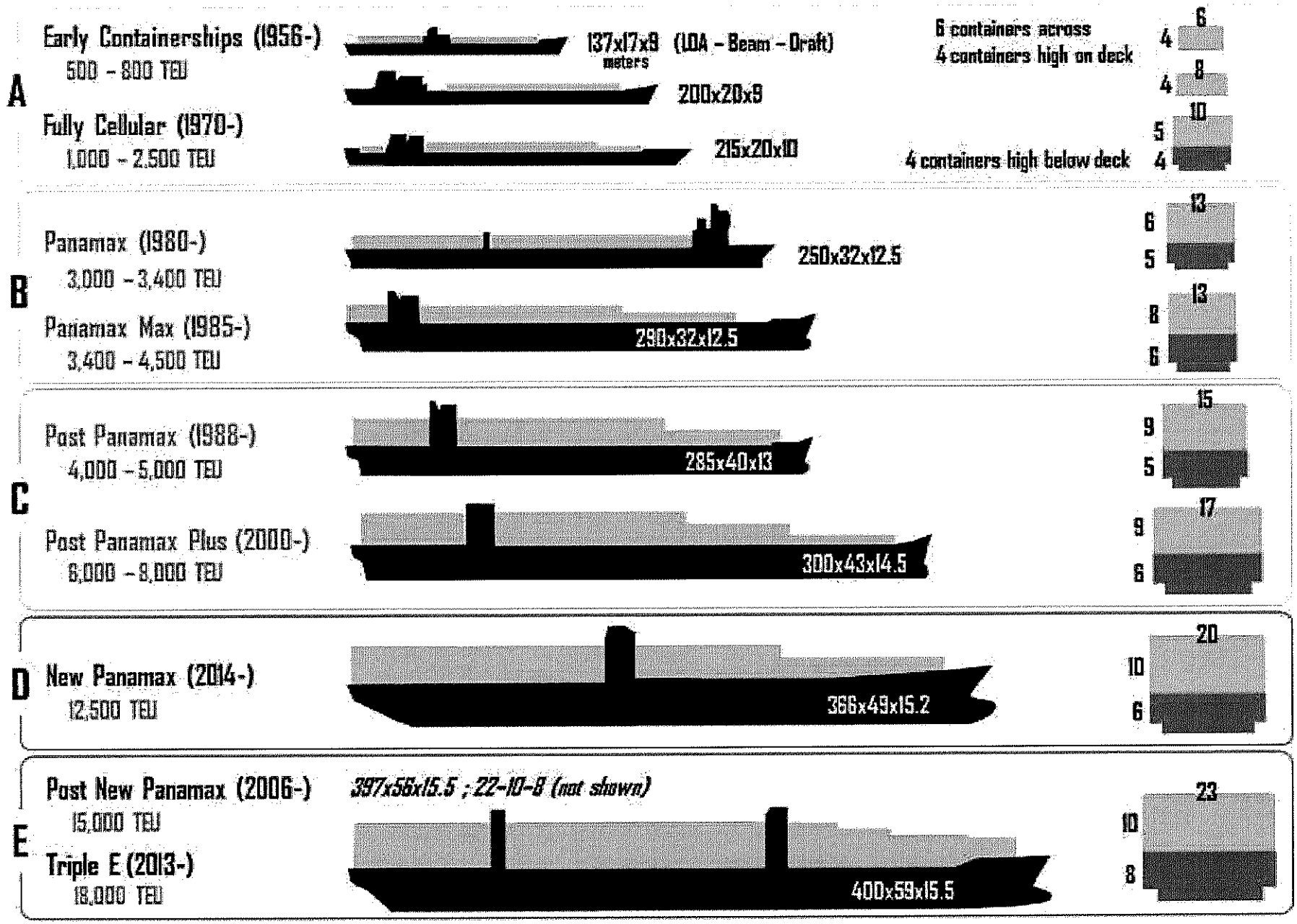
- Traversing the oceans of the world to move cargo can take weeks. **Very slow and inflexible**. Ocean vessels typically travel at speeds from 20 to 24 knots (23 – 28 miles per hour).

- In recent years ships have been "**Slow-Steaming**" - reducing their speeds to improve fuel efficiency and reduce carbon emissions, but speed is not usually the highest priority as customers are seeking the lowest price, and predictable, reliable delivery.

- Water transport competes with rail and pipeline for some cargo shipments.

- Paired with trucks for door-to-door delivery.

Evolution of Container Ships

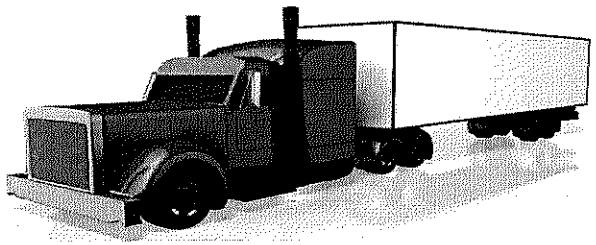


Ranking of Transportation Modes

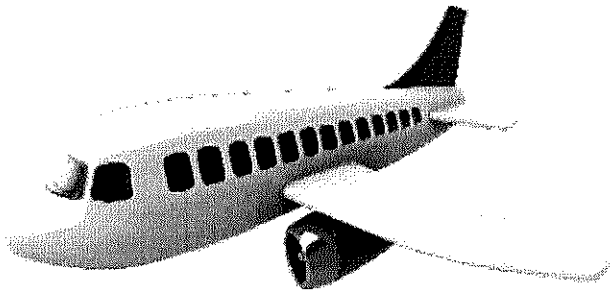
1 to 5 = Best to Worst

	Accessibility	Capability *(can handle the most kinds of freight, i.e., weight, size, type, etc.)*	Lowest Per-unit Cost	Reliability	Speed	Total
Truck	**1**	2	4	2	2	**11**
Rail	2	**1**	3	3	3	**12**
Pipeline	5	5	**1**	**1**	4	**16**
Air	3	4	5	4	**1**	**17**
Water	4	3	2	5	5	**19**

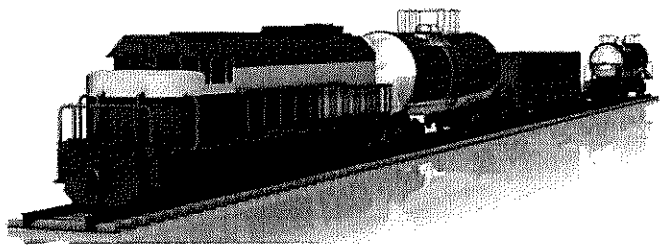
Containerized Cargo Capacity Comparisons



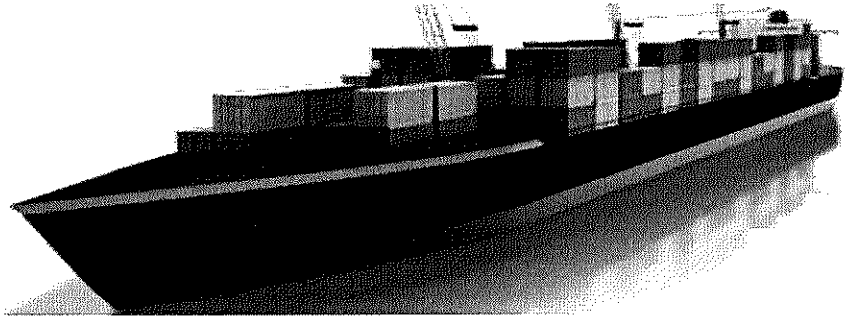
Truck *(53 foot Trailer)*
2.65 TEU's



Air *(DC-8 to 767)*
4 – 6.5 TEU's



Rail *(40 to 100 flatcars)*
40 - 200 TEU's



Water *(Panamax to Triple E)*
3,000 – 18,000 TEU's

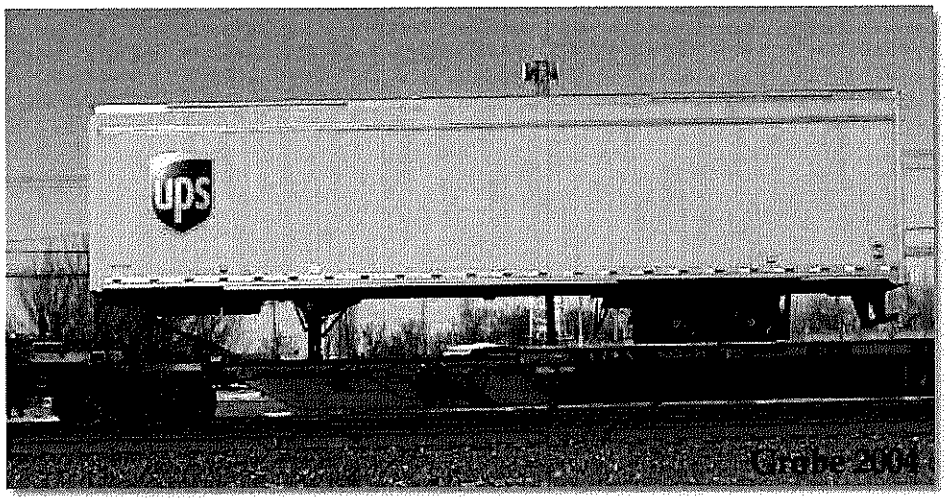
Intermodal Transportation

Intermodal is sometimes referred to as the sixth mode of transportation, but it is really the use of **multiple modes of transportation to execute a single transport shipment**.

- Intermodal is growing substantially because it is fairly cost-efficient and cost-effective.
- The most common forms of intermodal transportation involve:
  - Rail and Motor Carriers (i.e., trucks)
  - Rail and Water Carriers
  - Roll-on/Roll-off Ships

Intermodal Transportation *(continued)*

aka "Piggy-back" service



Rail and Motor Carriers (trucks)

Offer point-to-point pickup and delivery service known as **Trailer-on-Flatcar (TOFC)**

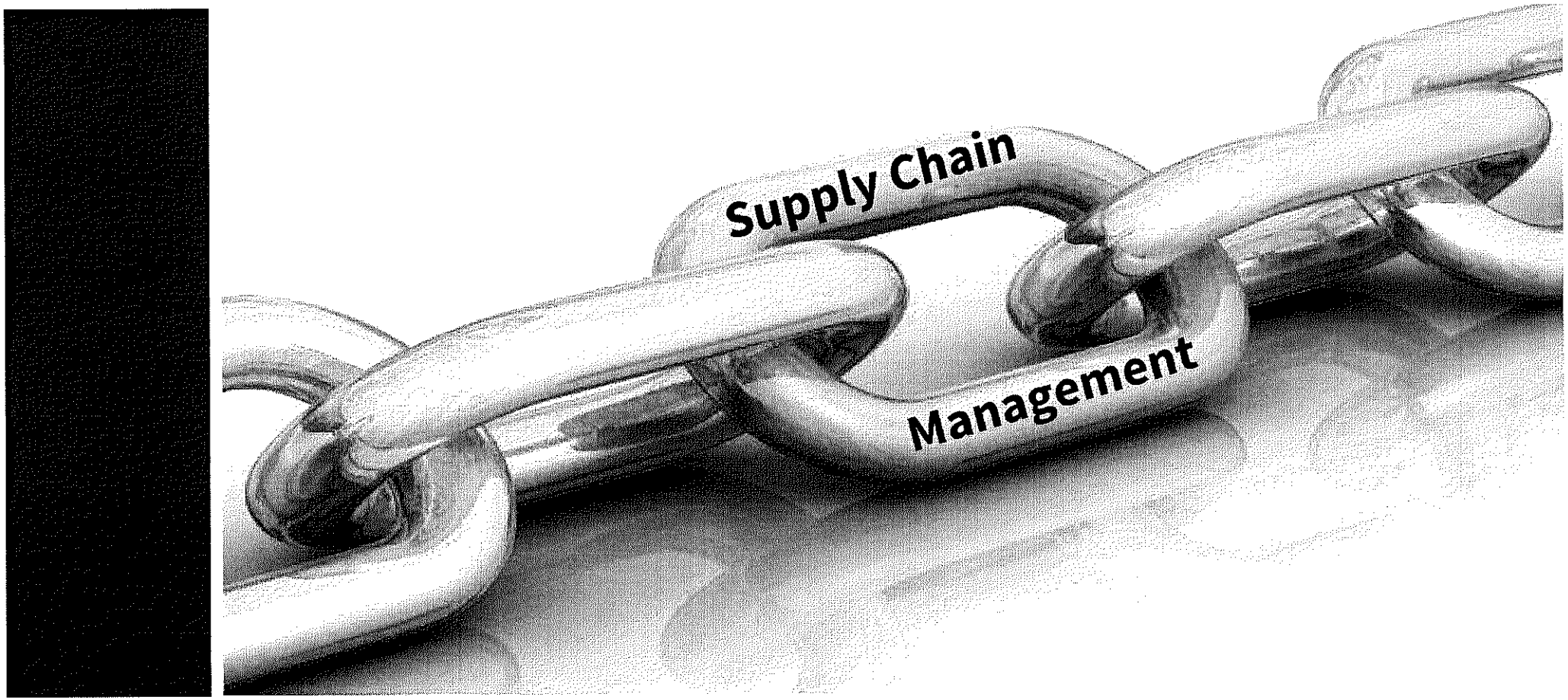
Rail and Water Carriers

Offer point-to-point pickup and delivery service known as **Container-on-Flatcar (COFC)**

Roll-On/Roll-Off Ship

specifically designed to allow trucks to be driven directly on and off the ship without the use of cranes.

Provides flexibility and speed

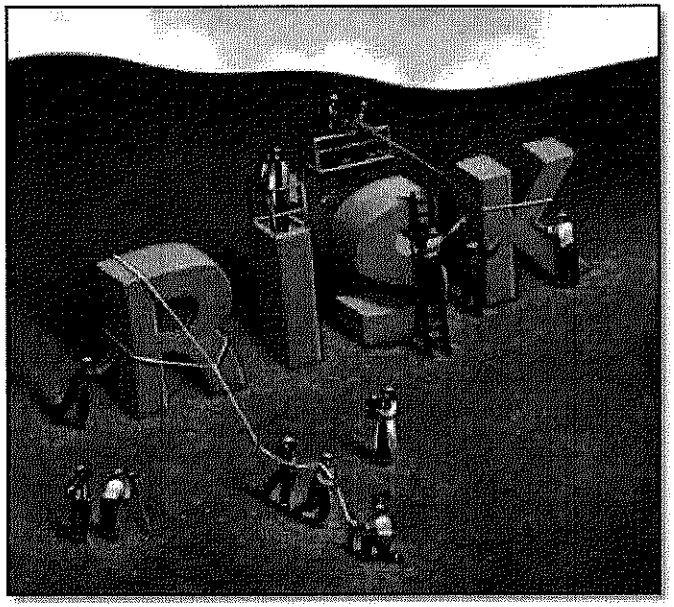


Supply Chain Risk and Resiliency

Supply Chain Risk

Supply Chain Risk:

The likelihood and consequence of damage, liability, loss, or other negative events at any point in the end-to-end supply chain, from sources of raw materials to the end use by customers.

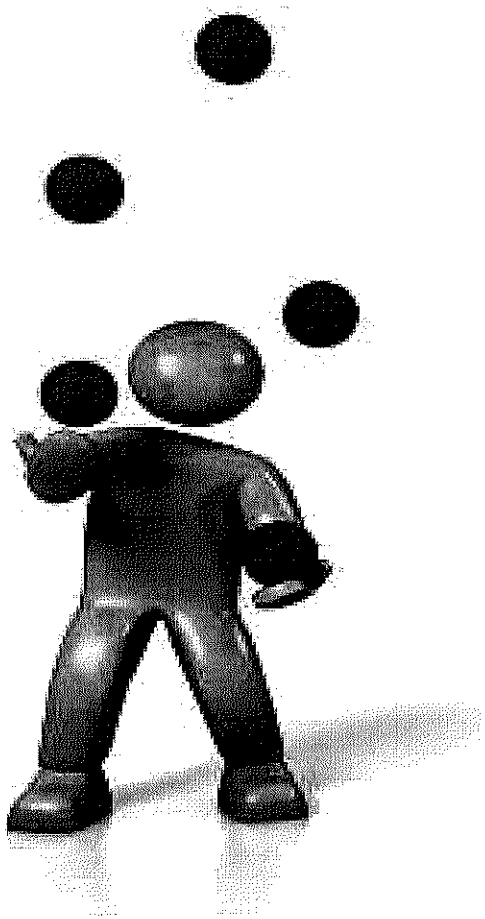


Supply Chain Risk Management:

The coordination of activities to direct and control an enterprise's end-to-end supply chain with regard to supply chain risks.

Risk is Inherent in Every Supply Chain

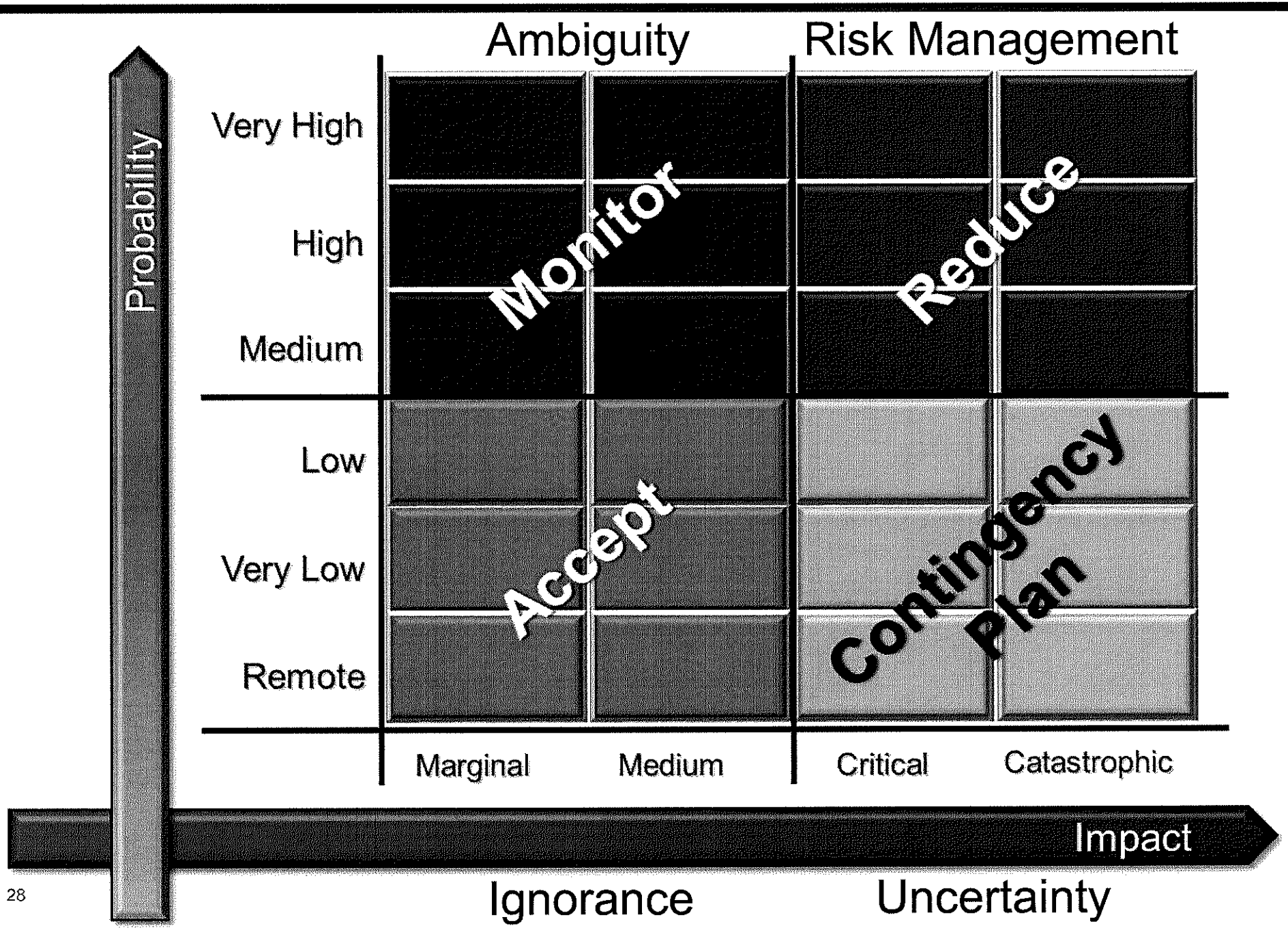
- Forecasts by their nature are inaccurate
- Suppliers (internal and external) don't always deliver on time
- Supply can get rejected, damaged, stolen, etc.
- Natural disasters happen, etc.



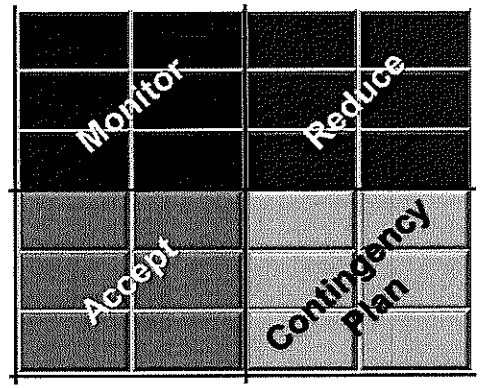
Supply Chain Risk Management

- A risk management process in the supply chain should be collaborative, involving internal and external key stakeholders from throughout the supply chain.
  - Communication and transparency of information among trading partners is critical to this collaboration.
- If you can actively manage vulnerabilities within the supply chain, risk can be significantly mitigated and minor disruptions won't turn into a major crisis.
- Nothing stays the same. Risks are not static, they must be continually managed in accordance with the dynamics of the global supply chain.

Risk Assessment



Risk Assessment *(continued)*



- **Accept**: If the Probability and Impact are both on the low end, the organization should **take no action** and accept that the risk may occur, and only deal with it if and when it does happen.
- **Monitor**: If the Probability is medium to high but the Impact is low, then the organization should **carefully monitor the risk and be ready to act** to resolve it if and when it occurs.
- **Contingency Plan**: If the Probability is low but the Impact is high, the organization should **have a pre-defined contingency plan in place** to implement immediately if the risk becomes a reality.

Mitigating Supply Chain Risks

The most common methods of mitigating supply chain risks are:

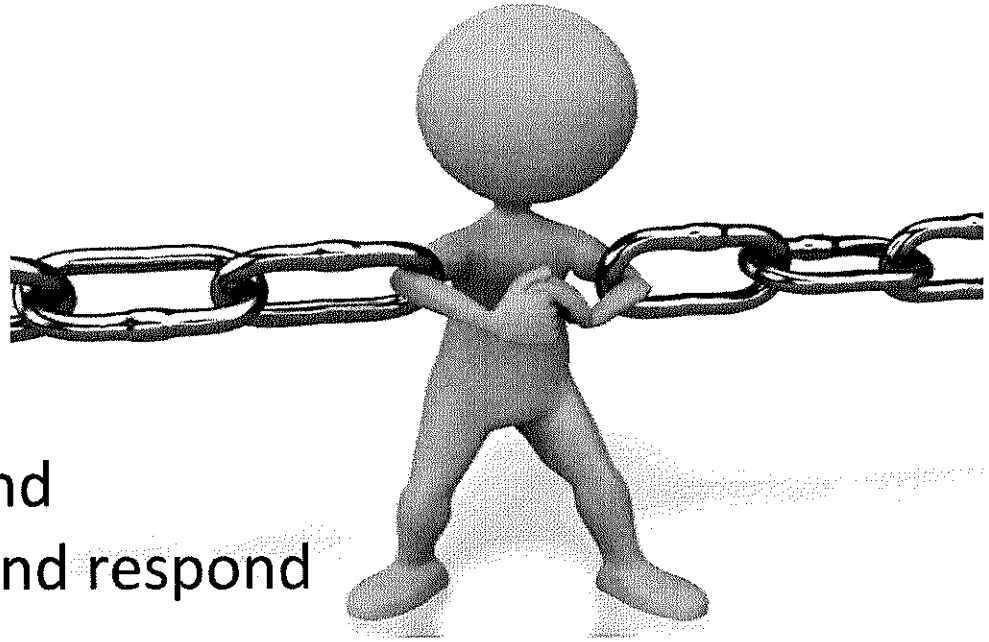
- Holding and/or increasing safety stocks - also known as stockpiling and forward buying.
  - Can be costly
  - May be used as a stopgap alternative
- Identify, qualify, and establish backup suppliers and logistics services.
  - Can create ill will with current suppliers.
  - Takes time to build relationships
  - May be used as either emergency sourcing or as multi-sourcing

Other Methods of Mitigating Supply Chain Risks

- Redesigning the product to eliminate the items at risk
- Finding alternative items to use in place of the at risk items
- Acquiring an @ risk supplier so that your company can manage the risk directly.
- Buying insurance
- Diversifying the supply base from geographically dispersed markets
- Utilizing a supply chain IT system to share information between supply chain partners
- Developing a formal risk management program

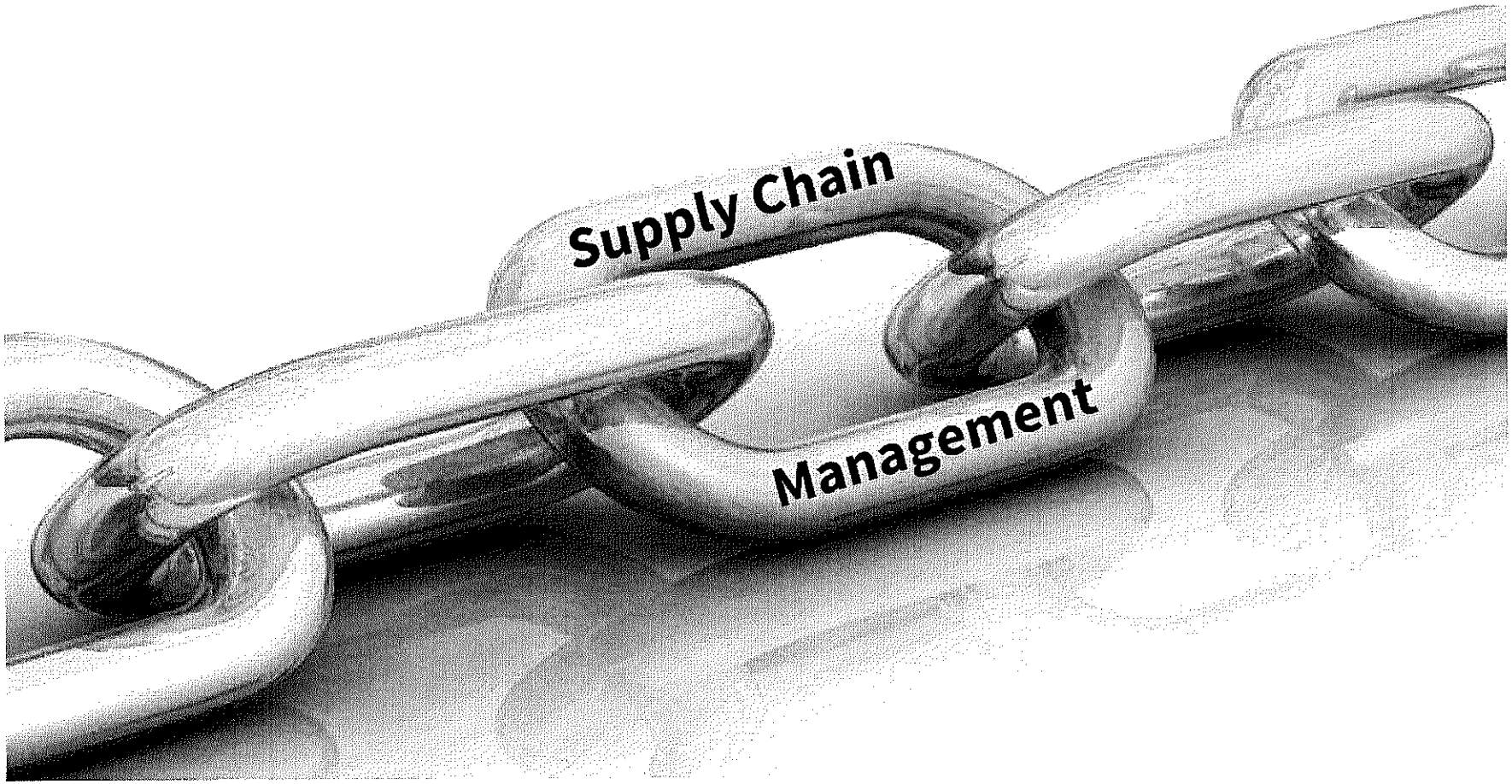
Supply Chains Need to be Secure and Resilient

Supply Chain Resiliency is the ability of the supply chain to withstand and recover from an incident



Resilient supply chains:

- Are proactive in anticipating and establishing steps to prevent and respond to security incidents
- Can quickly rebuild or reestablish alternative means of operations when they experience a security incident



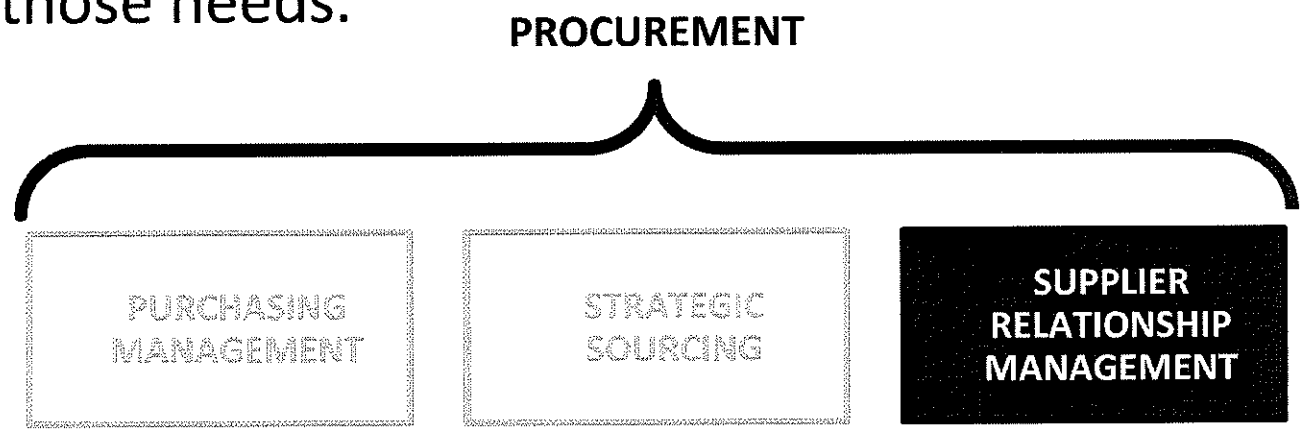
Supplier Relationship Management

R SCM Rigorous. Relevant. Renowned.
The Global Leader in Supply Chain Knowledge

Supplier Relationship Management (SRM)

The discipline of strategically planning for, and managing, all **interactions with the third party organizations** that supply goods and/or services to an organization in order to **maximize the value** of those interactions.

- Most supply professionals view SRM as an **organized approach** to **defining what they need and want from a supplier**.
- Establishing and managing the company-to-company link to obtain those needs.



Plan, Source, Make, Deliver / Return, and Enable

Supplier Relationship Management (SRM)

SRM is often a part of the rollout of Strategic Sourcing and is typically applied with suppliers:

- Providing **high volumes** of a product/service
- Providing lesser quantities of a **crucial product/service**
- That serve many **business units of a company** or organization
- Where **intensive engineering, manufacturing** and/or **logistics** interaction is essential.

Successful Strategic Partnerships

Strong Supplier Partnerships

- Important to achieving **win-win** competitive performance for the buyer and supplier
  - These require a **strategic perspective** as opposed to a tactical perspective.
- Involves "a **mutual commitment** over an **extended time** to work together to the **mutual benefit** of both parties, **sharing** relevant information and the **risks and rewards** of the relationship"

Keys to Successful Strategic Partnerships

Building Trust

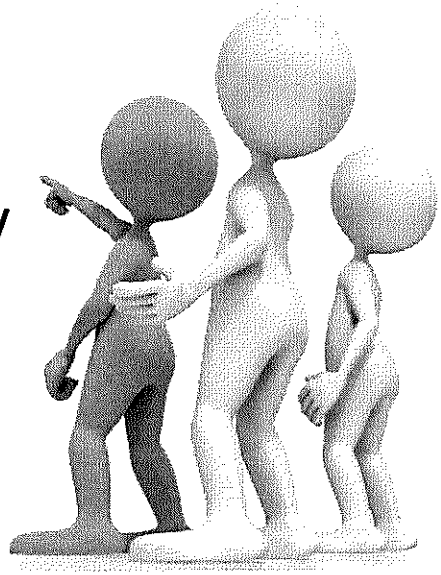
Trust is earned.

It is also easily lost, and almost impossible to regain once lost!

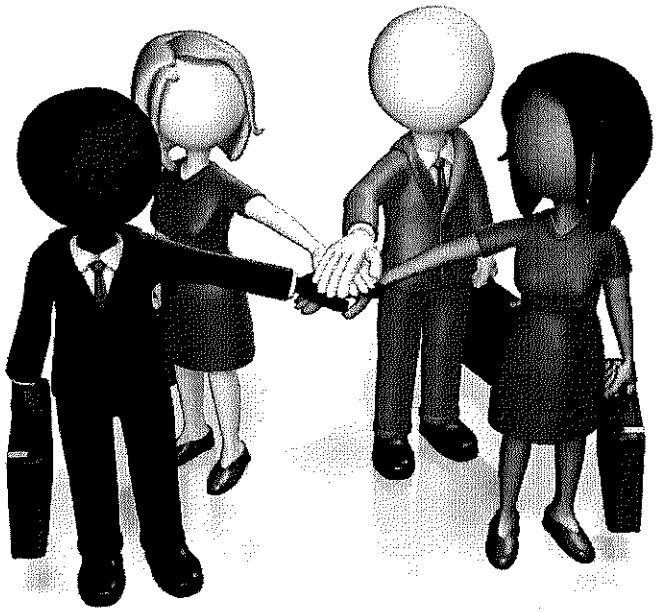
- With trust, partners are more **willing to work together**, find compromise solutions to problems, work toward achieving long-term benefits for both parties, and go the extra mile.

Shared Vision and Objectives

- Both partners must **share the same vision** and have objectives that are not only clear but mutually agreeable.
- The focus must move beyond tactical issues and toward a more strategic path to corporate success.



Keys to Successful Strategic Partnerships

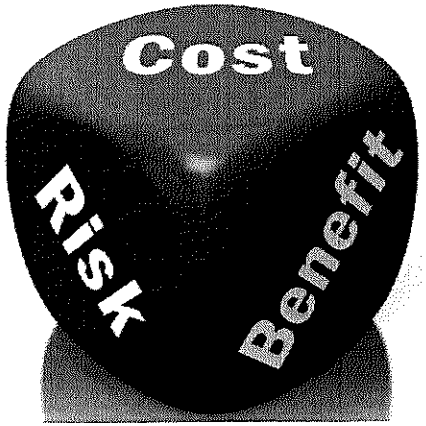


Personal Relationships

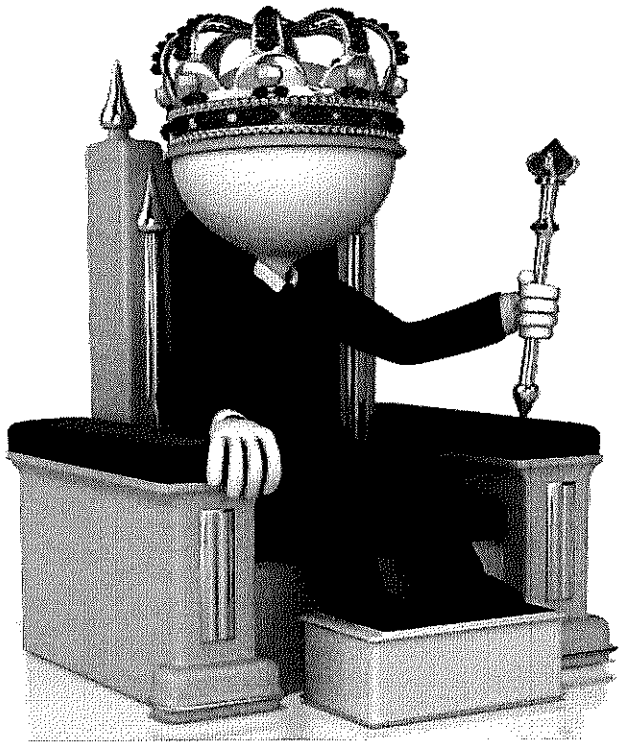
- Strategic Partnerships begin with the development of personal relationships between key people at each company
- It is people who **communicate** and make things happen

Mutual Benefits and Needs

- Partnership should **result in a win-win** situation, which can only be achieved if both companies have **compatible needs**.
- An **alliance is much like a marriage**, and if only one party is happy, then the marriage (i.e., alliance) is not likely to last

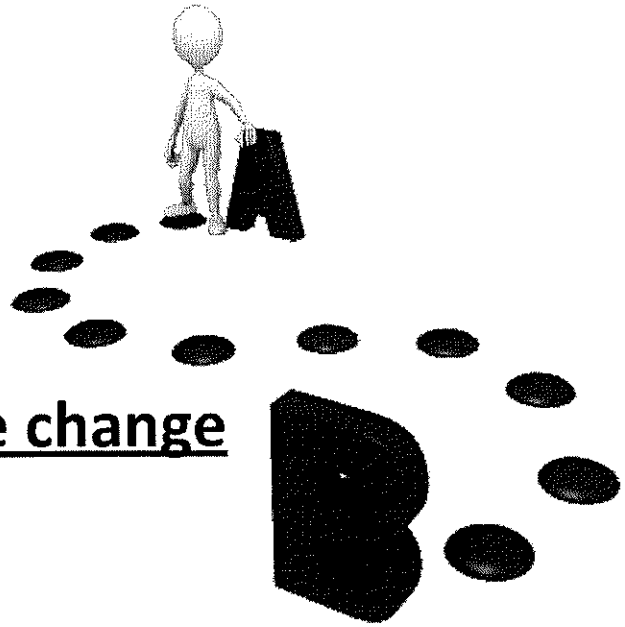


Keys to Successful Strategic Partnerships *(continued)*



Commitment and Top Management Support

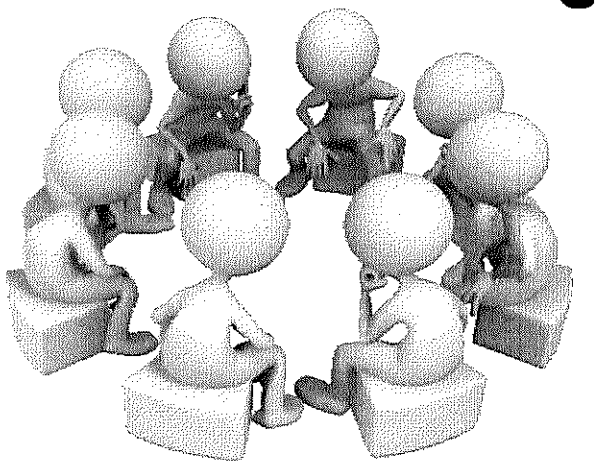
- Commitment must start at the highest management level.
- Partnerships tend to be successful when top executives are **actively supporting** the partnership



Change Management

- Companies must be **prepared to manage change** that comes with the formation of new partnerships

Keys to Successful Strategic Partnerships *(continued)*

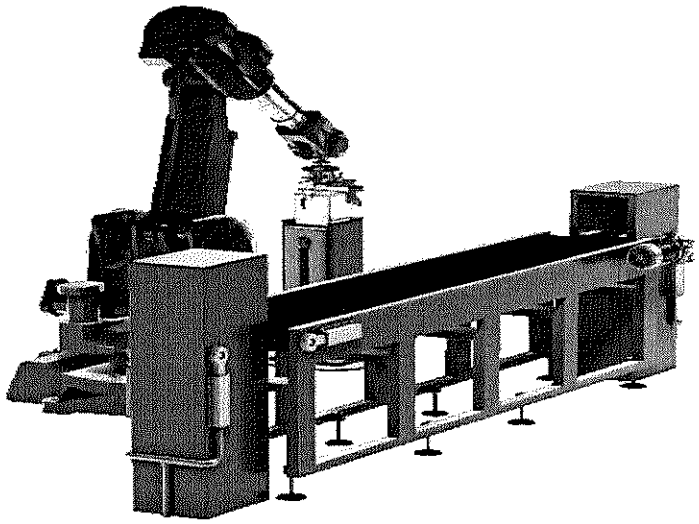


Information Sharing and Lines of Communication

- Both **formal and informal** lines of communication should be set up to facilitate the free flow of information.
- Confidentiality of sensitive information must be maintained

Capabilities

- Key suppliers must have the right **technology and capabilities** to meet cost, quality, and delivery requirements in a timely manner *(current and future)*

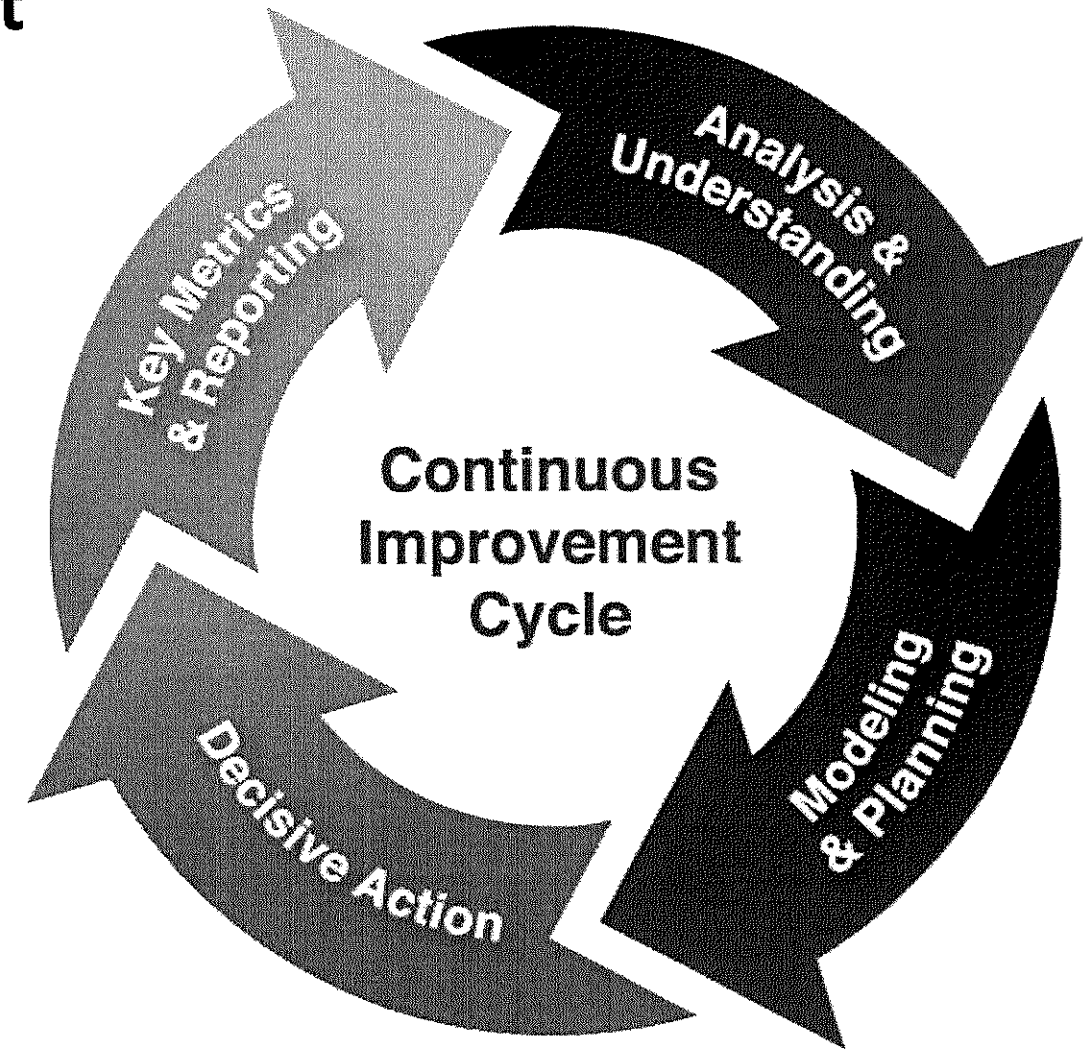


Keys to Successful Strategic Partnerships *(continued)*

Continuous Improvement

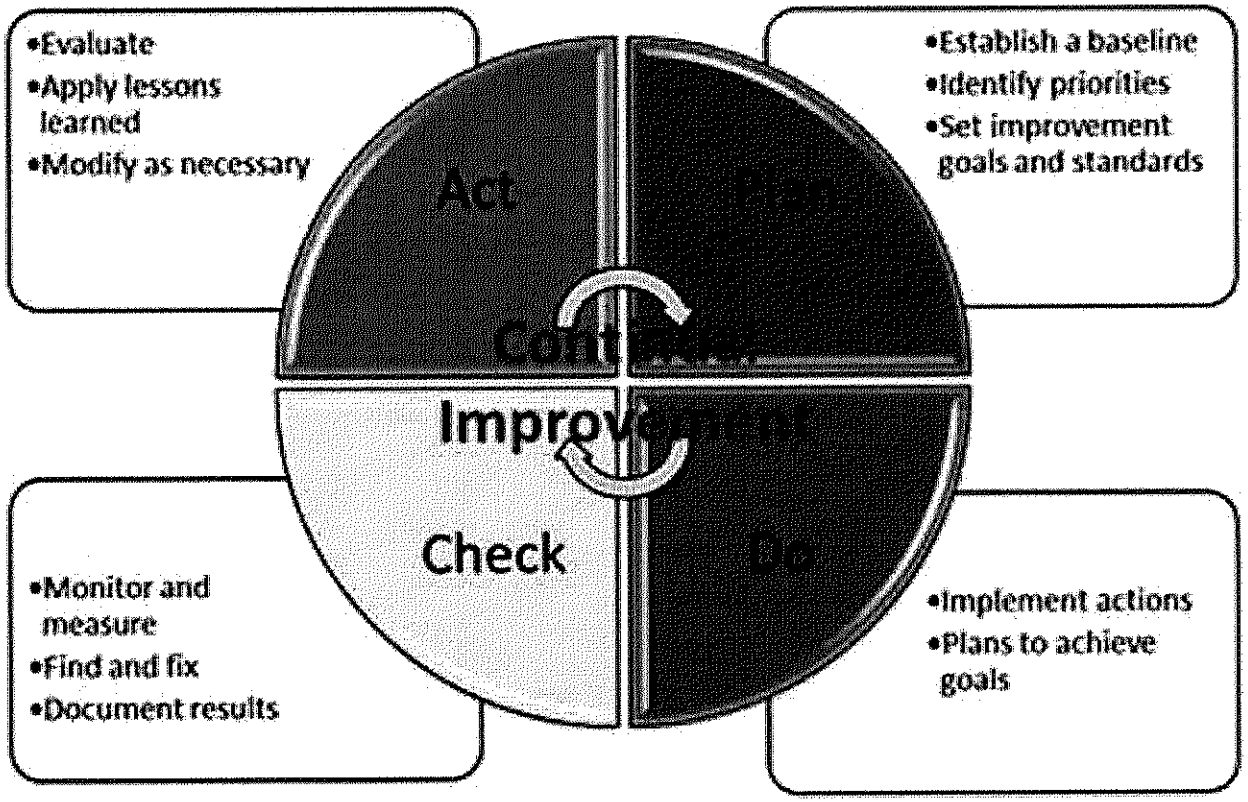
- Making a **series of small improvements** over time results in the elimination of waste in a system

- Buyers and suppliers must be **willing to continuously improve** their capabilities in meeting customer requirements



Keys to Successful Strategic Partnerships *(continued)*

The process commonly utilized in continuous improvement is; **Plan, Do, Check, & Act**



Plan: Identify an opportunity and plan for change.

Do: Implement the change on a small scale.

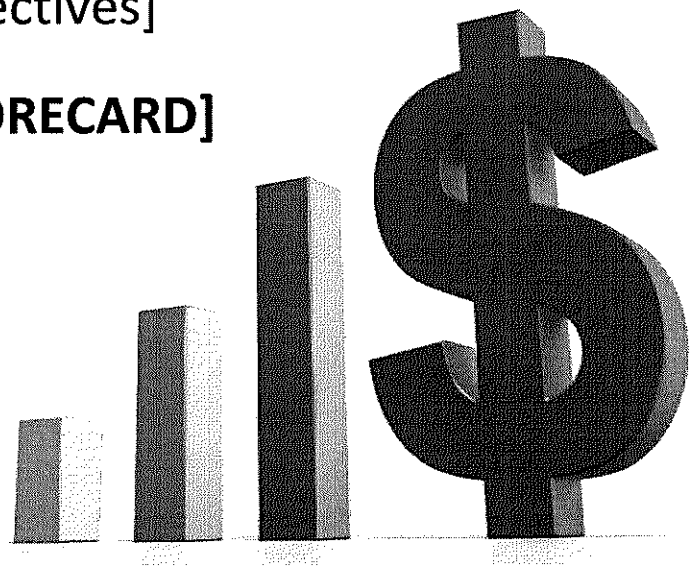
Check: Use data to analyze the results of the change and determine whether it made a difference.

Act: If the change was successful, implement it on a wider scale and continuously assess your results. If the change did not work, begin the cycle again.

Keys to Successful Strategic Partnerships *(continued)*

Performance Metrics

- **You can't improve what you can't (or don't) measure**
  - Measures related to quality, cost, delivery, and flexibility are used to evaluate suppliers.
  - Metrics should be: 1) understandable, 2) easy to measure, and 3) focused on real value-added results [S.M.A.R.T. objectives]
  - A multi-criteria approach is best **[i.e., a SCORECARD]**
- **Total Cost of Ownership**, is made up of all costs associated with the acquisition, use, and maintenance of a good or service



S.M.A.R.T. = Specific, Measurable, Achievable, Relevant, Time-oriented

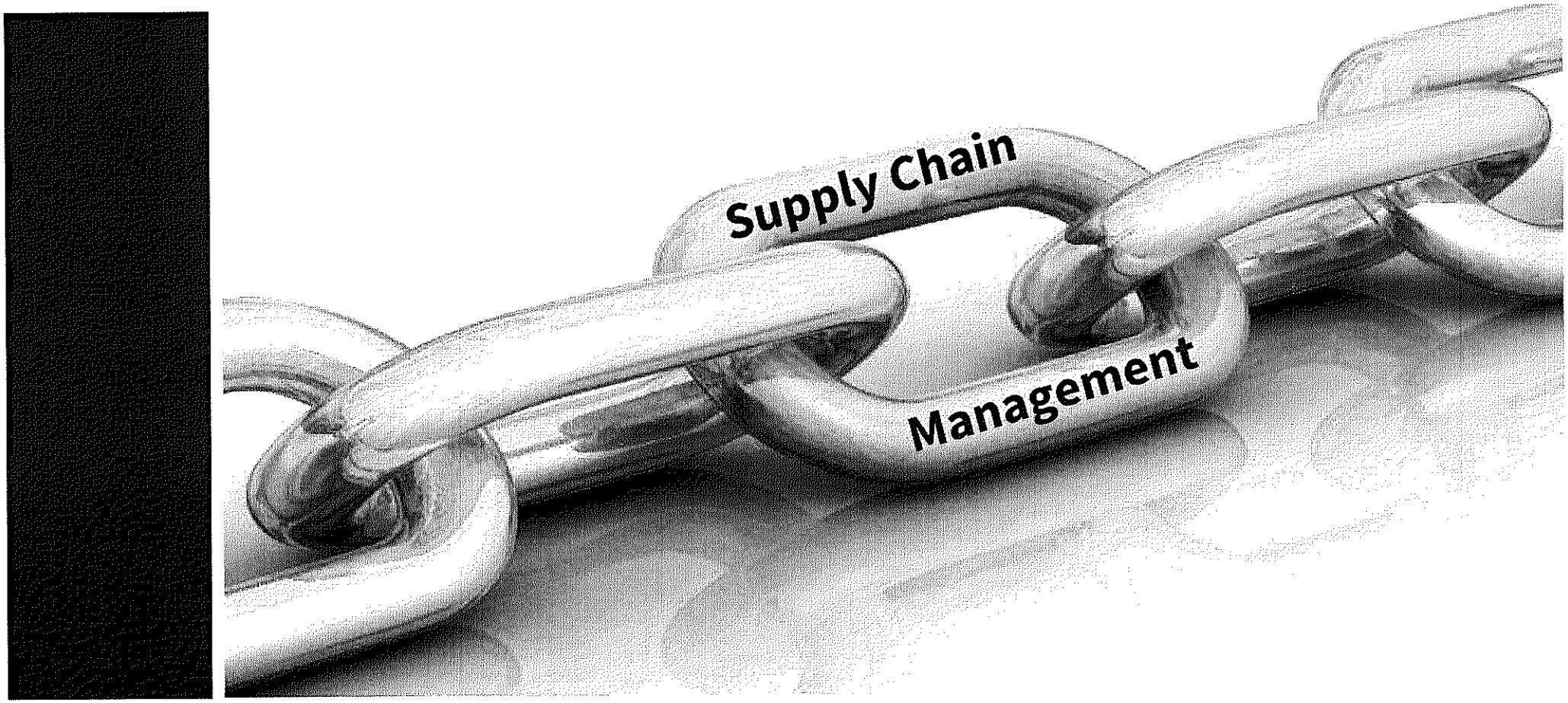
Benefits of Strategic Partnerships with Suppliers

Benefits for Buyers:

- Preferred access to the supplier's **best people**
- Increased operating **efficiencies**
- Lower **costs**
- Improved **quality**
- Enhanced **service**
- Influence over **supplier investments** and technology
- Preferred access to supplier **ideas**
- Increased **innovation** from and with suppliers, leading to lower costs and incremental revenue
- Sustainable **competitive advantage**

Benefits for Suppliers:

- Greater **visibility** into buyer's purchasing plans
- Increased operating **efficiencies**
- Longer term buyer commitments; greater predictability of **future business**
- Increased scope of business and **revenue**
- Lower **cost** of sales; increased **margins**
- Opportunities to develop, pilot, and showcase **innovative solutions**
- Sustainable **competitive advantage**



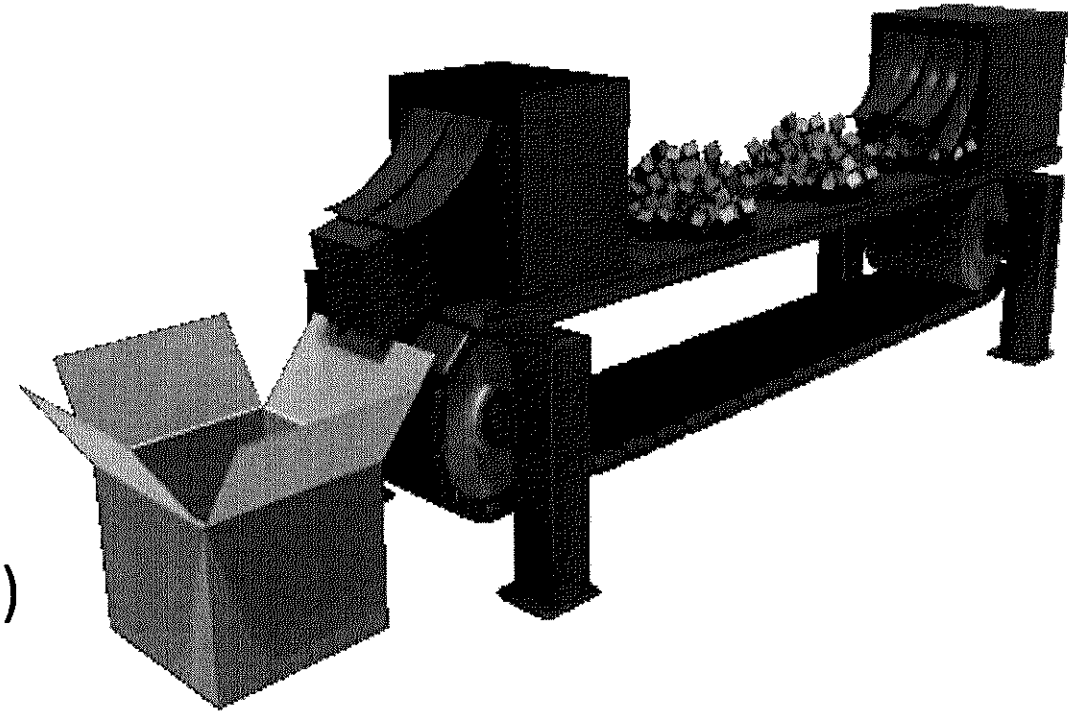
Manufacturing

Major Manufacturing Strategies

Make-to-Stock (MTS)

Make-to-Order (MTO)

Assemble-to-Order (ATO)



Engineer-to-Order (ETO)

Make-to-Stock (MTS)

Make-to-Stock (MTS) - means to **manufacture products for stock** based on demand forecasts. Push system.

- Since accurate forecasts will prevent creating **excess inventory** and avoid **stockouts**, the critical issue is how to forecast demands accurately.

- Most daily necessities such as foods, sundries, and textiles are MTS-type products.

- The challenge of MTS is to **avoid having excess inventory**.

- Companies that operate with a MTS model tend to **hold more inventory just in case they need it**, therefore, they struggle to ensure that inventory levels don't get out of control.

Make-to-Order (MTO)

Make-to-Order (MTO) is a manufacturing strategy in which manufacturing starts only **after a customer's order is received**.

- This strategy creates additional wait time for the customer to receive the product, but allows customers to purchase products that are **customized** to their specifications.

- The MTO strategy **relieves** the problems of **excessive inventory** that is common with the Make-to-Stock strategy.
  - MTO is **not appropriate for all types of products**.
    - It is not appropriate for products where customers expect immediate availability/delivery. Example: Grocery items
    - It is appropriate for highly configured products. Examples: aircraft, ocean vessels, bridges, or products that are very expensive to keep in inventory

Assemble-to-Order (ATO)

Assemble-to-Order (ATO) is a manufacturing strategy where products ordered by customers are produced quickly and are **customizable** to a certain extent.

- The ATO strategy requires that the basic parts for the product are already manufactured but not yet assembled.
- Once an order is received, the parts are assembled quickly into the finished product which is then sent to the customer.
- Example: Dell Laptop Computers

- ATO is a **hybrid strategy**, attempting to combine the benefits of both **Make-to-Stock** and **Make-to-Order** strategies, getting products into customers' hands quickly while allowing for some customization to take place.

Manufacturing Processes

Part of any manufacturing strategy involves developing a manufacturing process that can create the exact product that has been designed.

- Although there are differences between companies, many manufacturing processes have certain **characteristics in common**.
- Based on these characteristics, processes can be grouped into **two broad categories**:

✔ **Intermittent Processes** – used to produce a large variety of products with different processing requirements in **lower volumes**.

✔ **Repetitive Processes** – used to produce one, or a few, standardized products in **high volumes**.

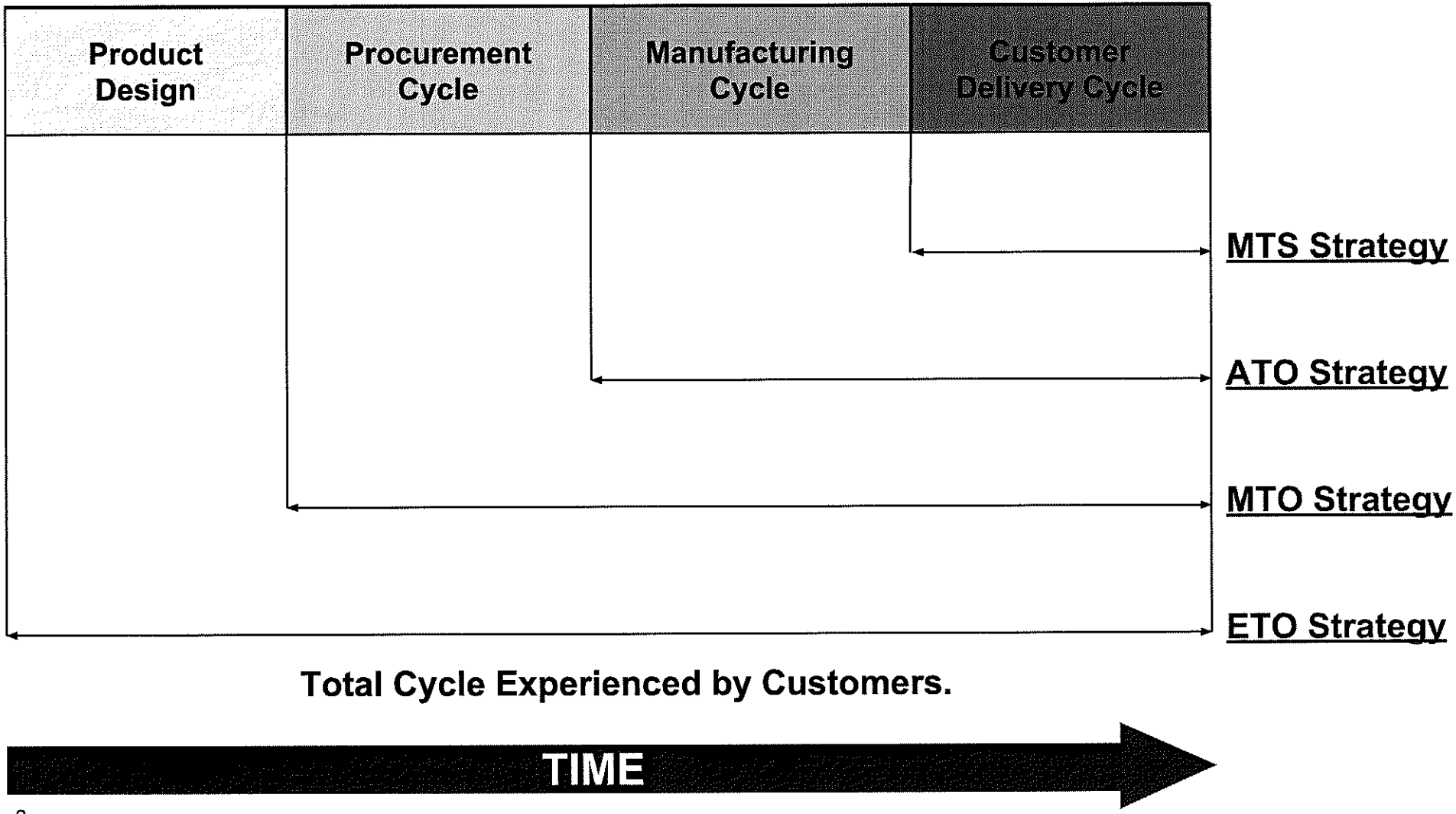
Manufacturing Process Characteristics

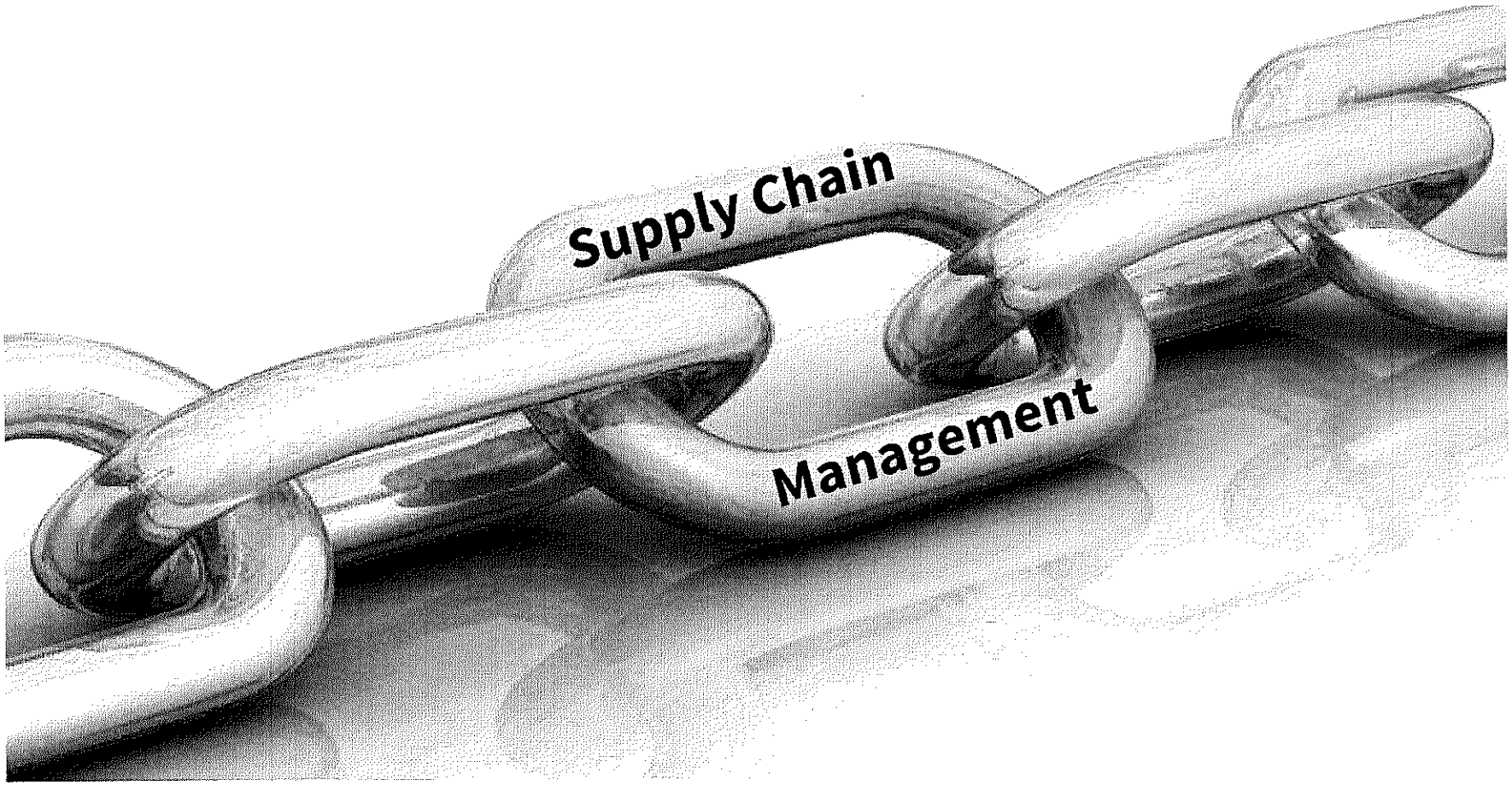
Category	Process	Product Variety	Volume	Strategy	Customer Lead time
Intermittent	Job Shop	Very high	Very low	ETO/MTO	Very long
	Batch Process	High	Low	MTO/ATO/MTS	Long
Repetitive	Line Process	Limited	High	ATO/MTS	Short
	Continuous Process	Very limited	Very high	MTS	Very short

- **Job Shop** *(also known as a "Project Process")* creates a custom product for each customer. High customization
- **Batch Process** manufactures a small quantity of an item in a single production run
- **Line Process** has standard products with a limited number of variations moving on an assembly line through stages of production
- **Continuous Process** is used to manufacture such items as gasoline, laundry detergent and chemicals. Inflexible processes. High capital

Manufacturing Strategy -vs- Performance Cycle

The choice of strategy determines which performance cycles (i.e., lead time) the customer experiences





Warehouse Layout & Material Handling

Smart Logistics Center of the Future

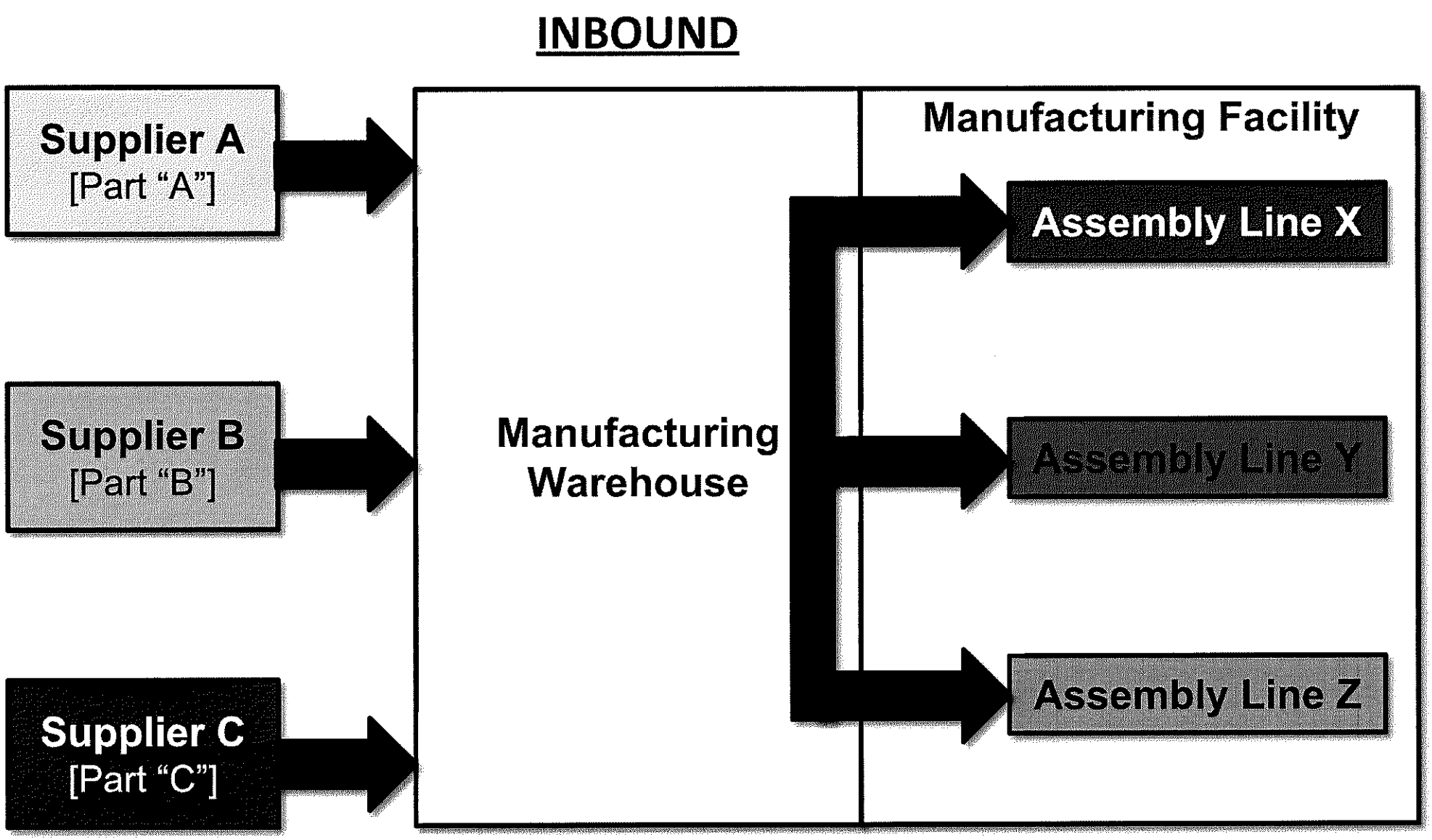
https://www.youtube.com/watch?v=udRYxhS4-Ow

Principles of Warehouse Layout Design

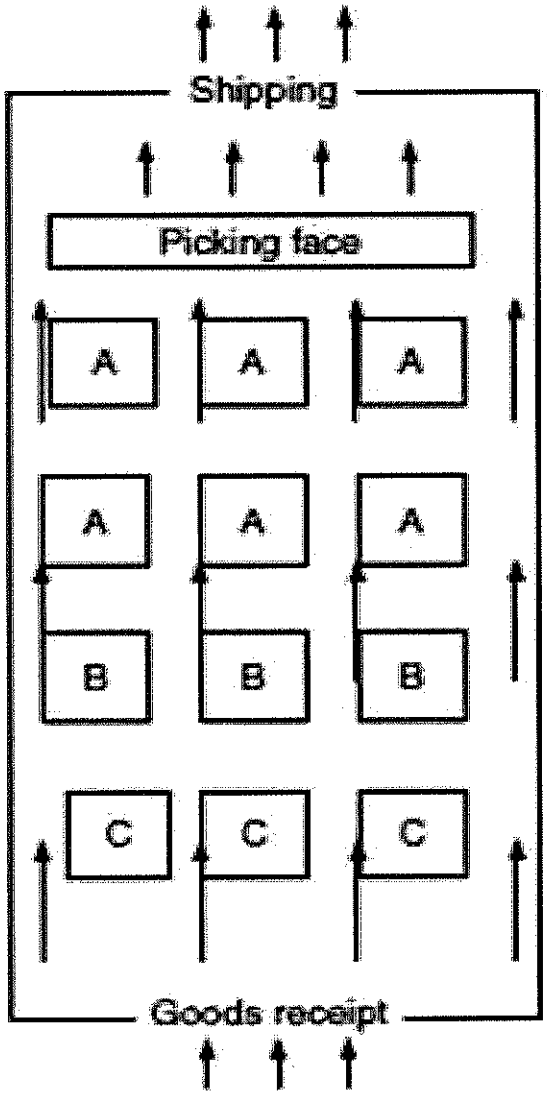
Layout of a warehouse depends on the **proposed material handling system** and requires development of a **floor plan** to facilitate product flow. Other layout principles include:

- Use one-story facilities
- Move goods in a straight line whenever possible
- Use efficient materials-handling equipment
- Use an effective storage plan
- Minimize aisle space
- Use the maximum height of the building

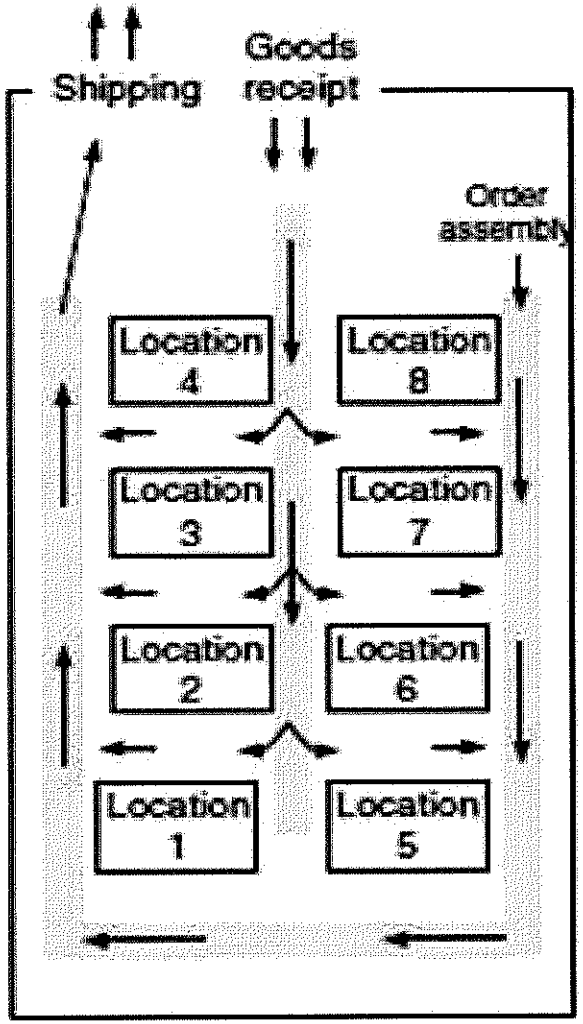
Manufacturing Warehouse



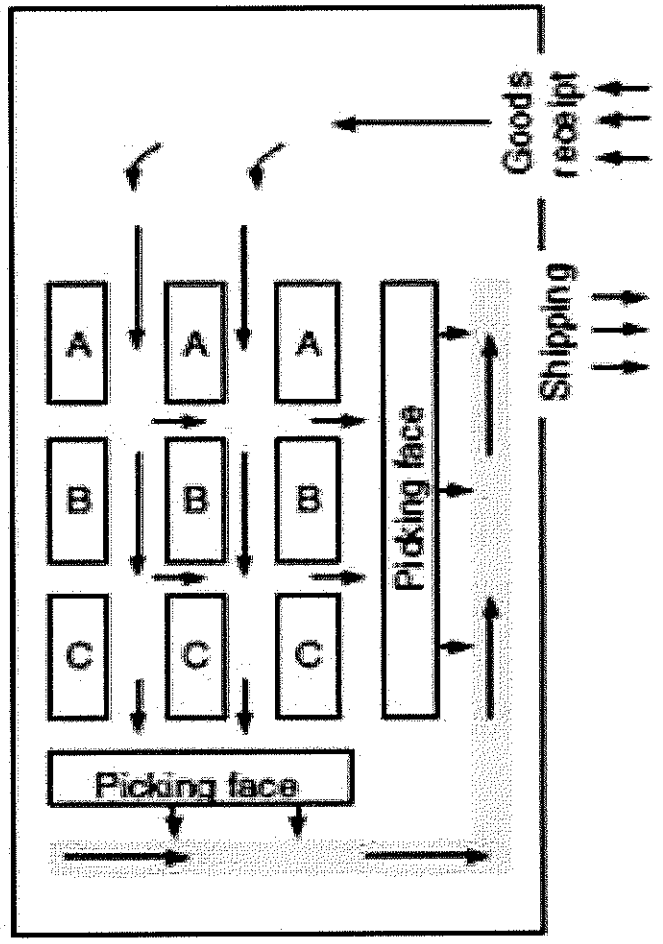
Warehouse Layouts



A straight flow operation



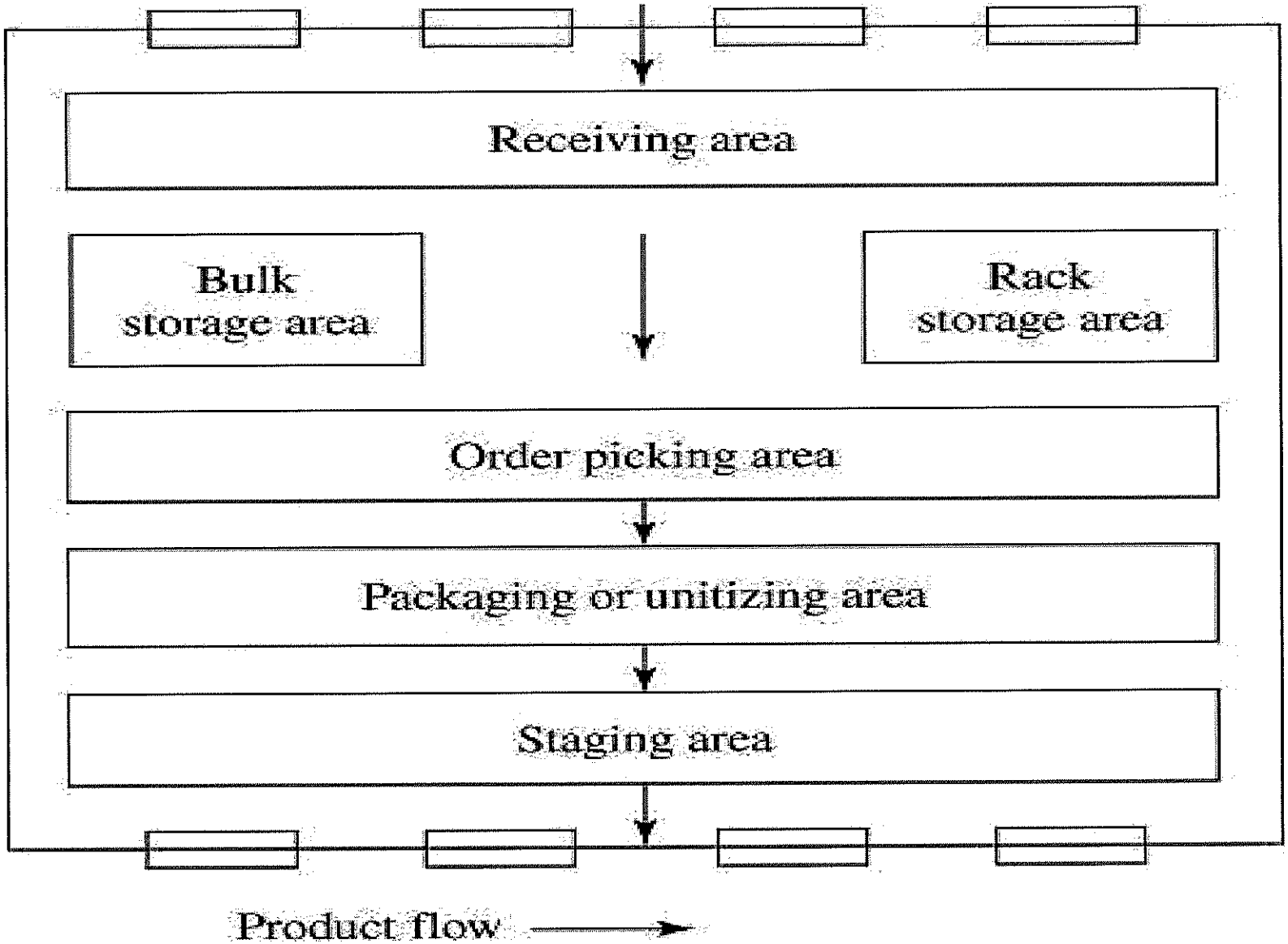
A 'U' flow operation with conveyors



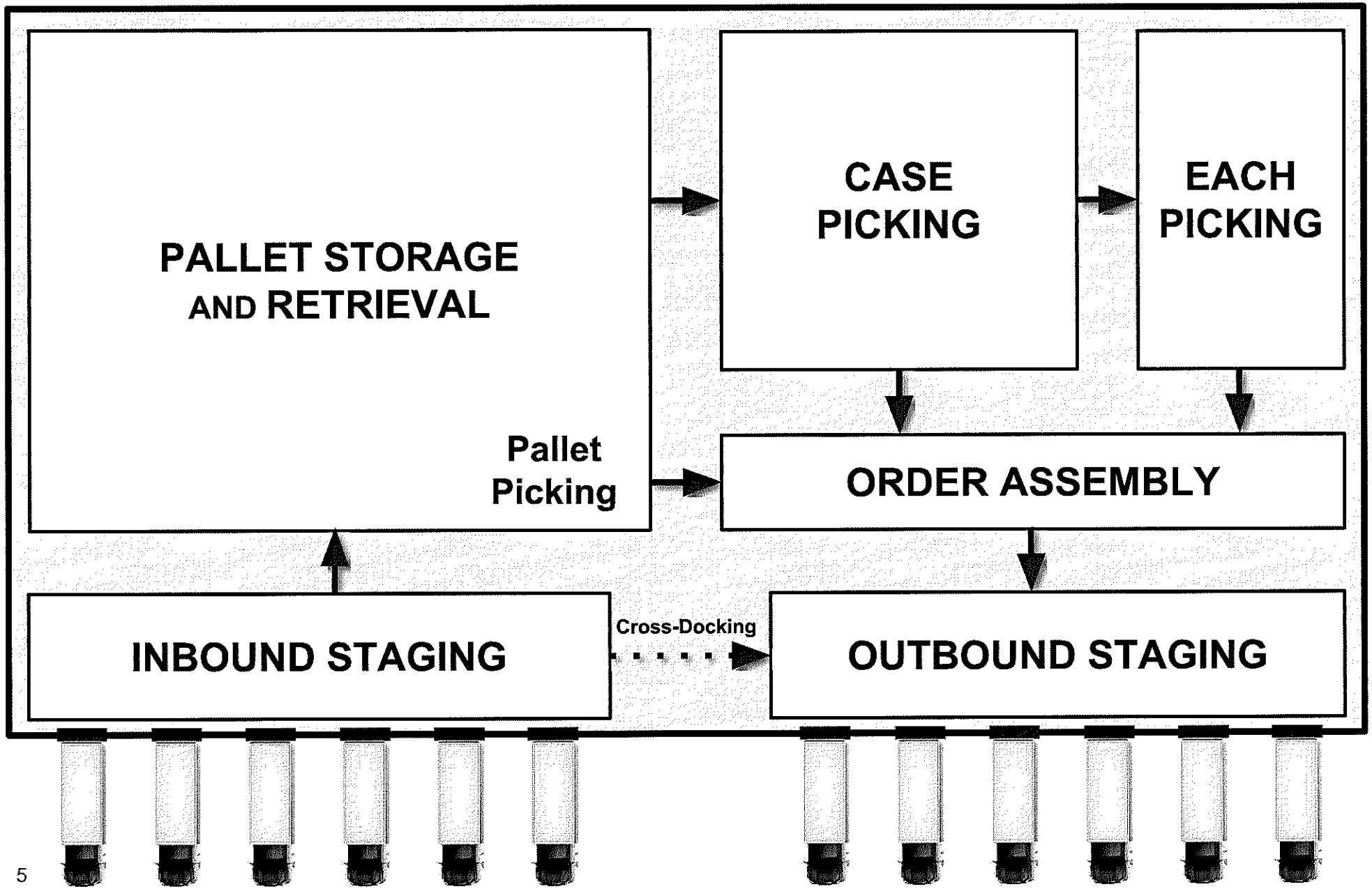
An 'L' flow operation with conveyor

Straight-line Warehouse Layout

Frequently used with warehouse operations attached to manufacturing facilities

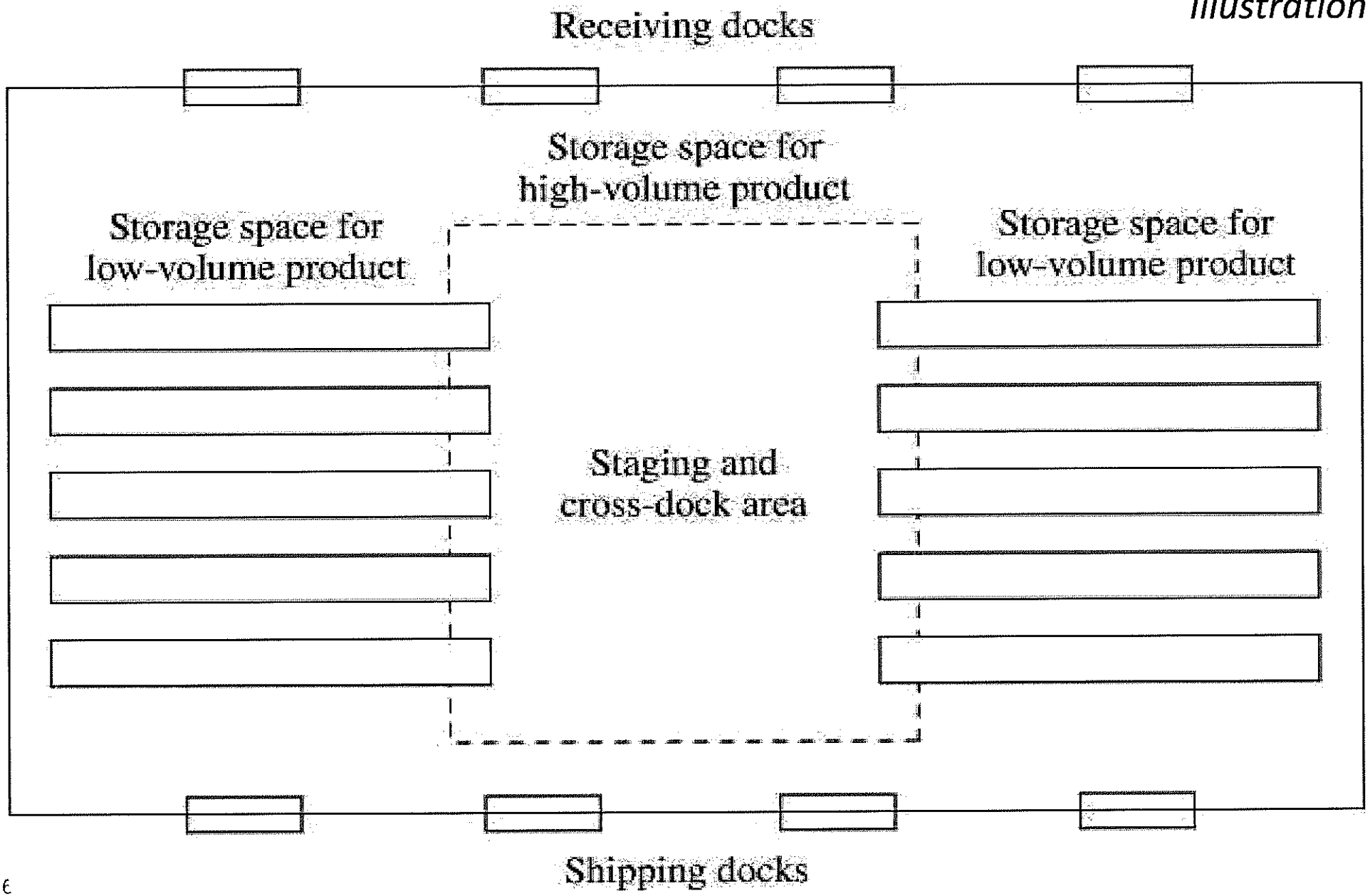


Basic Warehouse "U" Shaped Layout



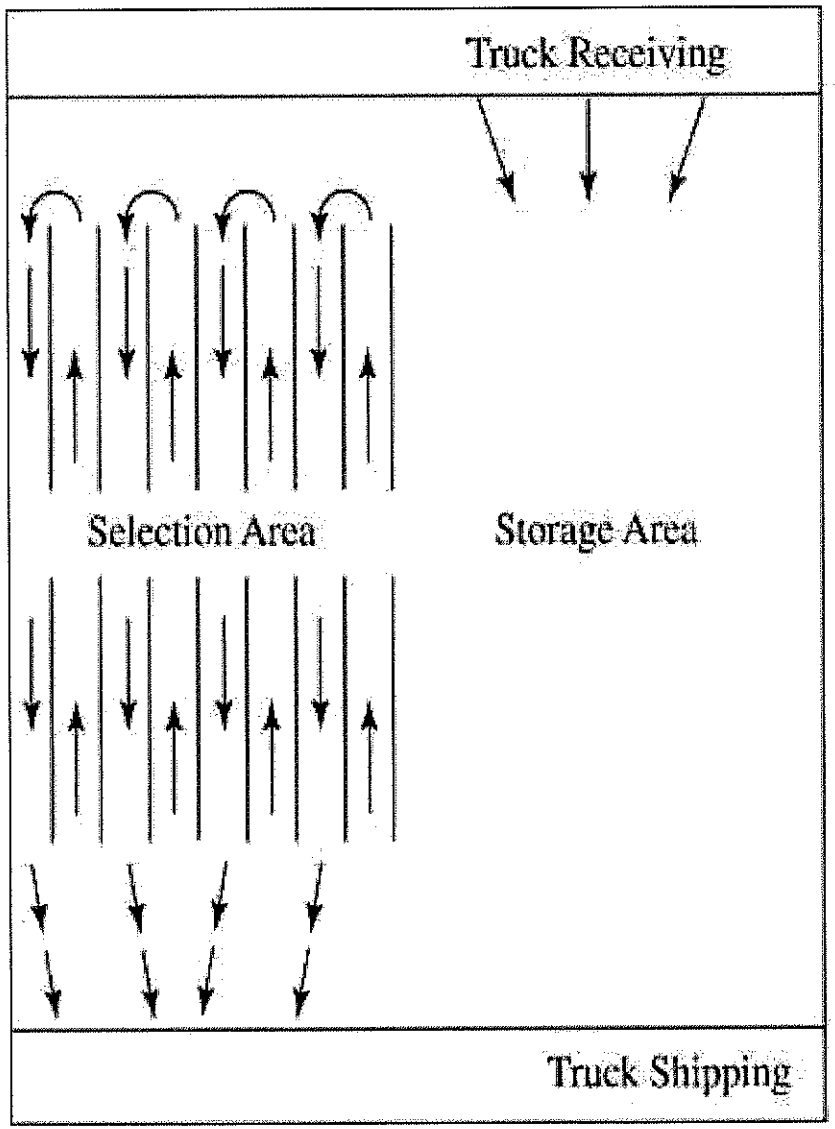
Product Movement Velocity – Warehouse Layout

Illustration

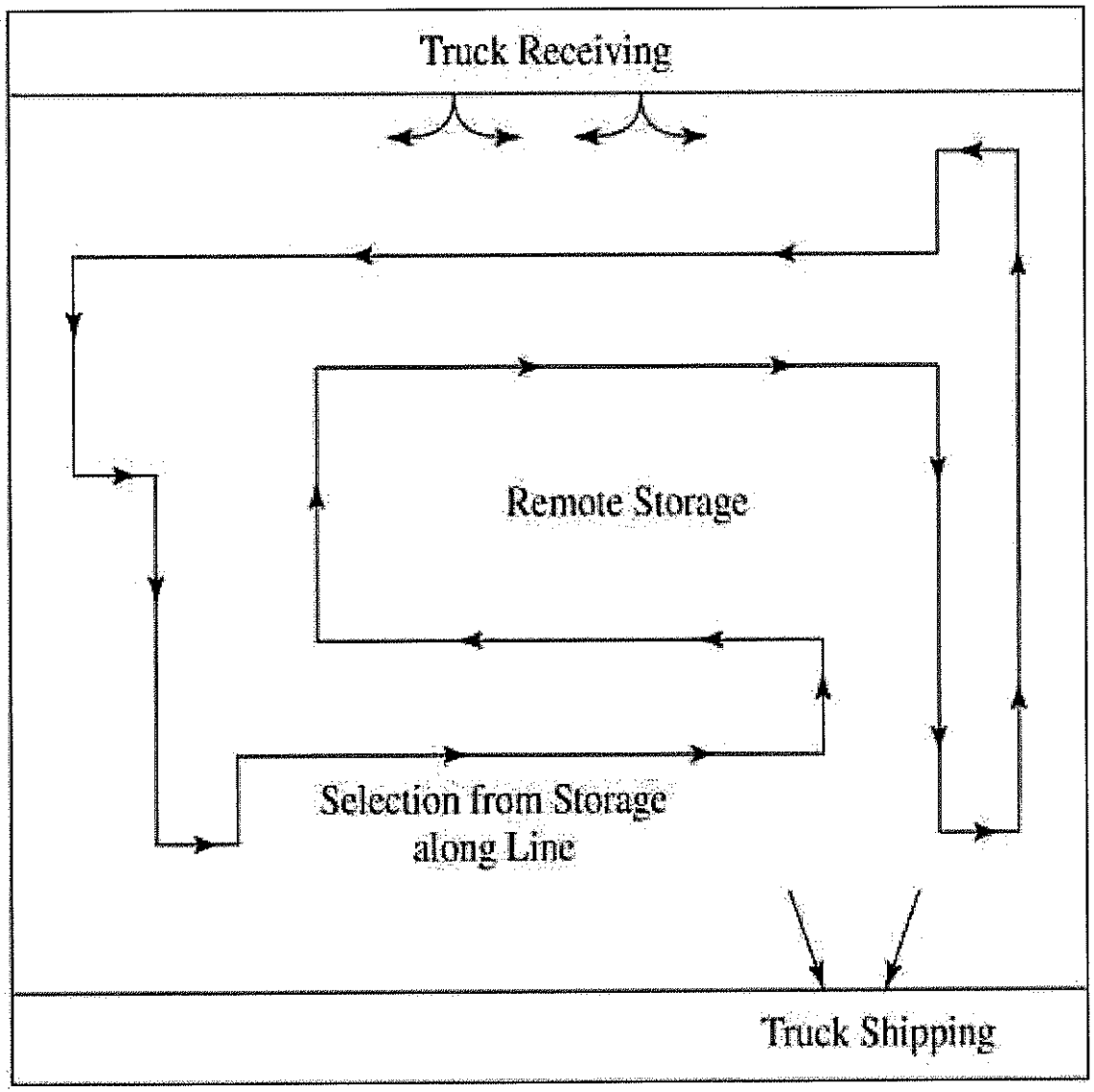


Integration of Handling Equipment w/Final Layout

Illustration



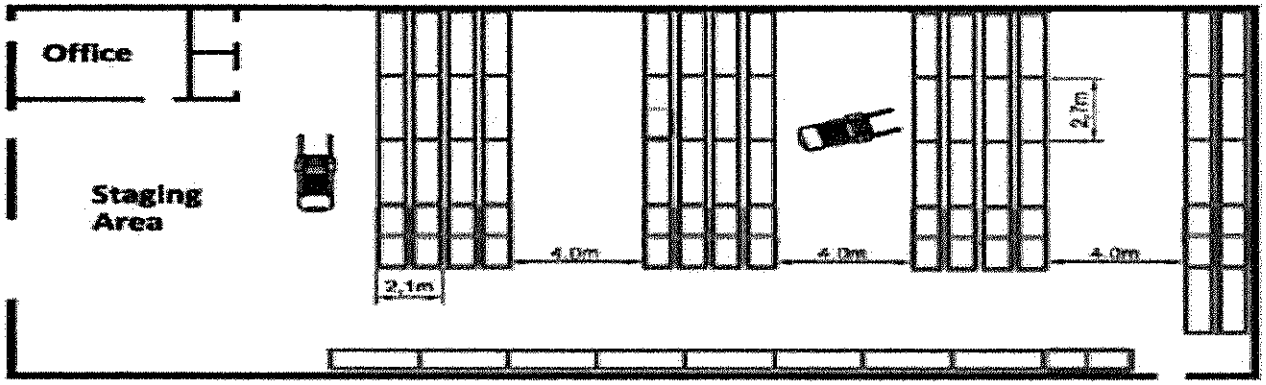
Layout A.



Layout B.

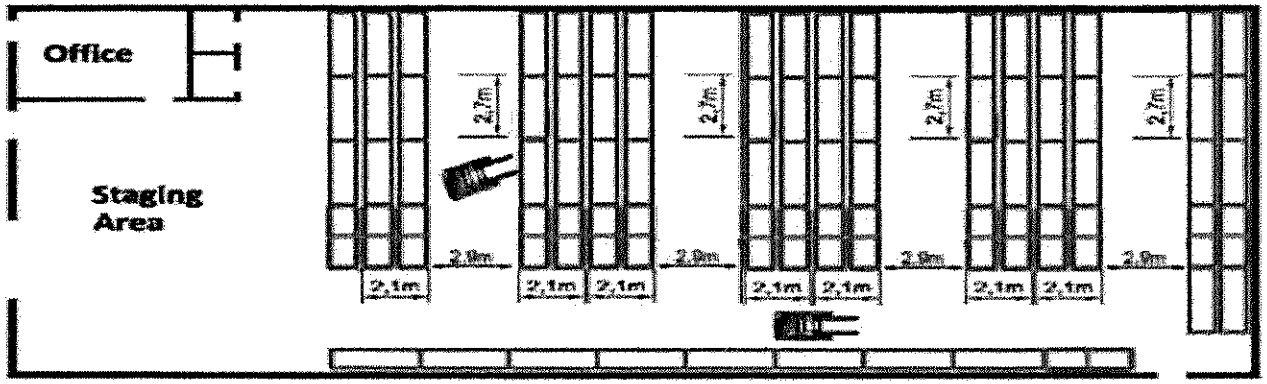
COUNTER-BALANCE

67 Pallets



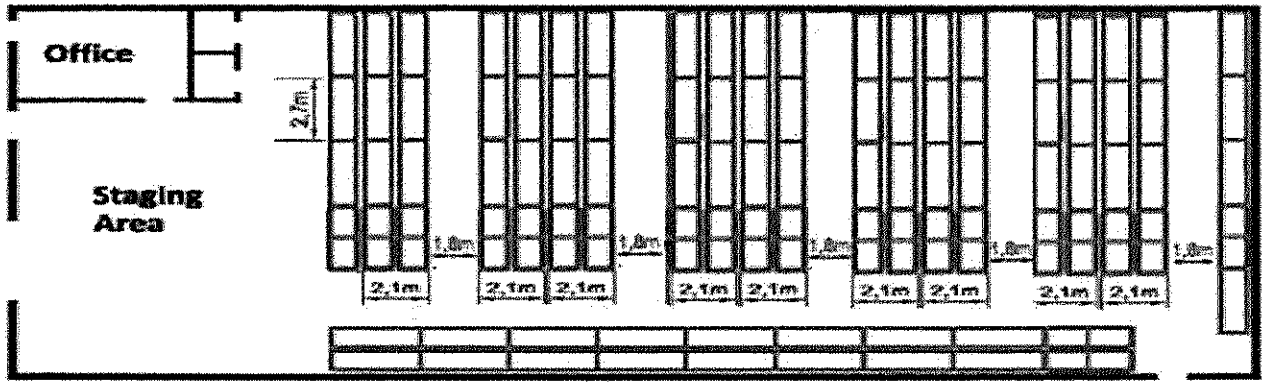
REACH TRUCK

79 Pallets



ARTICULATED

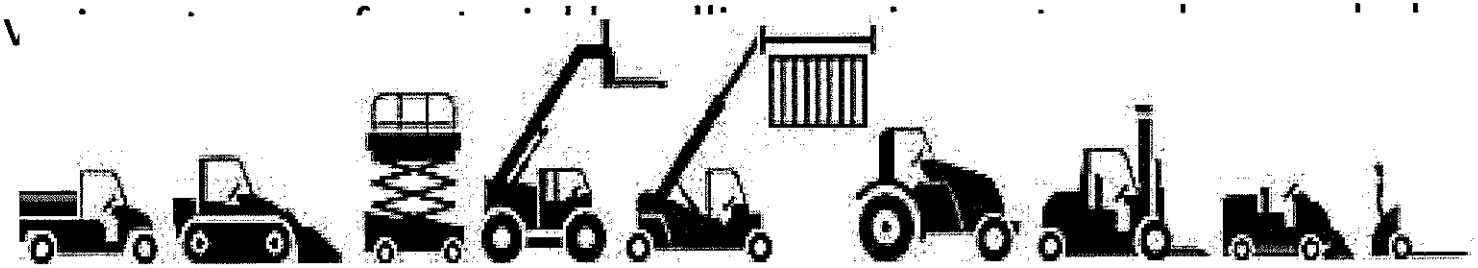
99 Pallets



Material Handling

Material Handling: The movement, control, and protection of materials and products throughout the process of their manufacture, distribution, consumption, and disposal.

- Efficient **short-distance movement of goods** that usually takes place **within the confines of a building** such as a plant, a warehouse, or between a building and a transport.
- Includes the movement of raw material, work in progress, finished goods, rejected materials, scrap/waste, packing material, etc.
- Includes loading, unloading, palletizing, de-palletizing, etc.
- Materials are generally of different shapes, sizes and weights, which means that v



Material Handling Principles

- **Standardize** material handling methods and equipment as much as possible.
- The design of the material handling equipment should be such that it can increase the **efficiency and effectiveness** of the material movement.
- Reduce time in motion by using the **shortest routes possible** and by using **automated and/or mechanical** material handling equipment.
- Eliminate **unnecessary movements**. Material should be moved as little as possible.
- The material movement **should be in lots** rather than in individual units. Handle product in a unit load as large as possible.
- **Re-handling** and **back tracking** of materials should be avoided.

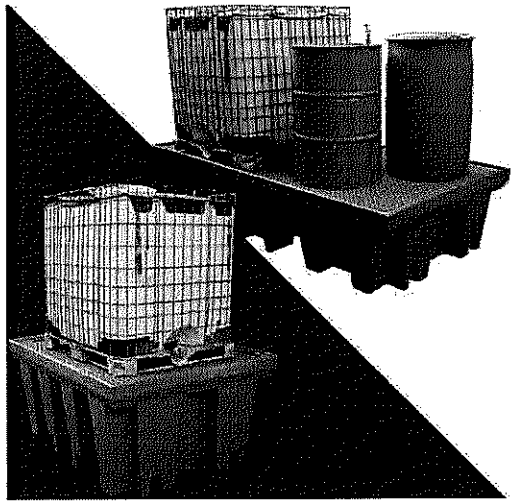
Material Handling Principles *(continued)*

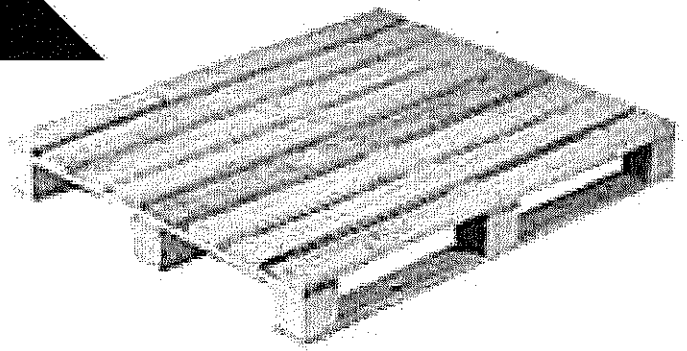
- Use **gravity** in the movement of goods whenever possible.
- Periodic **repair**, **maintenance**, and **inspection** of existing material handling equipment should be performed routinely.
- Use all available **space** efficiently and effectively.
- Design effective handling equipment that recognizes **human capabilities** and **limitation**.
- Consider consumption of **energy** during material handling.
- Minimize the impact on the **environment** during material handling.
- The design and operations of the material handling equipment should be in accordance with **safety rules and regulations.**

Unitization

Unitization is the process of grouping cartons into unit loads

- Unitization has the basic objective of increasing handling and transport efficiency
- Unit loads take **1/5 the time** required for manual loading and unloading
- Unitization methods:





A. Rigid Containers

- Air Freight Containers
- Sea-Land Containers
- Returnable Racks

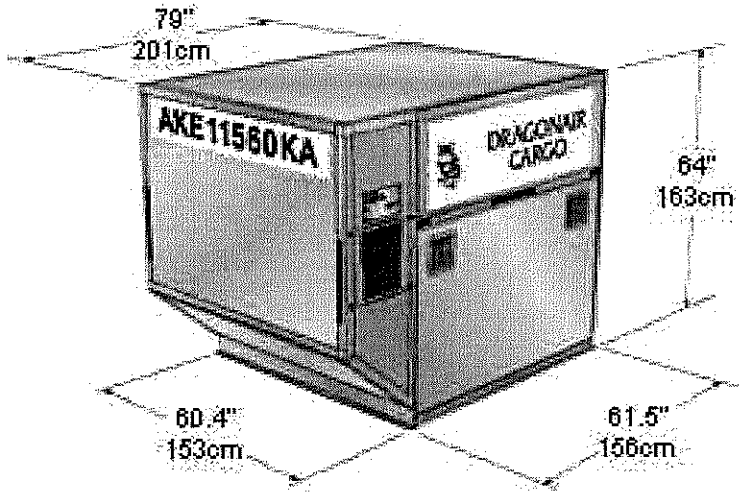
A. Flexible Containers

- Pallets
- Slip sheets

A. Rigid Containers - Benefits

1. Improves overall **material movement** efficiency

2. Provides a shipment unit that can be **reused** many times
   - Reduces waste
   - Reduces need to dispose of the container



3. Reduces **damage** in handling and transit

4. Reduces **pilferage**, *i.e., can be locked/sealed*

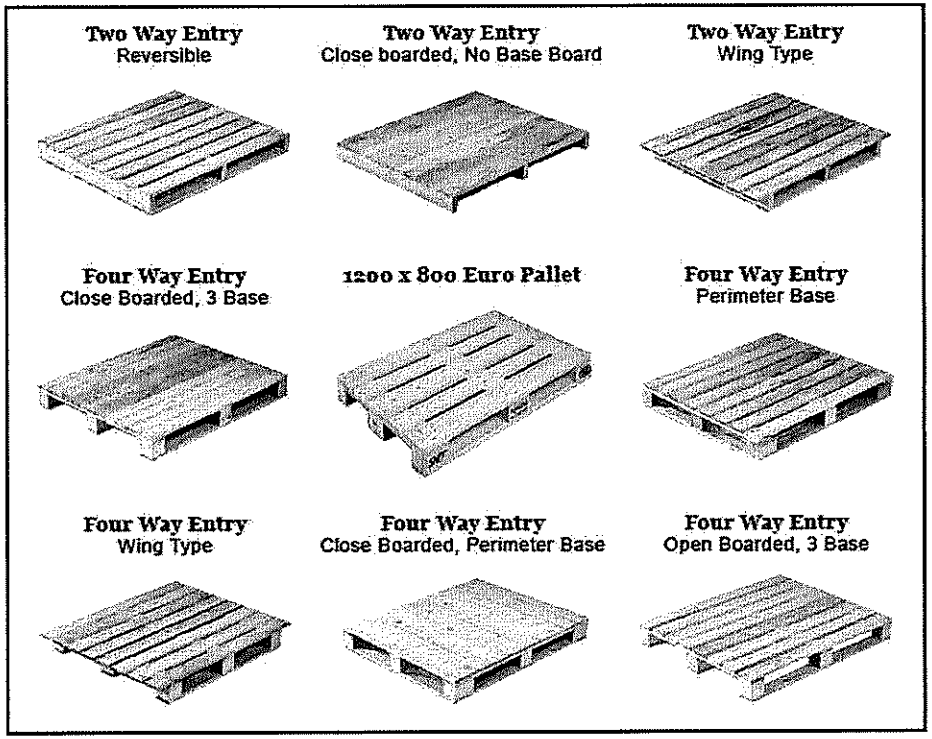
5. Provides greater **protection** from environment issues

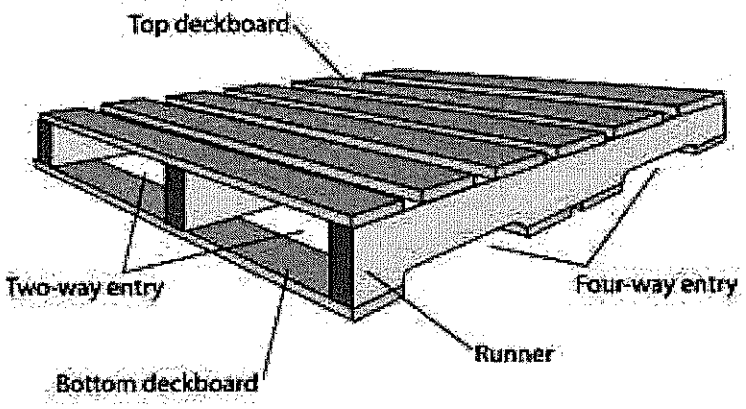
6. Reduces **protective packaging** requirements,
   i.e., outer ridged shell reduces/eliminates the need for inner protective packaging.

B. Flexible Containers - Hardwood Pallets

Advantages of hardwood pallets:

- Relatively **low cost**
- **Strong** material that can carry significant weight
- Easily **replaced** if damaged
- Fully **recyclable**
- Can be manufactured from **recycled supplies**



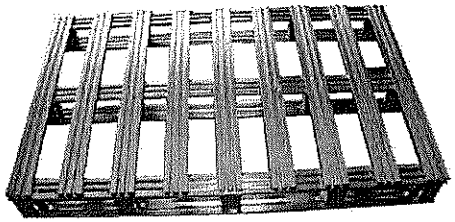


Disadvantages of hardwood pallets:

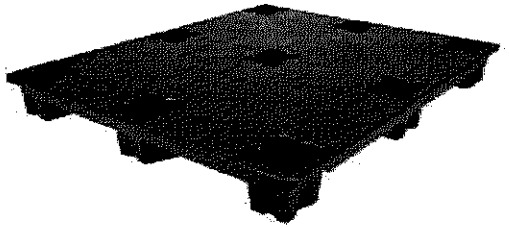
- Can be easily **damaged** *(safety issue)*
- Susceptible to **contamination** and **infestation**
- Fire **hazard** if stored in bulk

B. Flexible Containers - Durable Pallets (i.e., metal, plastic, etc.)

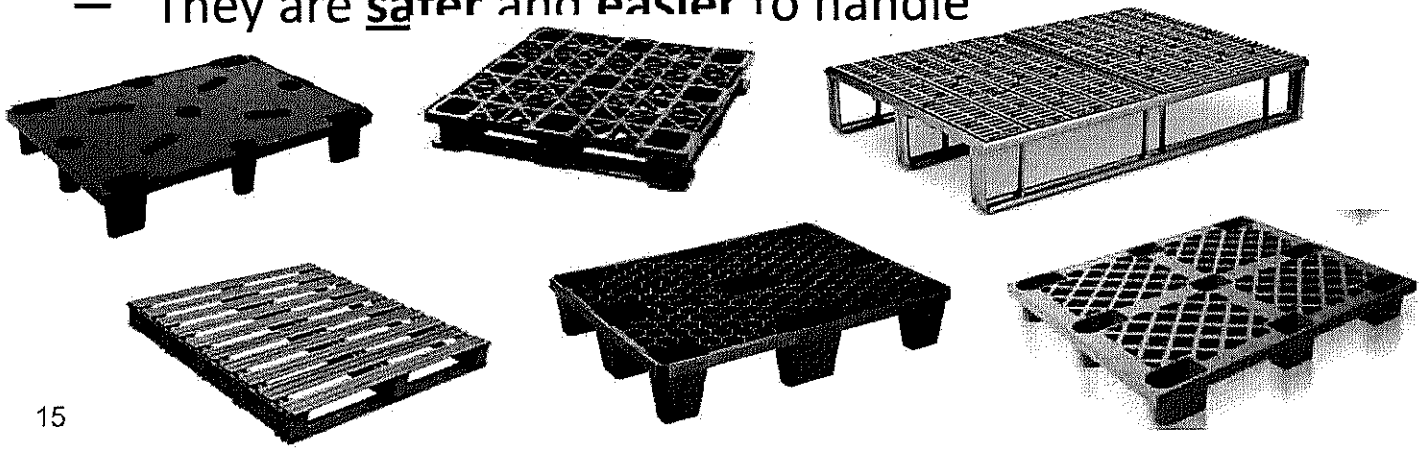
There are many advantages of using durable pallets, however, they cost **3 x's as much** as wood pallets



- They are **lighter** and easier to transport
- They take up **less space**, *i.e., they can be nested*
- They are more **eco-friendly**
- They won't **break** and less likely to become **damaged**
- They are **clean**, **hygienic**, and **weather-resistant**
- They are more **flexible**
- They are **safer** and **easier** to handle



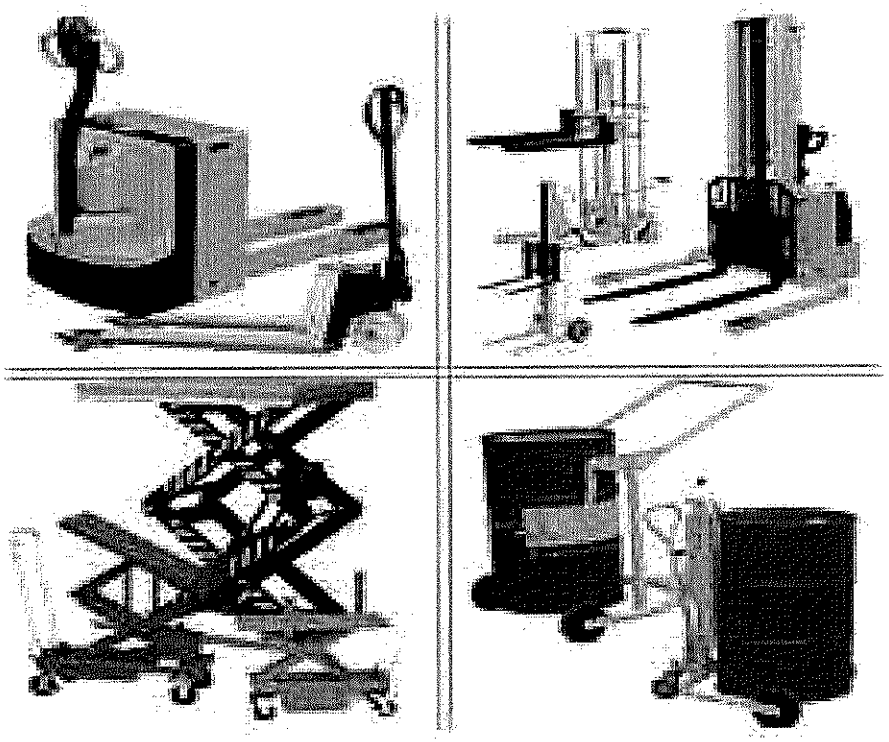
RFID Equipped



Material Handling Equipment (MHE)

Material Handling Equipment (MHE): equipment used for the movement, storage, protection, consumption, and disposal of materials within a facility or site, including:

- **Transport Equipment**: industrial trucks, automated guided vehicles (AGVs), monorails, conveyors, cranes and hoists.
- **Storage Systems**: bulk storage, rack systems, shelving and bins, drawer storage, automated storage systems.
- **Unitizing Equipment**: palletizers
- **Identification and Tracking Systems**: Labels, Bar codes, RFID, etc..

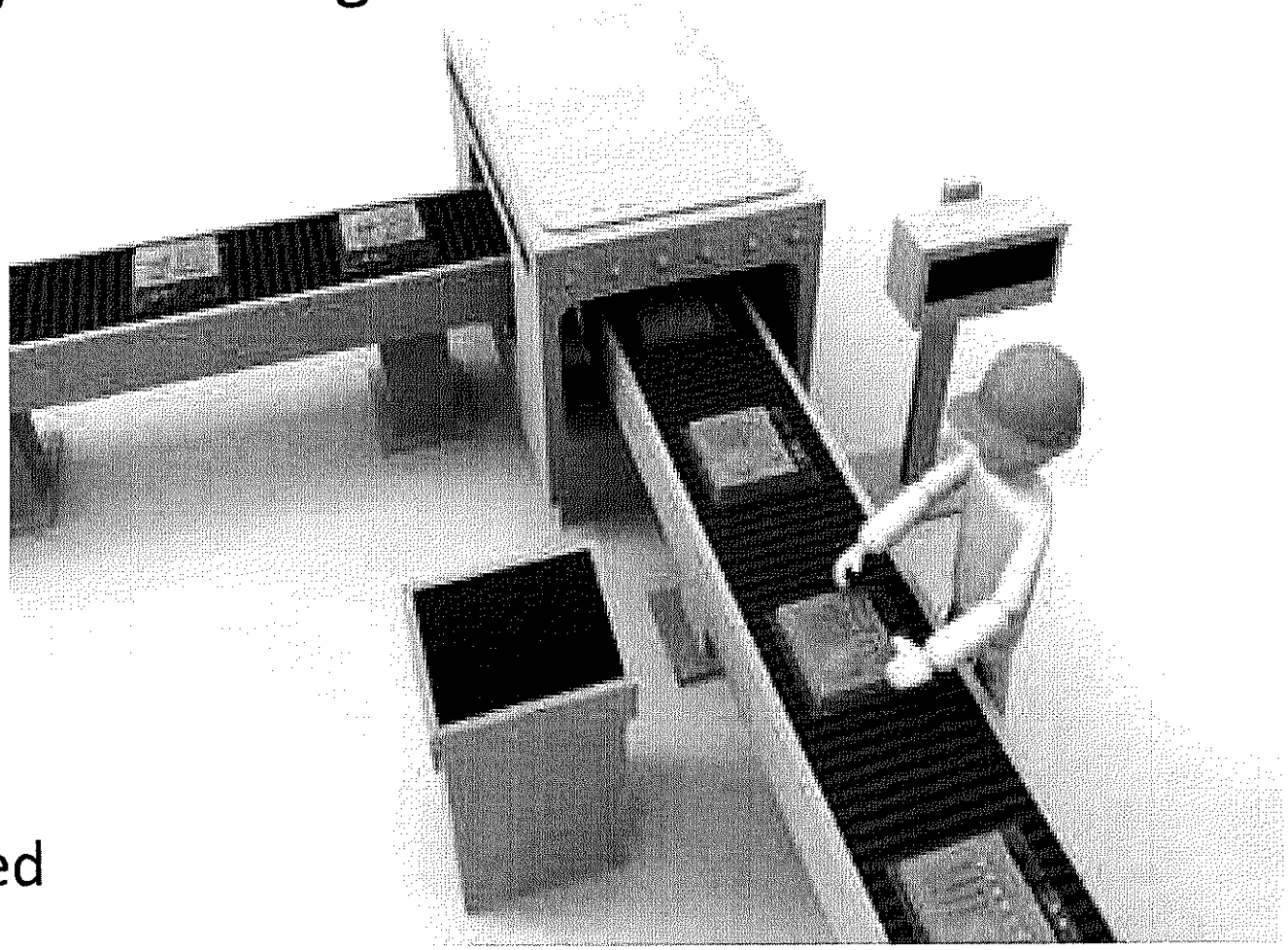


Material Handling Systems

Material handling systems require different amounts of **labor** and **capital investments**.

Material Handling System Categories:

- Manual
- Mechanized
- Semi-automated
- Automated
- Information-directed

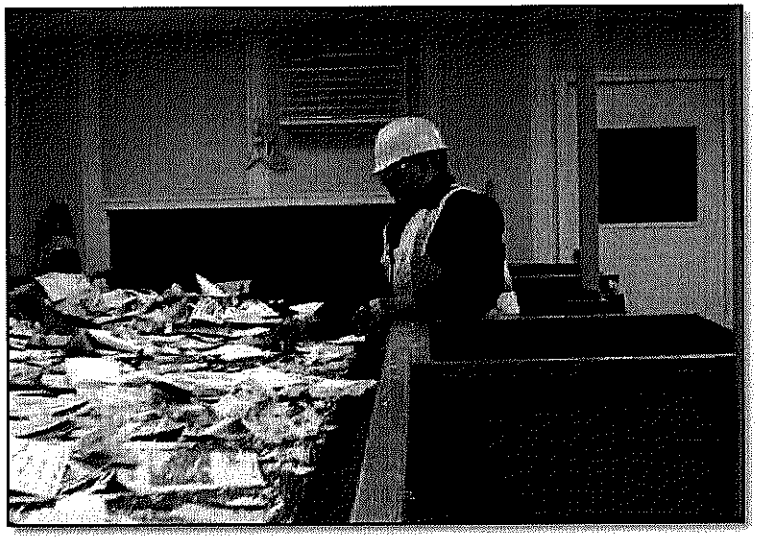


Manual Systems

Manual systems for picking, sorting and movement of inventory

- Labor-intensive
- Slow
- Human Limitations
  - Repetitive motion
  - Strain injuries
- Higher error rates

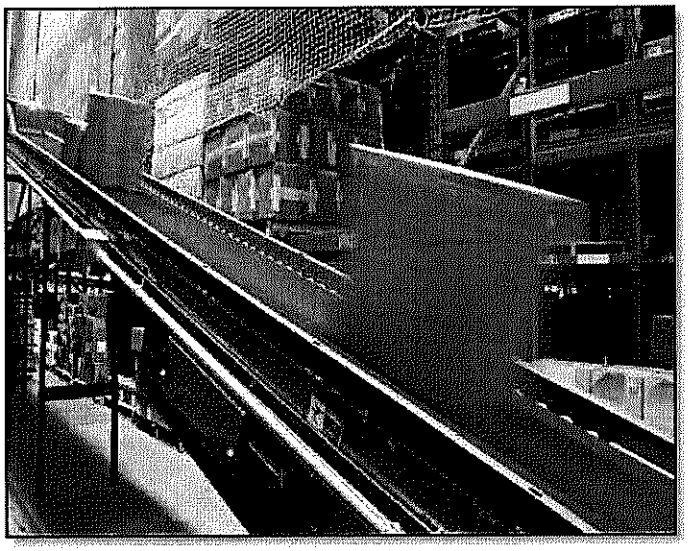
Manual material handling systems are the most commonly used



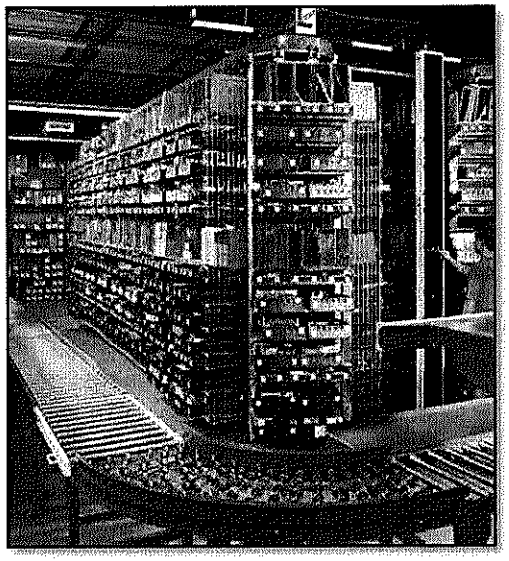
Easiest to implement and operate

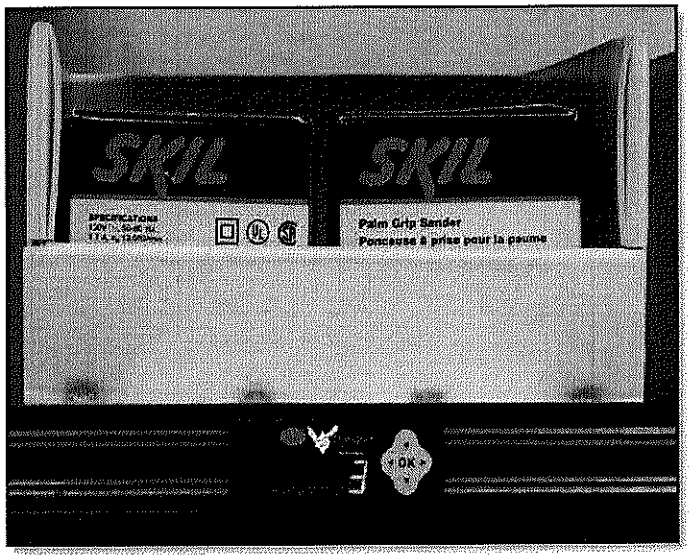
Mechanized Systems

Mechanized systems employ a wide range of handling equipment



- Most mechanized systems combine different handling devices
- They have moderate fixed and variable cost with good flexibility
- Examples:
  - Forklift
  - Rider pallet trucks
  - Towlines
  - Tractor trailers
  - Conveyors





Semi Automated Systems

Semi automated systems often supplement mechanized equipment. **Work with people**.

- High fixed cost, low variable cost with low flexibility
- Examples:
  - Sortation systems
  - Live racks
  - Robotics
  - Automated Guided Vehicles (AGV)

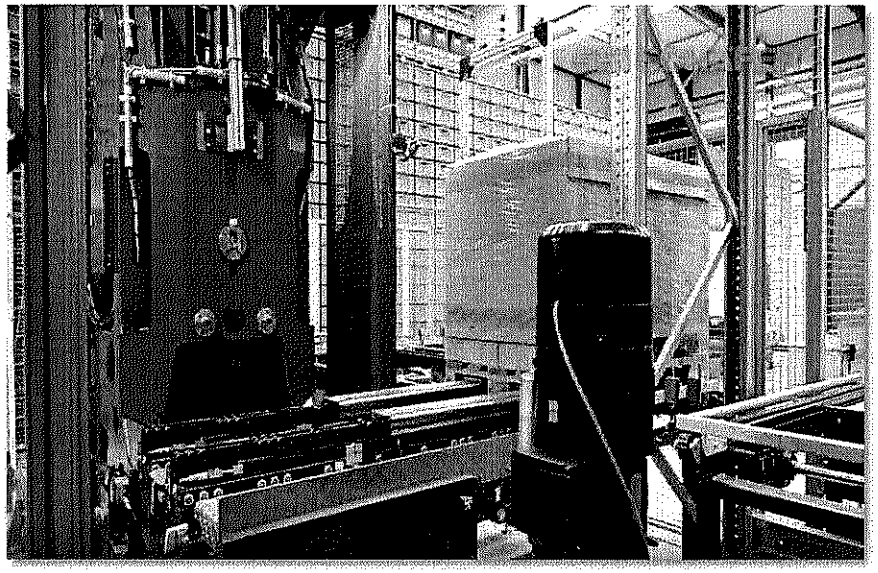
Kiva Robotic Order Picking:
www.youtube.com/watch?v=UtBa9yVZBJM

2.26 minutes

AGV is a material handling device used to move materials around a manufacturing facility or warehouse, by following markers or wires in the floor, using vision, magnets, or lasers for navigation, without direct operator intervention

Automated Systems

Automated systems now focus on high-rise storage and retrieval. **Largely independent**.



- Highest fixed cost, lowest variable and labor cost with low flexibility
- Potential to automate is the elimination of direct labor by substituting capital equipment
- Examples:
  - Order selection systems
  - Automated Storage and Retrieval System *(AS/RS)*

Shuttle-based Automated Storage And Retrieval System

2:41 minutes

AS/RS is a computer-controlled system utilizing special machines or vehicles for automatically loading and unloading high density inventory storage locations

Information-directed Systems

Information-directed systems combine the controls of automated handling with the flexibility of mechanized handling

- **Moderate fixed and variable cost with high flexibility and utilization**
- Offers selected benefits of automation without substantial capital investment
- Main drawback is accountability regarding work assignments
- Examples:
  - RF Wireless (Wi-Fi)
  - Pick-to-Light
  - Voice Picking