2019 HPC Fall Meeting

Friday, November 15, 2019
Montesi Room, Buckman Hall
Christian Brothers University
## 2019 HPC Fall Meeting

**Friday, November 15, 2019**

Montesi Room, Buckman Hall, Christian Brothers University
650 East Parkway South, Memphis, TN 38104

<table>
<thead>
<tr>
<th>Time</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30 a.m. – 9:00 a.m.</td>
<td>• Check-in/Continental Breakfast</td>
</tr>
</tbody>
</table>
| 9:00 a.m. – 9:15 a.m. | • **Welcome**  
Siripong Malasri, Healthcare Packaging Consortium Director, CBU |
| 9:15 am – 10:30 am  | • **The State of Logistics – 2019**  
Clifford F. Lynch, Supply Chain Executive in Residence, EpiCenter |
| 10:30 a.m. – 10:45 p.m. | • Coffee Break                               |
| 10:45 a.m. – 12:00 noon | • **Supply Chain Analytics: Past, Present and Future**  
Ravi Poluri, Master Planner, Containerboard, International Paper |
| 12:00 noon – 1:30 p.m. | • Lunch                                       |
| 1:30 p.m. – 2:45 p.m. | • **CBU Packaging Program Updates**  
S. Malasri  
**Effect of Slenderness to Corrugated Fiberboard and Boxes**  
S. Malasri, A. Brown, C. Gordy, B. Knighton, A. Moses, K. Nicholson, and Z. Tabor  
**Packaging Improvement for Thistle & Bee**  
S. Malasri, A. Brown, C. Gordy, B. Knighton, and Z. Tabor  
**Box Compression Strength Enhancement**  
S. Malasri, D. Duckworth, A. Moses, K. Snow, J. Housewirth, G. Johns, and J. Davenport  
Packaging Department, CBU |
| 2:45 p.m. – 3:45 p.m. | • **Optional CBU ISTA Certified Packaging Lab Tour**                                         |

Campus Map: [http://www.cbu.edu/assets/2091/cbumap2017.pdf](http://www.cbu.edu/assets/2091/cbumap2017.pdf)

---

**Active Members**

Evergreen Packaging, Fairway Biomed, FedEx, International Paper, Medtronic, Memphis Bioworks, MicroPort Orthopedics, Olympus Surgical Technologies America, Smith & Nephew, SweetBio, Thaddeus Medical Systems, Wright Medical
Sponsors

Epicenter Memphis
(https://www.epicentermemphis.org)

International Paper
(http://www.internationalpaper.com)

Christian Brothers University
(http://www.cbu.edu)

Active Members
Evergreen Packaging, FedEx, International Paper, Medtronic, Memphis Bioworks, MicroPort Orthopedics, Olympus Surgical Technologies America, Smith & Nephew, SweetBio, Thaddeus Medical Systems, Wright Medical
Registered Participants

1. Aflaki, James  
   Christian Brothers University
2. Alhajri, Hamoud  
   Christian Brothers University
3. Baker, Chad  
   Christian Brothers University
4. Berisso, Kevin  
   University of Memphis
5. Cloud, Eli  
   Thistle & Bee
6. Deutsch, Matthew  
   Christian Brothers University
7. Edwards, Evan  
   FedEx
8. Fantaziu, Victor  
   Christian Brothers University
9. Gadomski, Dick  
   Christian Brothers University
10. Gilman, Jay  
   FedEx
11. Gordy, Carl  
   Christian Brothers University
12. Johns, Georgina  
   Smith & Nephew
13. Johnson, Matthew  
   Autozone
14. Jordan, Braimma  
   Christian Brothers University
15. Kimble, Erin  
   International Paper
16. Kneipp, Wayne  
   FedEx
17. Lynch, Cliff  
   Epicenter
18. Malasisri, Pong  
   Christian Brothers University
19. Mcabee, Leslie  
   Christian Brothers University
20. Melo Escobedo, Jean  
   Christian Brothers University
21. Moritz, Brad  
   Thaddeus Medical Systems
22. Moses, Alex  
   Christian Brothers University
23. Nguyen, Ngn  
   Autozone
24. Ostrowski, Michael  
   Smith & Nephew
25. Podesta, Thomas  
   Christian Brothers University
26. Price, Gabriel  
   Christian Brothers University
27. Poluri, Ravi  
   International Paper
28. Pourhashemi, Ali  
   Christian Brothers University
29. Ray, Asit  
   Christian Brothers University
30. Rutledge, Larry  
   CBU ISTA Packaging Test Lab
31. Scully, Steve  
   Thaddeus Medical Systems
32. Shannon, Jack  
   Christian Brothers University
33. Snow, Kevesha  
   Christian Brothers University
34. Stevens, Ryne  
   Smith & Nephew
35. Stokes, James  
   Bass River Advisors
36. Swaffer, Maree  
   FedEx
37. Tazin, Mohammad  
   Nefab
38. Valverde Toledo, Guillermo Isaac  
   Christian Brothers University
39. Wellford, Brandon  
   Memphis Bioworks
40. Williams, James  
   Smith & Nephew
41. Zhou, Joe  
   FedEx

Active Members

Evergreen Packaging, FedEx, International Paper, Medtronic, Memphis Bioworks, MicroPort Orthopedics,
Olympus Surgical Technologies America, Smith & Nephew, SweetBio,
Thaddeus Medical Systems, Wright Medical
The State of Logistics – 2019

Clifford F. Lynch¹

Abstract: The logistics landscape is changing rapidly. This presentation describes some of the current developments and challenges, including such things as network design, transportation trends, and logistics disruptions.

Keywords: Disruptions, Transportation, Distribution Centers, Customer Requirements, Demands

Presenter:
Clifford F. Lynch – Clifford F. Lynch of C. F. Lynch & Associates has been in the logistics industry for over five decades. He was with The Quaker Oats Company for 29 years, the last 13 of those as Vice President – Logistics. He was president of Trammell Crow Distribution Corporation from 1987 – 1993 and has provided management advisory services in logistics for over 25 years. Currently, he serves as Supply Chain Executive in Residence at EpiCenter.

He is a Certified Member of the American Society of Transportation and Logistics and is a member of:
- Editorial Advisory Board, DC Velocity
- Editorial Review Board, Supply Chain Management Review
- Warehousing Education and Research Council
- Executive Board – Intermodal Freight Transportation Institute – University of Memphis

He is an adjunct professor at the University of Memphis, a frequent lecturer at other colleges and universities and an author of hundreds of articles on the subject of logistics, two books on logistics outsourcing and one on transportation in the supply chain. For 15 years, he was a regular columnist for DC Velocity Magazine. He also authored a cookbook entitled The Gourmet Logistician (An Oxymoron). In addition, Mr. Lynch reads novels for the visually impaired on a local radio station.

¹ cliff@epicentermemphis.org
Mr. John “Jack” Shannon is a distinguished higher education leader with many years of experience directing not only academic and student-centered initiatives but also public/private partnerships focused on economic development in some of the most economically-challenged communities in the country.

Shannon comes to CBU from Montclair State University in Montclair, New Jersey, where he led the Office of Strategic Alliances, Economic Development, and Civic Partnerships and previously served as the university’s vice president for advancement. Prior to his arrival at Montclair State, he served as the inaugural president and CEO of East Baltimore Development Inc., a groundbreaking initiative that successfully undertook the largest urban redevelopment initiative in Baltimore’s history through the integrated delivery of education, health, and human services programs; the construction of new mixed-income housing; the development of a leading-edge life sciences center; and the launch of a new K-8 community school.

He has also served as the associate vice president for economic development and chief of staff to the executive vice president of the University of Pennsylvania where he was one of the principal architects and implementers of the university’s highly acclaimed “West Philadelphia Initiatives,” a comprehensive neighborhood redevelopment strategy that was awarded the 2003 Urban Land Institute Award for Excellence.

Shannon holds a BA degree in English from La Salle University in Philadelphia, where he currently serves on the executive committee of its board of trustees. He also holds a Master of Public Policy degree from Harvard University and a JD degree from the University of Pennsylvania.
Supply Chain Analytics - Past, Present and Future

Ravi Poluri

Abstract: An engineered flow of goods and services is what defines a supply chain. However, past performance may not be sufficient to sustain and grow, with growing globalization and complexities. Real-time data transformation and predictive analytics will drive future supply chains. Rethinking supply chains in times of uncertainty, with the goal to make them more resilient will be key to staying ahead of the competition.

Keywords: Supply Chain; Supply Chain Analytics

Presenter:

Ravi Poluri – Ravi Poluri has over 25 years of supply chain experience in various industries. With a bachelor’s in mechanical engineering and a master’s in computer and information sciences, Ravi was recently APICS CSCP certified as well as a green belt in Lean Six Sigma methodologies and practices. He is an adjunct instructor at CBU.

1 rpoluri@cbu.edu, Master Planner, Containerboard, International Paper
CBU Packaging Program Updates

S. Malasri¹

Abstract: CBU Packaging Program updates will be discussed and feedback from the audience will be requested. Proposed changes include:

- Additional packaging courses
- Name change from BS in Engineering Management (Packaging Concentration) to BS in Packaging Engineering Technology
- Future BS in Packaging Engineering

Keywords: Packaging Curriculum

Presenter:

Siripong Malasri is the Dean of Engineering and Director of the Healthcare Packaging Consortium at CBU. He is a registered professional engineer (PE) in the State of Tennessee, ISTA certified packaging laboratory professional and IoPP certified packaging professional.

¹ pong@cbu.edu
Effect of Slenderness to Corrugated Fiberboard and Boxes

S. Malasri$^1$, A. Brown, C. Gordy, B. Knighton, A. Moses, K. Nicholson, and Z. Tabor

Abstract: This work is a refinement of previous work [1]. In the previous study, various lengths of corrugated strips that had a 2-inch width were compressed to develop buckling curves at 73F-50%RH and 73F-90%RH. However, the compression machine’s width of the grips was only 1-inch. Thus, the stress increased near the end grips. In this study, corrugated strips with a 1-inch width were used to improve the results.

In the previous study, corrugated boxes of the same size were used. Horizontal braces were applied to change the unsupported height of these boxes. In this study, boxes with different heights were used without horizontal braces. This resulted in a better representation of box slenderness.

Keywords: Corrugated; Slenderness

Reference:


Presenters:

Siripong Malasri is the Dean of Engineering and Director of the Healthcare Packaging Consortium at CBU. He is a registered professional engineer (PE) in the State of Tennessee, ISTA certified packaging laboratory professional and IoPP certified packaging professional.

Alexander Brown, Carl Gordy, Benjamin Knighton, Alex Moses, Kyle Nicholson, and Zach Tabor are BS in Engineering Management (Packaging Concentration) majors and ISTA certified packaging laboratory technicians.

---

$^1$ pong@cbu.edu
Packaging Improvement for Thistle & Bee

S. Malasri¹, A. Brown, C. Gordy, B. Knighton, and Z. Tabor

Abstract: Thistle & Bee is a non-profit organization. Its mission is to help women who have survived prostitution and trafficking thrive. The goal of this project is three-fold: (1) Product protection, (2) Environmental friendliness, and (3) Process improvement.

Product protection was done at both product and packaging levels. Environmental-friendly materials were chosen, and shipping box sizes were optimized. Process improvement included efficiency for manual operations and cost reduction.

This was a service-learning project that aligns with CBU’s mission. CBU prepares its students with a slogan “Enter to Learn. Leave to Serve.”

Keywords: Packaging Improvement; Sustainability; Protection; Service Learning

Presenters:

Siripong Malasri is the Dean of Engineering and Director of the Healthcare Packaging Consortium at CBU. He is a registered professional engineer (PE) in the State of Tennessee, ISTA certified packaging laboratory professional and IoPP certified packaging professional.

Alexander Brown, Carl Gordy, Benjamin Knighton, and Zach Tabor are BS in Engineering Management (Packaging Concentration) majors and ISTA certified packaging laboratory technicians.

¹ pong@cbu.edu
Box Compression Strength Enhancement

*S. Malasri¹, D. Duckworth, A. Moses, K. Snow, J. Housewirth, G. Johns, and J. Davenport*

**Abstract:** In this study, four different methods to increase corrugate box compression strength were explored.

- **Horizontal Brace:** This method was inspired by the belt of power lifters as shown below.
- **Diagonal Brace:** This method was modeled after diagonal single and double braces found in building structures.
- **Corner Post & Corner Stiffener:** About 2/3 of box compression strength is attributed to the strength of its four corners. Thus, strengthening box corners increases overall box strength.

**Keywords:** Corrugated Box; Compression Strength

**Presenters:**

- **Siripong Malasri** is the Dean of Engineering and Director of the Healthcare Packaging Consortium at CBU. He is a registered professional engineer (PE) in the State of Tennessee, ISTA certified packaging laboratory professional and IoPP certified packaging professional.

- **Deliya Duckworth, Alex Moses, and Kevesha Snow** are BS in Engineering Management (Packaging Concentration) majors and ISTA certified packaging laboratory technicians. Deliya received OSHA 10-Hr General Industry Safety Certification and Lean Six Sigma Yellow Belt Certification.

- **Jade Housewirth** graduated from BSEM (Packaging) at CBU in May 2019. She is currently a Structural Design Engineer with International Paper in Richmond, VA. Jade is an ISTA certified packaging laboratory technologist.

- **Georgina Johns** graduated from BSEM (Packaging) at CBU in May 2019. She is currently a Packaging Project Engineer with Smith & Nephew in Memphis, TN. Georgina is an ISTA certified packaging laboratory technologist. She is also working towards her MS in Engineering Management at CBU.

- **Jazzmyn Davenport** graduated from BSEM (Packaging) at CBU in May 2019. She is currently with Marvin Doors & Windows in Ripley, TN. Jazzmyn is an ISTA certified packaging laboratory technologist. She also received OSHA 10-Hr General Industry Safety Certification.

¹ pong@cbu.edu
THE STATE OF LOGISTICS
2019

Clifford F. Lynch
Epicenter

CBU HPC FALL MEETING
November 15, 2019

Supply chain defined...

All activities associated with the flow and transformation of goods from the raw material stage through to the end user, as well as the associated information flows.

-- Supply Chain Management, Handfield and Nichols

Logistics...

“Logistics is that part of the supply chain process that plans, implements, and controls the efficient, effective flow and storage of goods, services, and related information from the point of origin to the point of consumption in order to meet customers’ requirements.”

-- Council of Supply Chain Management Professionals

SUPPLY CHAIN

U.S. TOTAL LOGISTICS COSTS - 2018

<table>
<thead>
<tr>
<th>Component</th>
<th>$ Billions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inventory Carrying</td>
<td>341</td>
</tr>
<tr>
<td>Warehousing</td>
<td>153</td>
</tr>
<tr>
<td>Transportation</td>
<td>1037</td>
</tr>
<tr>
<td>Motor</td>
<td>669</td>
</tr>
<tr>
<td>Parcel</td>
<td>105</td>
</tr>
<tr>
<td>Rail</td>
<td>88</td>
</tr>
<tr>
<td>Water</td>
<td>46</td>
</tr>
<tr>
<td>Pipeline</td>
<td>53</td>
</tr>
<tr>
<td>Air</td>
<td>77</td>
</tr>
<tr>
<td>Administration</td>
<td>104</td>
</tr>
<tr>
<td>Total</td>
<td>1,635</td>
</tr>
</tbody>
</table>
THE SIGNIFICANT NINE

1. Distribution Networks
2. Transportation
3. Labor
4. Technology
5. Infrastructure
6. Sustainability
7. The Economy
8. Disruptions
9. The Wild Card

DISTRIBUTION NETWORKS

• How many distribution centers?
• Where?
• How big?

Inland Ports...

BNSF, Alliance, TX

Inland Ports...

Kansas City

WALMART AT BAYTOWN, TX
CUSTOMERS ARE BECOMING MORE DEMANDING

Buying more on-line

Becoming more difficult to serve.

Want fast, consistent service (often same or next day)

OMNICHANNEL

• A multichannel sales approach that provides the customer with a seamless shopping experience whether they are shopping on line, from a desktop or mobile device, by telephone or in a brick and mortar store

THE AMAZON EFFECT

“Huge E Commerce Company uses the internet to sell stuff cheap, wiping out the competition” Seattle Times

Rapid and dependable service, often same day deliveries, free shipping, and instant visibility

amazon

• OVER 200 DISTRIBUTION CENTERS AND SORTATION CENTERS
• $15 BILLION SPENT SINCE 2010
• MORE EXPENSIVE METRO LOCATIONS
• LARGER BUILDINGS WITH INCREASED CAPACITY

LARGE............
FULL............

Outsourcing...
Will continue to expand as other firms attempt to compete

Better Utilization of FTZ’s
• Foreign Trade Zones
  • 1970 – 8
  • Today – 300
• Users better educated about their value
• As are LSP’s

WALMART
40 Regional import centers
140 Domestic distribution centers
4625 stores
7000 tractors
50,000 trailers

TRANSPORTATION
TRUCKING

Capacity

“The capacity crunch is just around the corner.”

- UPS

Fuel

Fuel costs not likely to go back to 2003 levels anytime soon
39% of cost

Drivers (Or Lack Thereof)

- An increasingly unpopular occupation

Government

• Driver Hours of Service Rules
• 11 hour driving limit
• 34 hour restart after 60 hours/7 days

Short 60,800 by end of 2019
Government

• CSA 2010 collects, analyzes, and scores data on
  • Unsafe Driving
  • Fatigued Driving
  • Driver Fitness
  • Use of Controlled Substances/Alcohol
  • Vehicle Maintenance
  • Improper Loading or Securing
  • Crash Experience

RAIL

“Rails should have edge on trucks over the next ten years.”

- Bear, Stearns

Offshore manufacturing, whereby large shipments of freight that are produced well in advance in Asia and transported by ocean to U.S. ports lend themselves to longer-haul, non-service-sensitive rail shipments within the country.

A sharper focus on reducing fuel costs and dependence on imports (we estimate that the rails are about two to three times more fuel-efficient than truckload carriers).

Worsening highway service and growing public frustration with congested highways, causing federal and state governments to increasingly encourage rail, barge, and creative tolling programs to help alleviate this problem.

Rails Are Making a Comeback

• $10 billion in upgrades since 2000
• $12 billion more planned
• Energy efficient
• Deteriorating highway infrastructure
• Increased use by motor carriers
• Offshore sourcing

Intermodal

The primary momentum

is coming from intermodal

• is a $10 billion market
• Has adequate capacity
• Saves fuel
• Relieves congestion
• Reduces emissions
• Is utilized increasingly by motor carriers
**INTERMODAL**

2015-2019 Monthly Volume Totals

**LABOR CHALLENGES**

- Most major markets have warehouse labor problems.
- Relatively low wage rates
- Substance abuse/background checks.

**TECHNOLOGY**

- Visibility
- Warehouse Management Systems
- Transportation Management Systems
- Big Data
- IoT
- Just In Time

**INFRASTRUCTURE**

Truck Route Map - 2007

TRUCK ROUTE MAP - 2040
The Infrastructure

By 2020
• The volume of freight moved on our infrastructure will be 25 billion tons, worth $30 trillion.
• Trucks will be moving 75% of that over a woefully inadequate highway system.
• The rail system will be carrying 888 million tons.
• Foreign trade moving through American ports will be increasing.
• Port demand will exceed current capacity of many U.S. ports by 200%.

LACK OF A NATIONAL TRANSPORTATION POLICY

“If you don’t know where you are going, any road will take you there.”

- Cheshire Cat to Alice

INFRASTRUCTURE

In spite of President Trump’s promise, no action has been taken.
Fuel tax hasn’t been increased since 1993.
According to the American Society of Civil Engineers..............
1 of every 5 miles of highway pavement needs repair.
There is a capital backlog of $886 billion..

SUSTAINABILITY

• May be difficult to achieve, particularly for logistics service providers

THE ECONOMY
DISRUPTIONS

WHAT’S NEXT

• More automation

ENLARGED PANAMA CANAL

LARGER SHIPS

DRONES
HIGH – RISE WAREHOUSES

AMAZON SKYSCRAPER WAREHOUSE

AMAZON WAREHOUSE IN THE SKY

MORE CROWDSOURCING

AUTONOMOUS TRUCKS

THE WILD CARD
“Every morning in Africa, a gazelle wakes up. It knows that it must run faster than the fastest lion, or it will be killed. Every morning a lion wakes up. It knows that it must outrun the slowest gazelle, or it will starve to death. It doesn’t matter whether you are a lion or a gazelle; when the sun comes up, you’d better be running.”
CBU PACKAGING PROGRAM UPDATES

S. Malasri

2019 HPC Fall Meeting, November 15, 2019, Memphis, TN

Current Curriculum

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PKG 101</td>
<td>Introduction to Packaging</td>
<td>1</td>
</tr>
<tr>
<td>PKG 202</td>
<td>Packaging Lab (2 crs)</td>
<td></td>
</tr>
<tr>
<td>PKG 302</td>
<td>Distribution Packaging &amp; Logistics</td>
<td>3</td>
</tr>
<tr>
<td>PKG 203</td>
<td>Distribution Packaging Lab (1 cr)</td>
<td></td>
</tr>
<tr>
<td>PKG 303</td>
<td>Packaging Lab (2 crs)</td>
<td></td>
</tr>
<tr>
<td>PKG 102</td>
<td>Packaging Design (2 crs)</td>
<td></td>
</tr>
<tr>
<td>PKG 302L</td>
<td>Distribution Packaging Lab (1 cr)</td>
<td></td>
</tr>
<tr>
<td>PKG 315</td>
<td>Packaging Materials (3 crs)</td>
<td></td>
</tr>
<tr>
<td>PKG 319</td>
<td>Principles of Packaging (3 crs)</td>
<td></td>
</tr>
<tr>
<td>PKG 488</td>
<td>IoPP CPIT (3 crs)</td>
<td></td>
</tr>
<tr>
<td>PKG 321</td>
<td>Healthcare Packaging (3 crs)</td>
<td></td>
</tr>
<tr>
<td>PKG 411</td>
<td>Principles of Pkg Development (3 crs)</td>
<td></td>
</tr>
<tr>
<td>PKG 490</td>
<td>Packaging Project (2 crs)</td>
<td></td>
</tr>
<tr>
<td>PKG 495</td>
<td>Packaging Internship (3 crs)</td>
<td></td>
</tr>
</tbody>
</table>

Proposed Change

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>PKG 202</td>
<td>No change</td>
</tr>
<tr>
<td>PKG 302</td>
<td>No change</td>
</tr>
<tr>
<td>PKG 203</td>
<td>No change</td>
</tr>
<tr>
<td>PKG 303</td>
<td>No change</td>
</tr>
<tr>
<td>PKG 102</td>
<td>No change</td>
</tr>
<tr>
<td>PKG 302L</td>
<td>No change</td>
</tr>
<tr>
<td>PKG 315</td>
<td>No change</td>
</tr>
<tr>
<td>PKG 319</td>
<td>No change</td>
</tr>
<tr>
<td>PKG 488</td>
<td>No change</td>
</tr>
</tbody>
</table>

Current Special Graduation Requirements

- ISTA Packaging Lab Technician Certification
- IoPP Packaging Professional In-Plant Training Certification
- OSHA 10 - Hr General Industry Safety Certification
- Lean Six Sigma Yellow Belt Quality Certification

Proposed Change

- No change

Current Degree Name

- BS in Engineering Management
- BS in Packaging Engineering Technology

Concentration: Packaging

Minor: Business Administration

Accreditation: None

Proposed Change

- BS in Packaging Engineering Technology

Concentration: Packaging

Minor: Business Administration

Accreditation: ABET Engineering Technology Criteria

Accreditation: ABET Engineering Criteria

Current Degree Name

- BS in Engineering Management
- BS in Packaging Engineering Technology

Concentration: Packaging

Minor: Business Administration

Accreditation: None

Proposed Change

- BS in Packaging Engineering Technology

Accreditation: ABET Engineering Criteria

Group | BSME Pkg | BSPT |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Communications</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Math</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Arts</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Science</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Business</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Engineering</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Packaging</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Elective</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>122</td>
<td>126</td>
</tr>
</tbody>
</table>

Proposed Change

- BS in Packaging Engineering Technology

Accreditation: ABET Engineering Criteria

Group | BSME Pkg | BSPT | BSPE |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Communications</td>
<td>6</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Art</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Math</td>
<td>11</td>
<td>11</td>
<td>30</td>
</tr>
<tr>
<td>Business</td>
<td>30</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>Engineering</td>
<td>12</td>
<td>12</td>
<td>38</td>
</tr>
<tr>
<td>Packaging</td>
<td>20</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>Elective</td>
<td>16</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>122</td>
<td>126</td>
<td>132</td>
</tr>
</tbody>
</table>

Proposed Change

- BS in Packaging Engineering Technology

ABET Engineering Criteria

Accreditation: ABET Engineering Criteria

PLTW Schools

Other High Schools

CBU ME Program (Transfer)

B.S. in Packaging Engineering Technology

CBU UNEN

ACT Prep

PLTW Schools

Private High Schools

B.S. in Packaging Engineering Technology

ABET Engineering Technology Criteria
EFFECT OF SLENDERNESS TO CORRUGATED FIBERBOARD AND BOXES

S. Malasri, A. Brown, C. Gordy, B. Knighton, A. Moses, K. Nicholson, and Z. Tabor

Corrugated Fiberboard
1” x 6”-16”

Corrugated Box
3” x 3” x 3”-60”

Previous Study
Specimen Width = 2”
Higher Stress
Specimen Width = 2”
Grip Width = 1”

Uniform Stress
Specimen Width = 1”
Grip Width = 1”

Current Study

Figure 4: Uniform Stress
Figure 5: Compression Test of Corrugated Fiberboard Strip

Figure 6: Compression Test of Corrugated Box
C-flute single-wall RSC Boxes
- 5"x5"x12"
- 5 each
- Approximate unsupported lengths of 12", 6", 4", 3"
Conditioning
- 73F / 50% RH
Compression Test

Previous Study

Table 4: Compressive Strength of 5"x5"x12" Corrugated Box at 75°F / 50% RH with Different Unsupported Heights

<table>
<thead>
<tr>
<th>Approx. Unsupported Height (in)</th>
<th>P1</th>
<th>P2</th>
<th>P3</th>
<th>P4</th>
<th>P5</th>
<th>P6</th>
<th>Favg</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>844</td>
<td>847</td>
<td>874</td>
<td>800</td>
<td>818</td>
<td>808</td>
<td>810</td>
</tr>
<tr>
<td>6</td>
<td>491</td>
<td>506</td>
<td>515</td>
<td>498</td>
<td>501</td>
<td>494</td>
<td>499</td>
</tr>
<tr>
<td>4</td>
<td>461</td>
<td>465</td>
<td>471</td>
<td>460</td>
<td>460</td>
<td>456</td>
<td>461</td>
</tr>
<tr>
<td>3</td>
<td>431</td>
<td>433</td>
<td>431</td>
<td>430</td>
<td>430</td>
<td>429</td>
<td>430</td>
</tr>
</tbody>
</table>
Current Study

<table>
<thead>
<tr>
<th>Ambient Conditioning</th>
<th>Specimen</th>
<th>P max [lb]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp F</td>
<td>RH %</td>
<td>LxW</td>
</tr>
<tr>
<td>74.1</td>
<td>55</td>
<td>73</td>
</tr>
<tr>
<td>74.1</td>
<td>55</td>
<td>73</td>
</tr>
<tr>
<td>74.1</td>
<td>55</td>
<td>73</td>
</tr>
<tr>
<td>74.1</td>
<td>55</td>
<td>73</td>
</tr>
<tr>
<td>74.1</td>
<td>55</td>
<td>73</td>
</tr>
<tr>
<td>74.1</td>
<td>55</td>
<td>73</td>
</tr>
<tr>
<td>74.1</td>
<td>55</td>
<td>73</td>
</tr>
<tr>
<td>74.1</td>
<td>55</td>
<td>73</td>
</tr>
</tbody>
</table>

Conclusion

<table>
<thead>
<tr>
<th>Ambient Conditioning</th>
<th>Specimen</th>
<th>P max [lb]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp F</td>
<td>RH %</td>
<td>LxW</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ambient Conditioning</th>
<th>Specimen</th>
<th>P max [lb]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp F</td>
<td>RH %</td>
<td>LxW</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ambient Conditioning</th>
<th>Specimen</th>
<th>P max [lb]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp F</td>
<td>RH %</td>
<td>LxW</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
<tr>
<td>73.9</td>
<td>47</td>
<td>73</td>
</tr>
</tbody>
</table>

Current Study

y 73 - 50 = -5.3504x + 408.06
R² = 0.9643

y 150 - 50 = -5.5273x + 422.85
R² = 0.96

y 150 - 10 = -8.2443x + 478.54
R² = 0.8559

y 73F 85%RH = -4.1257x + 300.62
R² = 0.9422

Average Maximum Compression Strength (lb)

Box Height (in)

Conclusion
PACKAGING IMPROVEMENT FOR THISTLE & BEE
S. Malasri, A. Brown, C. Gordy, B. Knighton, Z. Tabor

2019 HPC Fall Meeting, November 15, 2019, Memphis, TN

https://www.thistleandbee.org/

Protection
• Product Level
• Packaging Level

Environmental Friendliness
• Packaging Material Selection
• Shipping Box Optimization

Process Improvement
• Efficiency
• Cost

For a manual operation, it is more difficult to prepare cardboard partitions.

Using corrugated wrap to isolate jars in multiple-jar package.

Drop orientation of an empty jar without wrapper.

The jar shattered at 48-inch drop.
A jar with corrugated wrap was dropped at the same 48-inch drop height, which caused a small dent on the lid.

A honey jar with corrugated wrap was dropped at the same 48-inch drop height. Only a small hairline crack on the jar as shown. No shattering or leakage.

A new honey jar with corrugated wrap was dropped at 30-inch drop height. No damage was found.

The jar was dropped again at 48-inch drop height and a hairline crack was observed at the bottom of the jar as shown. No shattering nor leak was found.

Crinkle paper cushion looks better and is easier to use for product arrangement than the biodegradable peanuts.

A gift box was dropped at 48-inch drop height on one edge and one corner. Only a slight damage shown on a corner. The box lid did not pop out.
Using crinkle paper to cushion the products looks better than biodegradable peanuts.

Using corrugated wrap around honey jar protects damages of the jar and candle.

### Number of Gift Box | Recommended Shipping Box | Packing Arrangement
---|---|---
1 | 9x7x4 | ✓
2 | 9x8x8 | ✓
3 | 11x9x9 | ✓
4 | 16x8x8 | ✓
5 | 10x10x14 | ✓

Shipping box optimization

Use UPSable Peanuts (Biodegradable) to tighten up the unused space in shipping box.

Shipping box can be made from recycled paper.

A granola tray without a paper label was dropped at 48” height. No lid popping occurred. The tray was dropped again at the same height but with two paper labels on it. No lid popping occurred.

A granola tray without a paper label was dropped at 48” height on its side. The lid was popped out.

A granola tray with two paper labels was dropped at 48” height on its side. The lid was popped out slightly and some granular pieces could be seen on seams along the sides with no label.
A granola tray with four paper labels was dropped at 48" height on its side. The lid was popped out slightly and some granular pieces could be seen along seams.

A granola tray with four paper labels was dropped at 48" height on its corners. The lid was popped out slightly as shown.

Using four 1 ½ inch paper labels prevents popping of granular tray lid.
BOX COMPRESSION STRENGTH ENHANCEMENT

S. Malasri, D. Duckworth, A. Moses, J. Housewirth, G. Johns, and J. Davenport

2019 HPC Fall Meeting, November 15, 2019, Memphis, TN

1. Horizontal Brace
2. Diagonal Brace
3. Corner Post
4. Corner Stiffener

5. Horizontal Brace
6. Diagonal Brace
**Conclusion**

- Diagonal braces increase box compression strength.
- Double braces give more strength than single braces.
- Horizontal braces cut down box slenderness.
- More braces make the box stronger.

- Both interior and exterior posts increase compression strength of the box.
- Interior posts increase more strength than exterior posts.

- Corner stiffeners increase compression strength of the box.
- Longer stiffeners give better strength.