20-18 EOQ for a retailer.

1. \( D = 26,400 \text{ yards per year}, \ P = $165, \ C = 20\% \times $9 = $1.80 \text{ per yard per year} \)

\[
EOQ = \sqrt{\frac{2DP}{C}} = \sqrt{\frac{2 \times 26,400 \times $165}{$1.80}} = 2,200 \text{ yards}
\]

2. Number of orders per year:

\[
\frac{D}{EOQ} = \frac{26,400}{2,200} = 12 \text{ orders per year}
\]

3. Demand each working day

\[
= \frac{D}{\text{Number of working days}} = \frac{26,400}{250} = 105.60 \text{ yards per day}
\]

\[
= 528 \text{ yards per week (105.60} \times 5 \text{ days per week)}
\]

Purchasing lead time = 2 weeks
Reorder point = 528 yards per week \times 2 \text{ weeks} = 1,056 \text{ yards}
20-19  EOQ for manufacturer.

1. Relevant carrying costs per part per year:
   Required annual return on investment 15% × $60 = $ 9
   Relevant insurance, materials handling, breakage, etc.
   costs per year
   Relevant carrying costs per part per year $15

With D = 18,000 parts per year; P = $150; C = $15 per part per year, EOQ for manufacturer is:

\[ \text{EOQ} = \sqrt{\frac{2DP}{C}} = \sqrt{\frac{2 \times 18,000 \times 150}{15}} = 600 \text{ units} \]

1. Relevant annual ordering costs
   \[ = \left( \frac{D}{Q} \times P \right) \]
   \[ = \left( \frac{18,000}{600} \times 150 \right) \]
   \[ = 4,500 \]
   where Q = 600 units, the EOQ.

2. At the EOQ, total relevant ordering costs and total relevant carrying costs will be exactly equal. Therefore, total relevant carrying costs at the EOQ = $4,500 (from requirement 2). We can also confirm this with a direct calculation:

   Relevant annual carrying costs
   \[ = \left( \frac{Q}{2} \times C \right) \]
   \[ = \left( \frac{600}{2} \times 15 \right) \]
   \[ = 4,500 \]
   where Q = 600 units, the EOQ.

4. Purchase order lead time is half a month.

   Monthly demand is 18,000 units ÷ 12 months = 1,500 units per month.

   Demand in half a month is \( \frac{1}{2} \times 1,500 \) units or 750 units.

   Lakeland should reorder when the inventory of rotor blades falls to 750 units.
20-30  JIT purchasing, relevant benefits, relevant costs.

1. Solution Exhibit 20-30 presents the $37,500 cash savings that would result if Margro Corporation adopted the just-in-time inventory system in 2011.

2. Conditions that should exist in order for a company to successfully adopt just-in-time purchasing include the following:

   • Top management must be committed and provide the necessary leadership support to ensure a company-wide, coordinated effort.

   • A detailed system for integrating the sequential operations of the manufacturing process needs to be developed and implemented. Direct materials must arrive when needed for each subassembly so that the production process functions smoothly.

   • Accurate sales forecasts must be available for effective finished goods planning and production scheduling.

   • Products should be designed to maximize use of standardized parts to reduce manufacturing time and costs.

   • Reliable vendors who can deliver quality direct materials on time with minimum lead time must be obtained.
SOLUTION EXHIBIT 20-30
Annual Relevant Costs of Current Purchasing Policy and JIT Purchasing Policy for Margro Corporation

<table>
<thead>
<tr>
<th>Related Costs under Current Purchasing Policy</th>
<th>Relevant Costs under JIT Purchasing Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required return on investment</td>
<td></td>
</tr>
<tr>
<td>20% per year × $600,000 of average inventory per year</td>
<td>$120,000</td>
</tr>
<tr>
<td>20% per year × $0 inventory per year</td>
<td>$0</td>
</tr>
<tr>
<td>Annual insurance and property tax costs</td>
<td>14,000</td>
</tr>
<tr>
<td>Warehouse rent</td>
<td>60,000</td>
</tr>
<tr>
<td>Overtime costs</td>
<td></td>
</tr>
<tr>
<td>No overtime</td>
<td>0</td>
</tr>
<tr>
<td>Overtime premium</td>
<td>40,000</td>
</tr>
<tr>
<td>Stockout costs</td>
<td></td>
</tr>
<tr>
<td>No stockouts</td>
<td>0</td>
</tr>
<tr>
<td>$6.50(^b) contribution margin per unit × 20,000 units</td>
<td>130,000</td>
</tr>
<tr>
<td>Total incremental costs</td>
<td>$194,000</td>
</tr>
<tr>
<td>Difference in favor of JIT purchasing</td>
<td>$37,500</td>
</tr>
</tbody>
</table>

\(^a\)$13,500 = Warehouse rental revenues, [(75% × 12,000) × $1.50].

\(^b\)Calculation of unit contribution margin

<table>
<thead>
<tr>
<th>Selling price</th>
<th>$12.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable costs per unit:</td>
<td></td>
</tr>
<tr>
<td>Variable manufacturing cost per unit</td>
<td>$4.50</td>
</tr>
<tr>
<td>($4,050,000 ÷ 900,000 units)</td>
<td></td>
</tr>
<tr>
<td>Variable marketing and distribution cost per unit</td>
<td>1.00</td>
</tr>
<tr>
<td>($900,000 ÷ 900,000 units)</td>
<td></td>
</tr>
<tr>
<td>Total variable costs per unit</td>
<td>$5.50</td>
</tr>
<tr>
<td>Contribution margin per unit</td>
<td>$6.50</td>
</tr>
</tbody>
</table>

Note that the incremental costs of $40,000 in overtime premiums to make the additional 15,000 units are less than the contribution margin from losing these sales equal to $97,500 ($6.50 × 15,000). Margro would rather incur overtime than lose 15,000 units of sales.
20-31 (25 min.) Supply chain effects on total relevant inventory costs.

1. The relevant costs of purchasing from Maji and Induk are:

<table>
<thead>
<tr>
<th>Cost Category</th>
<th>Maji</th>
<th>Induk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10,000 boards × $93 per board</td>
<td>$930,000</td>
<td></td>
</tr>
<tr>
<td>10,000 boards × $90 per board</td>
<td></td>
<td>900,000</td>
</tr>
<tr>
<td>Ordering costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 orders × $10 per order</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>50 orders × $8 per order</td>
<td></td>
<td>400</td>
</tr>
<tr>
<td>Inspection costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10,000 boards × 5% × $5 per board</td>
<td>2,500</td>
<td></td>
</tr>
<tr>
<td>10,000 boards × 25% × $5 per board</td>
<td></td>
<td>12,500</td>
</tr>
<tr>
<td>Required annual return on investment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 boards × $93 per board × 10%</td>
<td>930</td>
<td></td>
</tr>
<tr>
<td>100 boards × $90 per board × 10%</td>
<td></td>
<td>900</td>
</tr>
<tr>
<td>Stockout costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 boards × $5 per board</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>300 boards × $8 per board</td>
<td></td>
<td>2,400</td>
</tr>
<tr>
<td>Return costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 boards × $25 per board</td>
<td>1,250</td>
<td></td>
</tr>
<tr>
<td>500 boards × $25 per board</td>
<td></td>
<td>12,500</td>
</tr>
<tr>
<td>Other carrying costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 boards × $2.50 per board per year</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>100 boards × $2.50 per board per year</td>
<td></td>
<td>250</td>
</tr>
<tr>
<td>Total Cost</td>
<td>$935,930</td>
<td>$928,950</td>
</tr>
</tbody>
</table>

2. While Induk will save Cow Spot $6,980 ($935,930 − $928,950), Cow Spot may still choose to use Maji for the following reasons:
   a. The savings are less than 1% of the total cost of the mother boards.
   b. With ten times the number of returns, Induk will probably have a negative effect on Cow Spot’s reputation.
   c. With Induk’s higher stockouts, Cow Spot’s reputation for availability and on time delivery will be effected.
   d. The increased number of inspections may necessitate the hiring of additional personnel and the need for additional factory space and equipment.
20-32 (20 min.) **Blackflush costing and JIT production.**

1. (a) Record purchases of direct materials
   - Materials and In-Process Inventory Control 546,000
   - Accounts Payable Control 546,000

(b) Record conversion costs incurred
   - Conversion Costs Control 399,000
   - Various Accounts (such as Wages Payable Control) 399,000

(c) Record cost of good finished units completed
   - Finished Goods Control\(^a\) 900,000
   - Materials and In-Process Inventory Control
     - 520,000
   - Conversion Costs Allocated\(^a\) 380,000

(d) Record cost of finished goods sold
   - Cost of Goods Sold\(^b\) 855,000
   - Finished Goods Control 855,000

\(^a\)20,000 \times ($26 + $19) = $900,000; 20,000 \times $26 = $520,000; 20,000 \times $19 = $380,000

\(^b\)19,000 \times ($26 + $19) = $855,000

2. **Diagram of Cost Flow**

   - Direct Materials
     - (a) 546,000
     - Bal. 26,000
   - Conversion Costs Allocated
     - (c) 380,000

   - Conversion Costs
     - (b) 399,000

   - Finished Goods Control
     - (c) 900,000
     - Bal. 45,000
   - Cost of Goods Sold
     - (d) 855,000
20-33  (20 min.)  **Backflush, two trigger points, materials purchase and sale**  
(continuation of 20-32).

1.
(a) Record purchases of direct materials  
   Inventory Control  
   Accounts Payable Control  
   546,000
(b) Record conversion costs incurred  
   Conversion Costs Control  
   Various Accounts (such as Wages Payable Control)  
   399,000
(c) Record cost of good finished units completed  
   No entry
(d) Record cost of finished goods sold  
   Cost of Goods Sold$  
   Inventory Control$  
   Conversion Costs Allocated$  
   855,000
   494,000
   361,000
(e) Record underallocated or overallocated conversion costs  
   Conversion Costs Allocated  
   Cost of Goods Sold  
   Conversion Costs Control  
   361,000
   38,000
   399,000

$19,000 \times ($26 + $19) = $855,000; 19,000 \times $26 = $494,000; 19,000 \times $19 = $361,000

2.

```
<table>
<thead>
<tr>
<th></th>
<th>Inventory Control</th>
<th>Cost of Goods Sold</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) 546,000</td>
<td>Bal. 52,000</td>
<td>(d) 855,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(e) 38,000</td>
</tr>
<tr>
<td>Conversion Costs Allocated</td>
<td>(e) 361,000</td>
<td></td>
</tr>
<tr>
<td>(b) 399,000</td>
<td></td>
<td>(e) 399,000</td>
</tr>
</tbody>
</table>
```

20-7
20-34  (20 min.)  **Backflush, two trigger points, completion of production and sale (continuation of 20-32).**

1.  
(a) Record purchases of direct materials  
No Entry

(b) Record conversion costs incurred  
Conversion Costs Control  
Various Accounts (such as Wages Payable Control)  
399,000

(c) Record cost of good finished units completed  
Finished Goods Control\(^a\)  
Accounts Payable Control\(^b\)  
Conversion Costs Allocated\(^a\)  
900,000  
520,000  
380,000

(d) Record cost of finished goods sold  
Cost of Goods Sold  
Finished Goods Control  
855,000

(e) Record underallocated or overallocated conversion costs  
Conversion Costs Allocated  
Cost of Goods Sold  
Conversion Costs Control  
380,000  
19,000  
399,000

\(^a\)20,000 \times ($26 + $19) = $900,000; 20,000 \times $26 = $520,000; 20,000 \times $19 = $380,000

\(^b\)19,000 \times ($26 + $19) = $855,000

2. 

\[
\begin{array}{c}
\text{Direct Materials} \\
\text{Conversion Costs}
\end{array}
\]

\[
\begin{array}{c}
\text{Conversion Costs Allocated} \\
\text{Conversion Costs Control}
\end{array}
\]

\[
\begin{array}{c}
\text{Finished Goods Control} \\
\text{Cost of Goods Sold}
\end{array}
\]

\[
\begin{array}{c}
(c) 900,000 \\
Bal. 45,000
\end{array}
\]

\[
\begin{array}{c}
(d) 855,000
\end{array}
\]

\[
\begin{array}{c}
(d) 855,000
\end{array}
\]

\[
\begin{array}{c}
(e) 19,000
\end{array}
\]

20-8
Lean accounting.

1. The cost object in lean accounting is the value stream, not the individual product. FSD has identified two distinct value streams: Mechanical Devices and Electronic Devices. All direct costs are traced to the value streams. However, not all plant-level overhead costs are allocated to the value streams when computing operating income. Value streams are only charged for the percentage of space they actually use, only 90% of the $200,000 plant facility costs are charged to the two value streams. The remaining 10%, or $20,000, is not used to compute value stream profits, nor are other corporate-level overhead costs.

2. Operating income under lean accounting are the following (in thousands of dollars):

<table>
<thead>
<tr>
<th></th>
<th>Mechanical Devices</th>
<th>Electronic Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales ($700 + $500; $900 + $450)</td>
<td>$1,200</td>
<td>$1,350</td>
</tr>
<tr>
<td>Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct materials purchased ($210 + $120; $250 + $90)</td>
<td>330</td>
<td>340</td>
</tr>
<tr>
<td>Direct manufacturing labor ($150 + $75; $200 + $60)</td>
<td>225</td>
<td>260</td>
</tr>
<tr>
<td>Equipment costs ($90 + $120; $200 + $95)</td>
<td>210</td>
<td>295</td>
</tr>
<tr>
<td>Design and marketing costs ($95 + $50; $105 + $42)</td>
<td>145</td>
<td>147</td>
</tr>
<tr>
<td>Plant facility costs ($200,000 × 40%)</td>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value stream operating income</td>
<td>$210</td>
<td>$208</td>
</tr>
</tbody>
</table>

In addition to the differences discussed in Requirement 1, FSD’s lean accounting system accounts for direct materials as expenses in the period the materials are purchased. The following factors explain the differences between traditional operating income and lean accounting income for the two value streams (in thousands of dollars):

<table>
<thead>
<tr>
<th></th>
<th>Mechanical Devices</th>
<th>Electronic Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional operating income ($100 + $105; $45 + $140)</td>
<td>$205</td>
<td>$185</td>
</tr>
<tr>
<td>Additional cost of direct materials purchased over direct materials used ($330 – $200 – $100; $340 – $250 – $75)</td>
<td>(30)</td>
<td>(15)</td>
</tr>
<tr>
<td>Decrease in allocated plant-level overhead ($50 + $40 – $80; $80 + $30 – $100)</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Add back allocated corporate overhead costs ($15 + $10; $20 + $8)</td>
<td>25</td>
<td>28</td>
</tr>
<tr>
<td>Value stream operating income</td>
<td>$210</td>
<td>$208</td>
</tr>
</tbody>
</table>
1. Solution Exhibit 20-37 presents the annual net benefit of $105,000 to Parson Container Corporation of implementing a JIT production system.

2. As part of the IMA’s Standards of Ethical Professional Practice, Sue Winston, the company controller has an obligation under the competence standard to “provide decision support information and recommendations that are accurate, clear, concise and timely”. Therefore, Sue must provide the cost benefit analysis to Parson’s senior management in a timely fashion, even if it could result in layoffs for some employees. The credibility standard also requires Sue to disclose any relevant information that could expect to influence an intended user’s decision. This would indicate that Sue has an ethical obligation to disclose the potential cost/benefits of the new JIT system to management.

3. It is understandable that Jim Ingram the company’s operations manager would be concerned about potential layoffs in his department and the resulting morale issues. However, recommendations could include 1) fully engage the production staff in the upcoming changes to minimize negative morale issues 2) retrain existing staff to manage the new JIT production and purchasing system, so as to avoid as many potential layoffs, as possible 3) relocate existing staff to other production and or administrative positions wherever possible to minimize layoffs. As for Jim’s other concerns, the new system will be costly to implement and maintain and there is a likelihood for additional stockouts, but the financial benefits clearly outweigh the costs.

**SOLUTION EXHIBIT 20-37**
Annual Relevant Costs and Benefits of new JIT Production System for Parson Container Corporation

<table>
<thead>
<tr>
<th>Relevant Items</th>
<th>Relevant Benefits under JIT Production System</th>
<th>Relevant Costs under JIT Production System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual additional costs for JIT system implementation and management</td>
<td>$220,000</td>
<td></td>
</tr>
<tr>
<td>Additional expected stockout costs $10,000 × 5% × $250</td>
<td></td>
<td>$125,000</td>
</tr>
<tr>
<td>Required return on investment: 10% per year × $2,000,000 × 75% of average inventory</td>
<td>$150,000</td>
<td></td>
</tr>
<tr>
<td>Insurance, and warehousing costs 60% per year × $350,000</td>
<td></td>
<td>$210,000</td>
</tr>
<tr>
<td>Reduction in payroll expense for current inventory management staff 15% per year × $600,000</td>
<td></td>
<td>90,000</td>
</tr>
<tr>
<td>Incremental revenues from higher selling prices</td>
<td>$450,000</td>
<td>$345,000</td>
</tr>
<tr>
<td>Total net incremental benefits/costs</td>
<td>$105,000</td>
<td></td>
</tr>
</tbody>
</table>

20-10