A DIRECT approach to resource efficiency in the food supply chain

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What a waste!

- Cost of waste not just waste disposal bill
- Purchase cost of the food itself
- Energy in cooling, freezing, cooking
- Staff time to prepare it, then throw away

E.g., 180 litre wheelie bin filled with food per week
$360 per week x 52 weeks
= $18,720 per year
Reasons for food waste in food manufacturing

- **Supply**: Under or overweight products and trimmings
- **Production**: Product spillage through and on conveyors and gutters
- **Packing**: Incorrect stacking of products
- **Dispatch**: Last minute order cancellations
Source food waste (AUS)

Excludes food that doesn't reach its intended market and is either donated to charity, sold at a lower market value (e.g., as stock feed) or recycled.
Food waste C&I sector 2012 (AUS)
Development of DIRECT

- July 2012 – June 2014
- City of Whittlesea, Plenty Food Group, Centre for Design & Society RMIT Uni
- Sustainability Victoria Beyond Waste Funded Project
- Assist Plenty Food Group manufacturers to increase resource efficiency
Site visits

20 companies: bakery, confectionary, food processing, pasta and cereals, beverages, fresh fruit and vegetables
Site visits

• Some seasonality in generation volumes but consistency in percentage composition
• Generally production main source of waste
• There was an awareness of wastage of resources
• For some, volume too small to have viable alternative systems
• General desire to implement sophisticated resource efficiency procedures
DIRECT
Dynamic Industry Resource Efficiency Calculation Tool
www.directool.com.au
DIRECT Calculation Module

**INPUTS**

- Data collection
- Site assessment
- Results and report
- Hot spot analysis

**OUTPUTS**

- Review Benchmark Improve

**BUSINESS COSTS**

**Tips & Practices**
INPUTS in Calculation Module

- Food ingredients
- Packaging inputs
- Other inputs
- Energy
- Water

- Mass per annum (kg)
- Raw material purchase cost per annum ($)
- Approx. waste per annum (%)
- Approx. waste avoidable per annum (%)

2015 NATIONAL TECHNICAL FORUMS
OPEN INNOVATION & COLLABORATION
## INPUTS in Calculation Module

<table>
<thead>
<tr>
<th>Process Inputs</th>
<th>Average mass per annum (kg/year)</th>
<th>Average raw material purchase costs per annum ($/year)</th>
<th>Approximate waste p. a. (%)</th>
<th>Proportion of waste generated which is avoidable (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food ingredients</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flour, gums, spice, etc.</td>
<td>40000.00</td>
<td>$72,000.00</td>
<td>25.0%</td>
<td>10.0%</td>
</tr>
<tr>
<td>Green grocery</td>
<td>10000.00</td>
<td>$12,727.63</td>
<td>25.0%</td>
<td>5.0%</td>
</tr>
<tr>
<td>Grocery</td>
<td>15000.00</td>
<td>$145,000.00</td>
<td>25.0%</td>
<td>5.0%</td>
</tr>
<tr>
<td>Meat</td>
<td>5000.00</td>
<td>$39,043.62</td>
<td>25.0%</td>
<td>5.0%</td>
</tr>
<tr>
<td><strong>Packaging inputs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All trays</td>
<td>200</td>
<td>$3,975.04</td>
<td>5.0%</td>
<td>20.0%</td>
</tr>
<tr>
<td>Plastic trays and films</td>
<td>200</td>
<td>$8,361.94</td>
<td>5.0%</td>
<td>10.0%</td>
</tr>
<tr>
<td>Plastic films to cover contents</td>
<td>300</td>
<td>$6,364.24</td>
<td>5.0%</td>
<td>5.0%</td>
</tr>
<tr>
<td><strong>Other inputs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand towels</td>
<td>300</td>
<td>$1,172.16</td>
<td>100.0%</td>
<td>10.0%</td>
</tr>
<tr>
<td>Labels</td>
<td>100</td>
<td>$8,335.62</td>
<td>5.0%</td>
<td>10.0%</td>
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<tr>
<td>Gloves</td>
<td>200</td>
<td>$822.56</td>
<td>5.0%</td>
<td>10.0%</td>
</tr>
<tr>
<td>Degreaser and detergent</td>
<td>1000</td>
<td>$1,164.00</td>
<td>100.0%</td>
<td>8.0%</td>
</tr>
<tr>
<td><strong>Packaged water inputs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>250000</td>
<td>$1,200.00</td>
<td>5.0%</td>
<td>50.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>322300.00</td>
<td>$201,119.38</td>
<td>5.7%</td>
<td>2.4%</td>
</tr>
</tbody>
</table>
OUTPUTS in Calculation Module

- Product
- Waste
- Packaging
- Wastewater

Costs per annum ($)
Income per annum (rebate/revenue $)
Volume per annum (cubic metre)
Contractor
## OUTPUTS in Calculation Module

<table>
<thead>
<tr>
<th>Process Outputs</th>
<th>Annual costs ($)</th>
<th>Annual income (rebate or revenue) ($)</th>
<th>Volume per annum (cubic meter)</th>
<th>Weight per annum (kg)</th>
<th>Contractor</th>
<th>Correct/confirm, and if needed, add some</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Waste outputs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Waste</td>
<td>$3,000.00</td>
<td>NA</td>
<td>1.0</td>
<td>250.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Packaging waste outputs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardboard and paper (average)</td>
<td>$1,000.00</td>
<td>NA</td>
<td>75</td>
<td>16342.5</td>
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<tr>
<td>Other Plastics</td>
<td>$200.00</td>
<td>NA</td>
<td>1</td>
<td>150.0</td>
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<td></td>
</tr>
<tr>
<td><strong>Wastewater output</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wastewater [average]</td>
<td>$500.00</td>
<td>NA</td>
<td>NA</td>
<td>225000.00</td>
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<td></td>
</tr>
<tr>
<td><strong>Product output</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross products sold in mass and revenue</td>
<td>NA</td>
<td>$5,000,000.00</td>
<td>NA</td>
<td>52500.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$4,700.00</strong></td>
<td><strong>$5,000,000.00</strong></td>
<td>77</td>
<td>234251.17</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### BUSINESS COSTS in Calculation Module

- Facilities
- Rent
- Energy
- Storage including freezing
- Freight
- Waste collection and treatment

Average costs per annum ($)
for overhead processes such as …
### BUSINESS COSTS in Calculation Module

<table>
<thead>
<tr>
<th>Business cost</th>
<th>Average cost per annum ($/year)</th>
<th>Related cost of waste management of this process per annum ($/year)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rent</td>
<td>$1,000,000.00</td>
<td>$97,288.62</td>
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<tr>
<td>Wages</td>
<td>$300,000.00</td>
<td>$29,160.69</td>
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<tr>
<td>Management</td>
<td>$200,000.00</td>
<td>$19,453.92</td>
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</tr>
<tr>
<td>Facilities (ex: rent)</td>
<td>$50,000.00</td>
<td>$4,663.48</td>
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<tr>
<td>Electricity</td>
<td>$10,000.00</td>
<td>$3,880.78</td>
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<tr>
<td>Gas</td>
<td>$25,000.00</td>
<td>$2,431.74</td>
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<tr>
<td>Storage (include freezing or fridge)</td>
<td>$20,000.00</td>
<td>$1,345.33</td>
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<tr>
<td>Freight</td>
<td>$3,000.00</td>
<td>$291.81</td>
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</tr>
<tr>
<td>Waste collection and treatment</td>
<td>$4,700.00</td>
<td>$4,700.00</td>
<td></td>
</tr>
</tbody>
</table>

*From inputs page, Efficiency percentage Applied to all business Costs (e.g., 9.7%)*

*From outputs page*
Results & reporting (Calculation Module)

Estimated true cost of waste
Results & reporting (Calculation Module)

Key production ratios for 1/01/2013 to 31/12/2013

- Utilised input to gross product ratio: 90.3%
- Stock holding to gross product ratio: 27.4%
- Food waste to solid waste output ratio: 104.5%
- Available waste to inputs ratio: 4%
- Available food waste to waste ratio: 24.6%
- Solid waste output to material input (excluding waste) ratio: 25.2%
- Packaging waste output to food input ratio: 23.6%
- Output packaging to gross product ratio: 1.8%
Hot spot analysis

- Each stage of production life cycle (supply chain of inputs to distribution of finished products and waste mgt) can be recorded
- Comprising
  - Observation
  - Resources involved
  - Opportunities and success stories
  - Descriptions and illustrations
  - Technologies and material involved
## Opportunities

<table>
<thead>
<tr>
<th>Stages</th>
<th>Observations we have made during our visit</th>
<th>Resources involved</th>
<th>Opportunities identified</th>
<th>Lessons learned</th>
<th>Technologies and materials (comments made during visit)</th>
<th>General insights (including numeric information)</th>
<th>Write your tags for future reference and efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply</td>
<td></td>
<td></td>
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<tr>
<td>Production</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Cleaning</td>
<td></td>
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<tr>
<td>Packing</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Dispatch</td>
<td></td>
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</tr>
<tr>
<td>Work in the office</td>
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<tr>
<td>Other (please add below)</td>
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</tr>
</tbody>
</table>
Review, Benchmark and Improve

- **Baseline**
  - Review input/output hotspots and true cost of waste / system efficiency ratios
  - Used to benchmark previous / subsequent production years

- **Improvements**
  - Can be predicted by modifying inputs and outputs and recalculating
  - Can be measured by benchmarking subsequent production years
Case studies

• November 2013 – March 2014
• Purpose:
  – Real time modelling of company data to judge how DIRECT would be used
  – To determine key gate keepers when using DIRECT
  – To determine key sources of data within companies to enter in DIRECT
  – Feedback on calculation module usability and value to business
  – Co-design of any changes required i.e., extra rations, functionality etc
  – DIRECT online feedback
Case studies

• Insights
  – Key gate keepers: generally accounts / finance, with interactions with production managers, etc.
  – Key data sources: digital inventory / accounts, paper bills, production floor measurements / estimations of waste, bin audits

“The development of DIRECT could provide us with the opportunity to involve production managers in using the tool for benchmarking and education, while empowering them to reduce hot spots of waste to potentially incentivise changes’.

“Packaging input to gross product ratio would assist in reporting for the Australian Packaging Covenant (APC).”

“Ratios given by DIRECT are good indicators of efficiencies in the food production system.”
• Launched: 26th June 2014
• www.directool.com.au
Contacts

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