

# Assessment and quantification of food waste control at point-of-packing: analysis of resource and process efficiency.

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## Introduction

Food waste within food manufacturing and retail is valued at £2.2 billion (WRAP, 2019) and ready-meals/chilled products produced in the food-sector are reported to generate >12% total waste in the food/drink supply chain due to issues such as machine performance problems and poor quality production (WRAP, 2016).

Resource efficiency and waste reduction in the food sector is considered to be a priority for business optimisation; minimisation of waste losses may also be of substantial financial benefit for food sector businesses and increase business sustainability.

To date, limited research has been conducted within food-sector businesses to quantify/assess specific waste inefficiencies in food manufacturing/processing.

## Purpose

This study aimed to determine and analyse food waste control in a high-care area of a chilled ready-meals company (>250 people), at point-of-packing.

## Methods

- Detailed, structured observational audits were undertaken along the chilled, ready-meal processing line.
- Repeated weight verifications were carried out on work-in-progress components and finished product.
- High-care line giveaway/over-depositing data was obtained from product lines such as complete meals (including protein) and accompaniments/dessert (n=8).
- Weight verifications (n=>1600) for key manufacturing process-control-points were determined and compared against company specified target/critical limits indicating weight tolerances.

## Results

- Weight verifications (n=>1600) on 8 products at point of packing indicated 'over-depositing' (n=3), within process depositing (n=3) and 'under-depositing' (n=2).
- In 37% of samples, over-depositing was observed on Stock-Keeping-Unit (SKU)-1, with between 1g-88g over-deposit, SKU-2 between 1g-141.5g and SKU-3 between 1g-119.0g. In these three products / SKUs averages were close to the target weight but it was the range of data that made the process not capable.

## References

- Waste and Resources Action Programme (WRAP) (2018) Waste reduction in the processed food sector. Internet Source: <http://www.wrap.org.uk/content/waste-reduction-processed-food-sector> [Accessed 09/06/19]
- Waste and Resources Action Programme (WRAP) (2019) Driving out waste in food & drink manufacturing and retailing. Internet Source: <http://www.wrap.org.uk/content/driving-out-waste-food-drink-manufacturing-and-retailing> [Accessed 02/11/19]

## Determination of High Care Line Giveaway

Data in Table 1 indicates the selected statistical data for finished product and component observational assessment in high-care. Key findings on capability indicated out of nine finished products and components, only one is capable of achieving target weight / process.

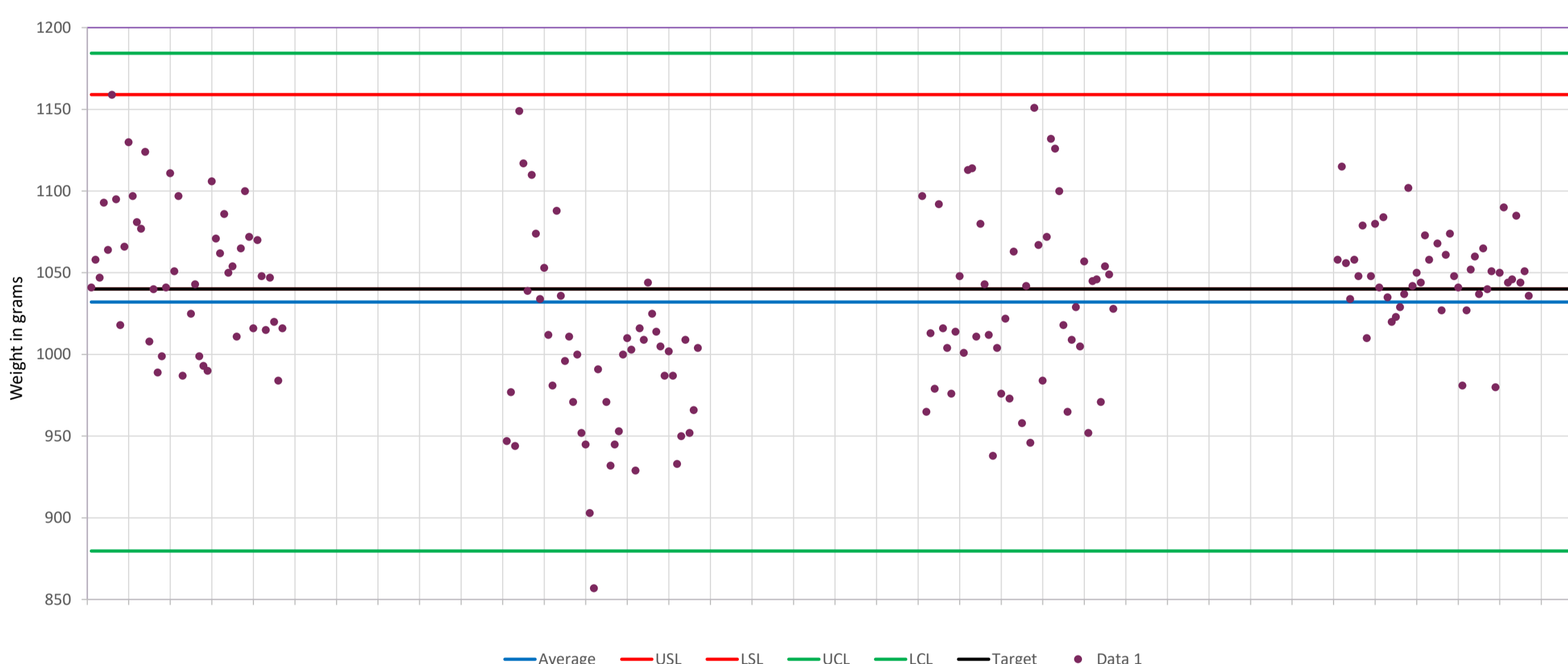
**Table 1. Waste audit analysis of selected finished products and components: specifications, actual process controls, statistical process controls.**

	FP 1	FP 2	C 3	FP 4	C 5	FP 6	C 7	FP 8	C 9
<b>Descriptive statistics</b>									
Number of samples (n)	110	90	123	144	86	184	138	128	124
Target (g)	800	840	37	380	75	1040	440	305	95
Average weight in grams (SD)	804 (32)	915 (10)	39 (1)	368 (12)	67 (5.5)	1032 (51)	449 (10)	304 (9)	90 (5)
% above / below target	0.47%	8.88%	5.44%	-3.09%	-10.28%	-0.77%	2.15%	-0.18%	-5.16%
<b>Specifications</b>									
Upper Specification Limit (USL)	810	982	40	415	86	1159	474	329	103
Lower Specification limit (LSL)	800	840	34	380	75	1040	440	305	95
<b>Actual Process Control</b>									
Upper Control Limit (UCL)	898.33	945.48	42.49	403.86	83.92	1184.35	479.16	332.37	105.47
Lower Control Limit (LCL)	709.12	883.72	35.53	332.67	50.66	879.68	419.76	276.56	74.72
<b>Statistical Process Control (SPC)</b>									
Capability of the process	0.05	2.29	0.86	0.49	0.32	0.39	0.57	0.44	0.25
Warning lines (+/- average)	63.07	20.58	2.32	23.73	11.09	101.56	19.80	18.60	10.25
Action lines (+/- average)	94.60	30.88	3.48	35.60	16.63	152.34	29.70	27.90	15.38

Key: SD = Standard Deviation; red shading = Process is not capable; green shading = process is capable

FP = Finished Product; C = Component

**Figure 1. Scatter diagram to illustrate distribution of product weight according to specification limits and control range: over depositing (FP 6).**



The graph (Figure 1) indicated that based on the specified target weight, the average weight data collected across the sample range is below the target weight.

The variance in weight data and can be seen on the graph, this is ultimately driving a process that is not capable.

The over depositing monetary value over a 6month period for the 3SKUs (finished product / SKU 1, 2 and 4), as shown in Figure 2 was cumulatively calculated as approximately £3,400.

In line with the finished pack over depositing, weight variance was seen in the raw materials which contributed to this.

Conversely, observations and weight verifications indicated substantial under-depositing (see finished products / SKUs 3 and 5 in Figure 2) on 25% lines of up to 82g per product.

**Figure 2. Costs associated with over and under depositing**

Finished product 1	Finished product 2	Finished product 4
<b>Over-deposit 30g</b> 0.000825 per g = 0.025ppp 6 months @ 9,598 units - <b>£239.95 raw material variance (RMV)</b> 12 month @ 19,196 - <b>£479.90 RMV</b>	<b>Over-deposit</b> 0.00285 per g 915g (over-deposit 75g) @ 6 months = 0.21ppp <b>£1,325.10 RMV</b> 930g (over-deposit 100g) @ 6 months = 0.26ppp <b>£1,640.60 RMV</b>	<b>Over-deposit</b> 0.0037 per g 1,100g (over-deposit 60g) @ 6 months = 0.222ppp <b>£1,830.39 RMV</b>
Finished product 3	Finished product 5	
SPC analysis conducted on cooked product Target weight cooked 75g x 2 pieces = 150g Average cooked weight 67g Cooked range 56.4g – 85.6g  <b>89% under target/minimum weight</b>	SPC analysis conducted on bought in cooked product Target weight 95g (spec 80-100g) Average weight of product based on actual SPC 75.6g – 102.8g  <b>78% under required target/minimum weight</b>	

## Conclusions

- Audit/weight verification data collated indicated considerable waste/product giveaway as well as under-depositing in SME high-care product lines highlighting the need for more effective product weight monitoring.
- Substantial financial savings may be achieved by implementation of processing control and efficiency methods to reduce product wastage.