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Firma, Ort/Company, Location: <b>Kostal Ireland GmbH</b>				Datum/Date: <b>20/07/22</b>

Betreff, Teilnehmer/Reference, Participants: Bertie Harte KOI

## Project Concept – First-Off Reduction (inspection time) by utilising HU information.

### 1.0 Scope:

This report details a concept to reduce first-off inspection time by identifying components to inspect based on HU distribution from MES XML data.

### 2.0 Status:

This project is currently in data-analysis / evaluation phase – results indicate a significant time saving is possible, without compromising the integrity of out products.

### 3.0 Current Method Details:

The current method of first-off (RL\_09-33-232\_KOI\_E) requires the AOI operator to visually inspect a fully assembled Nutzen, using autoview to ensure each placement is correct.

This process is time consuming, particularly where small lot sizes result in many first-offs to be completed.

As a compromise production requested that the requirement be reduced to a single PCBA per first-off.

This method introduces a risk whereby multi-components (more than one reel of a single component are distributed across the whole nutzen) are potentially missed during the reduced single PCBA inspection.

AQT asked that I perform analysis to determine the minimum required level of inspection that would address this coverage gap.

The results of the analysis on a single article (10528945 BR223 MAX 10-up) shows that a minimum of 2 PCBA on bottom side and 3 PCBA on Top side are required to cover the multiple components distribution. (fig 1 & fig 2 in appendix)

Any PCBA level mapping, for the purpose of first-off reduction is mutable, ie. Regular optimisations occur during normal production that would make it difficult to define the exact PCBA that would need to be inspected. As such a more robust method of determining inspection requirements would need to be considered.

HU mapping provides the solution to this problem, and results in even greater potential time savings.

### 4.0 HU Mapping Details:

The MES assembly data contains the HU record of each placement per PCBA on a nutzen.

Analysis of the XML data shows that it is possible to identify all unique HU in use for the assembly.

Thus it is possible to reduce the number of inspection points (visual inspection during first-off) to a single ref-des for each distinct HU. (i.e. Where a number of placement positions are the same component, and the same HU a single inspection would cover all other occurrences.)

This method also identified the multi-components, as these have different HU, thus the risk is mitigated by identifying these placements – irrespective of PCBA location.

As the source of the data is the MES "Assembly" data, it is in real-time, i.e., it covers the mutable nature of the assembly process, closing the gap identified above.

The table below illustrates the actual requirements in terms of inspection site counts for each method, the time reduction can then be estimated based on the values. In all scenarios, the use of HU mapping represents the optimal inspection requirement to ensure capture and integrity.

#### NOTES ON TABLE DATA:

- \*Single PCBA does not account for multiple components – 11 HU would escape.
- \*\* Multi PCBA is full inspection of 2 x Bot + 3 x Top PCBA.
- \*\*\* HU Mapping inspects at a HU level, hence the Count (comp) is 104, due to common usage top/bot.

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	Side	Count(Ref Des)	Count (Comp)	Count of unique HU
	Bot	130	46	55
	Top	158	59	49
Current	Full Nutzen	2880	105	104
Proposal Production	Single PCBA*	288	105	93
Proposal Quality	Multi PCBA**	734	105	104
Proposal APF	HU Mapping***	104	104*	104

As can be seen, the production proposal introduces specific risk of missing HU due to multiple components.

The AQT counter proposal fully satisfies the requirements to verify each unique HU, while also reducing the number of inspection sites. However the inspection time would still be significant.

The most significant reduction, while maintaining 100% HU coverage in inspection sites is possible by using HU mapping to guide the operators during first-off.

Furthermore, if HU changes (reel splices) are detected in real time, and the new HU is validated, (single ref-des first-off) as soon as it is detected by MES, it removes the requirement to complete first-off inspection on changeovers, as all HU in use are validated.

While this represents a significant improvement from our current method, it requires advanced methods outside of the scope of this report. It may be explored as part of development of this project.

## 5.0 Further development and requirements:

- Currently the proposal has demonstrated that it will work as a concept.
- Full Implementation may be possible following MES upgrade.
- A fully autonomous solution will require integration of MES and AOI systems to monitor, alert and control the first-off procedure.
- An interim solution may be possible, pending approval of project progression.(Will be developed in house for testing purposes)

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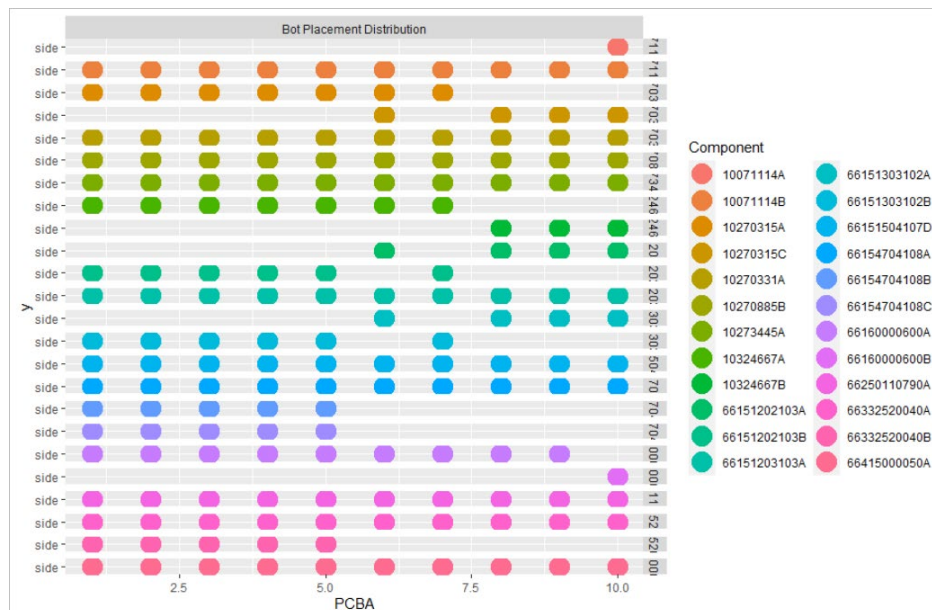


Fig. 1. Bottom Side Multi-Component distribution.

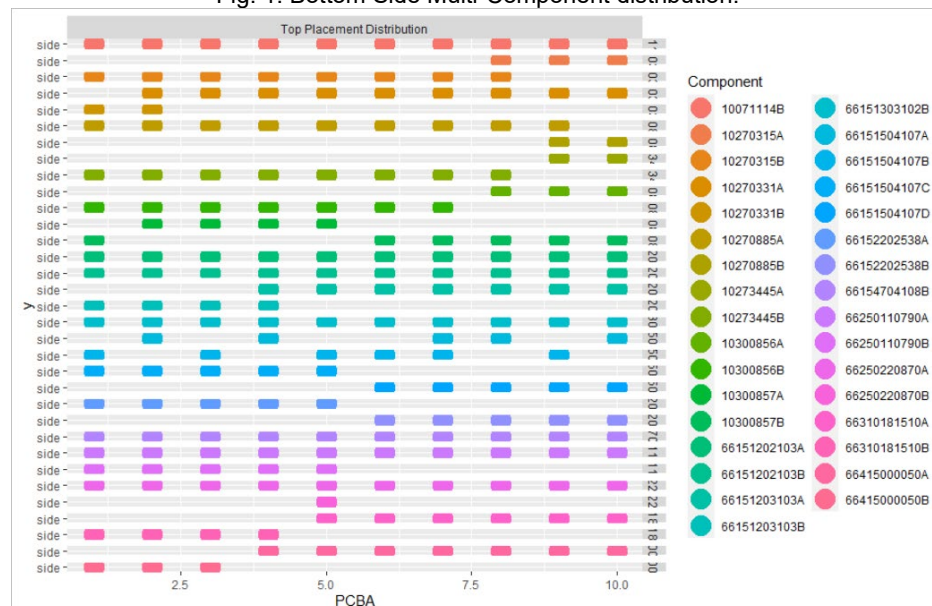


Fig. 2. Top Side Multi-Component distribution.