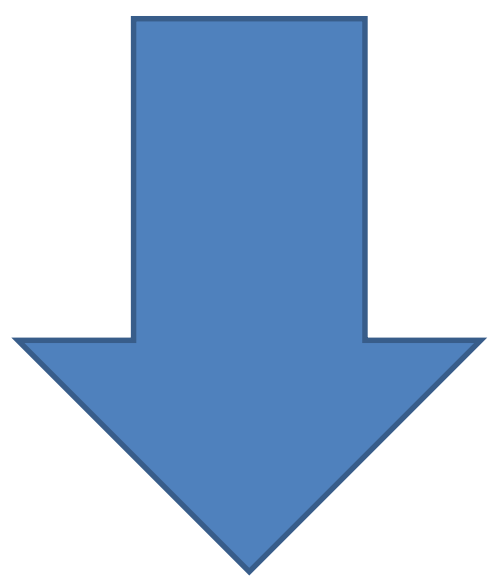# Z-Fact0r

Zero-defect manufacturing strategies towards on-line production management for European factories.

The Problem

European manufacturing sector is leading the world in areas such as automotive, machinery and agricultural engineering. However, it is threatened by both the lower-wage economies and other high-tech rivals, and the situation of EU companies was even made more difficult by the downturn. Nowadays, the efficiency and sustainability of the manufacturing processes of high-tech products depend on the introduction of Advance Manufacturing Technologies in the production processes. In particular, the development of metrology solutions for zero defect applications is considered as a robust technology able to provide a vast competitive advantage to manufacturing companies.

Z-Fact0r Overall Objective

Z-Fact0r aspires to enable manufacturing enterprises to achieve high precision manufacturing of complex products, and to initiate a fundamental rethinking process on how to increase the accuracy of machines and improve control. The improvement should not only concern the individual machines as isolated islands but encompass the totality of production process as a system of interrelated elements that seek to maximise efficiency, productivity, customer satisfaction; whilst at the same time eliminate waste and excess inventory.

The objectives are classified in three groups:
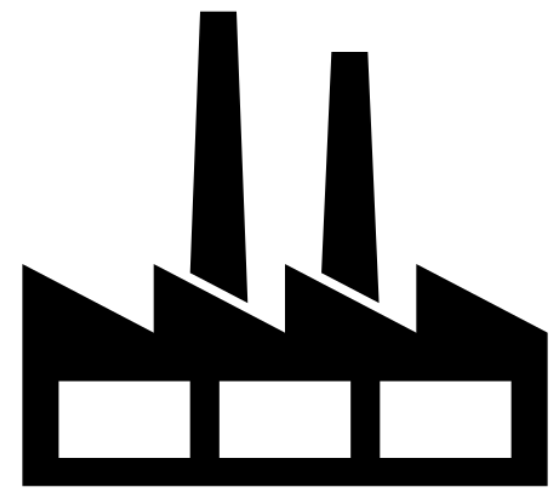
Industrial

Develop a sustainable manufacturing system, high performance and quality at cost-effective levels
Develop strategies for Zero defect manufacturing, synergizing human skills with technology
Develop a system integrating green scheduling, reducing resource consumption and waste generation

Economic
Social
Environmental
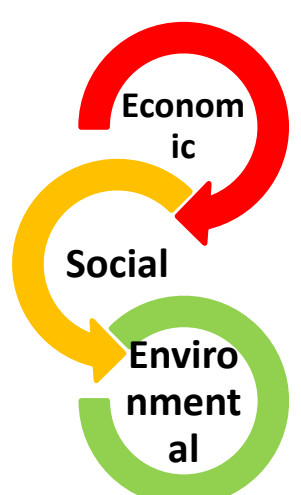
Sustainability

Technical

Monitoring of condition and performance
Detect defects parallel in production
Introduction of autonomous diagnosis capabilities and context-awareness
Develop a laser scanning solution detecting dimensional deviations
Install a sensor network to build autonomous real-time inspection & control and self adjustment
Integrate different strategies for monitoring and quality control
Employ adaptive learning controllers with >95% coverage of all cases
Develop an event modelling system for quality inspection
Employ green scheduling algorithms
Develop strategies for product rework to repair defects using Additive Manufacturing techniques

Standardisation

Standard Interfaces
Communication Protocols
Best-Practice Standards
Reduce checks, promote automatic checks, increase production
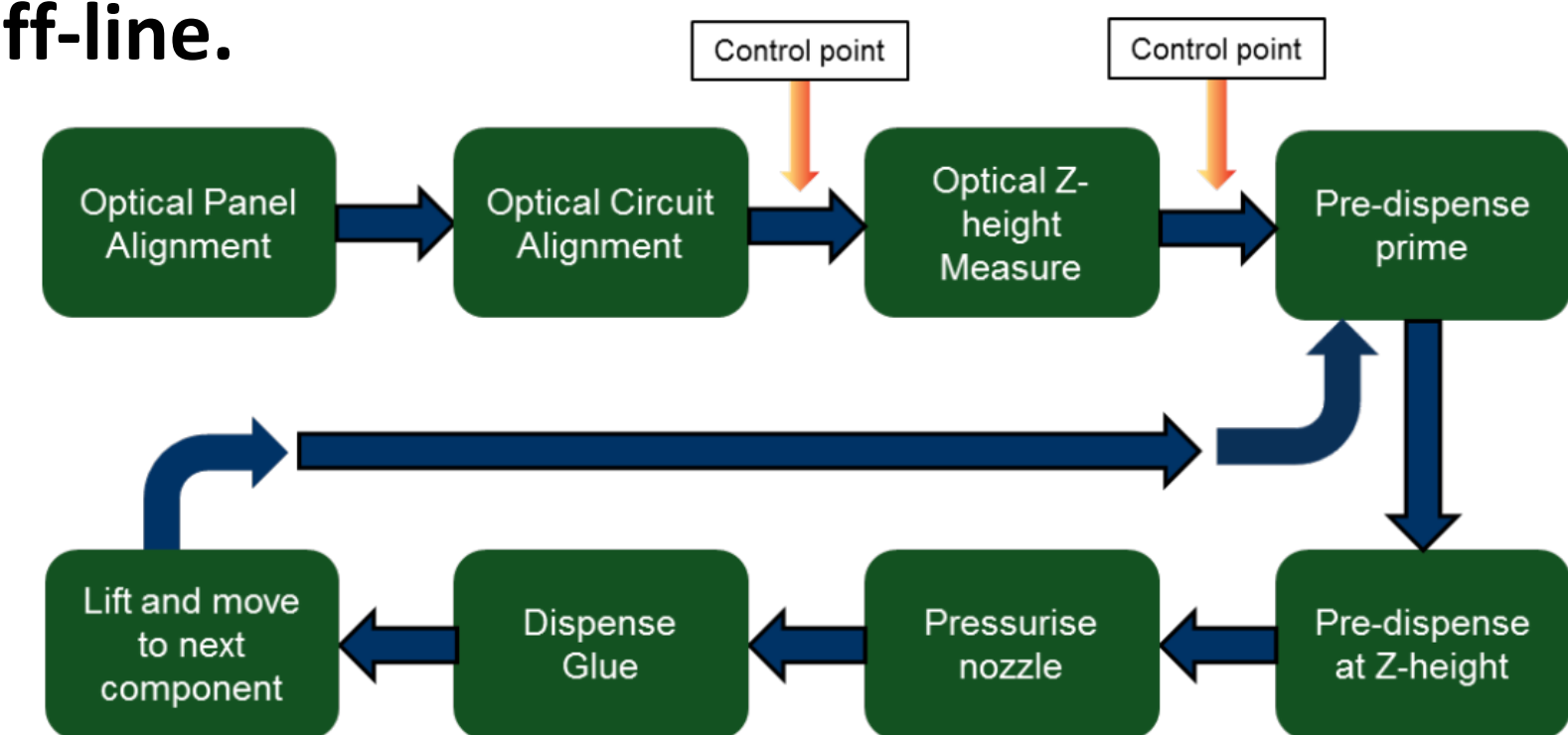Dissemination of innovation

The Approach
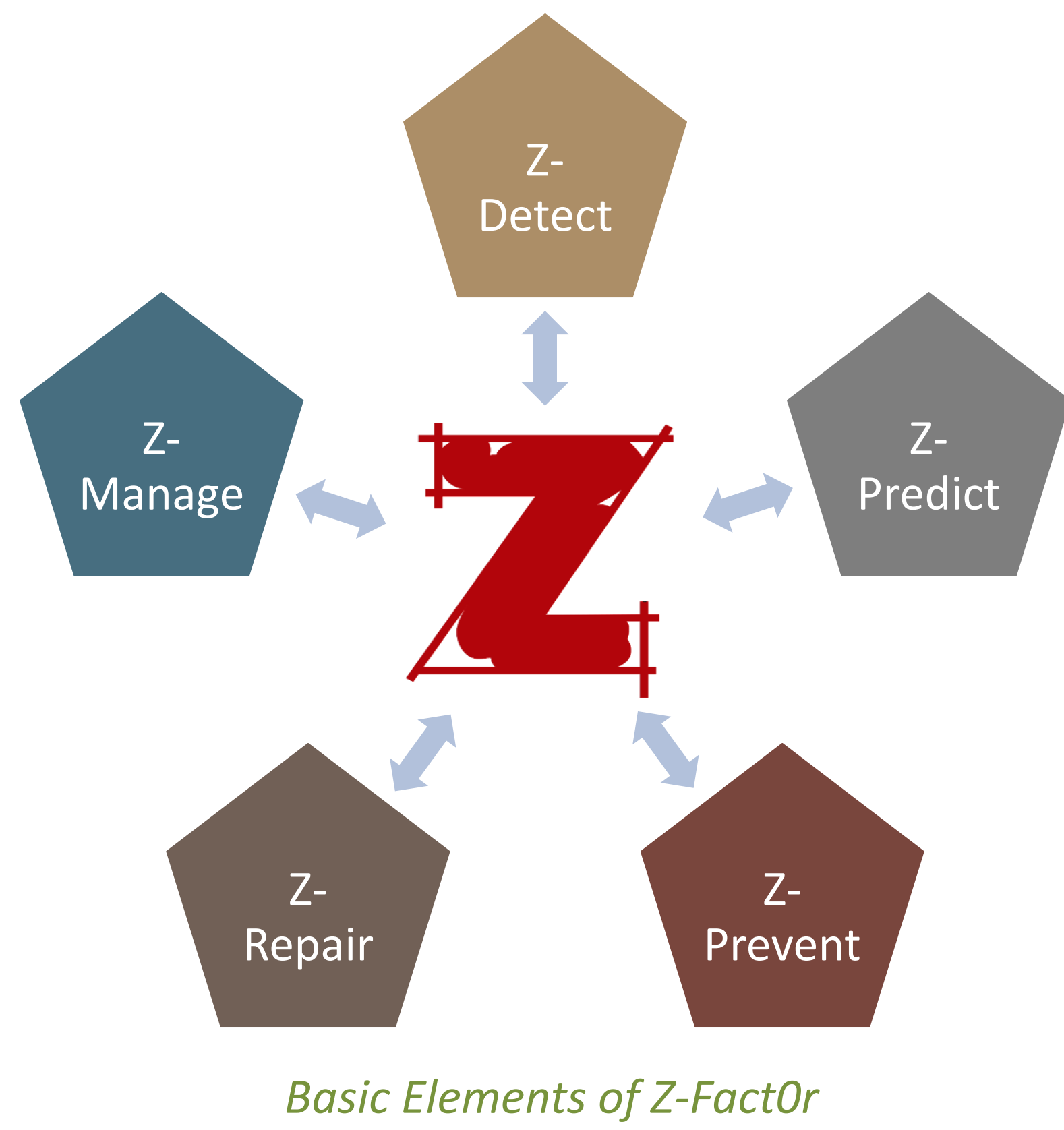
Basic Elements of Z-Fact0r
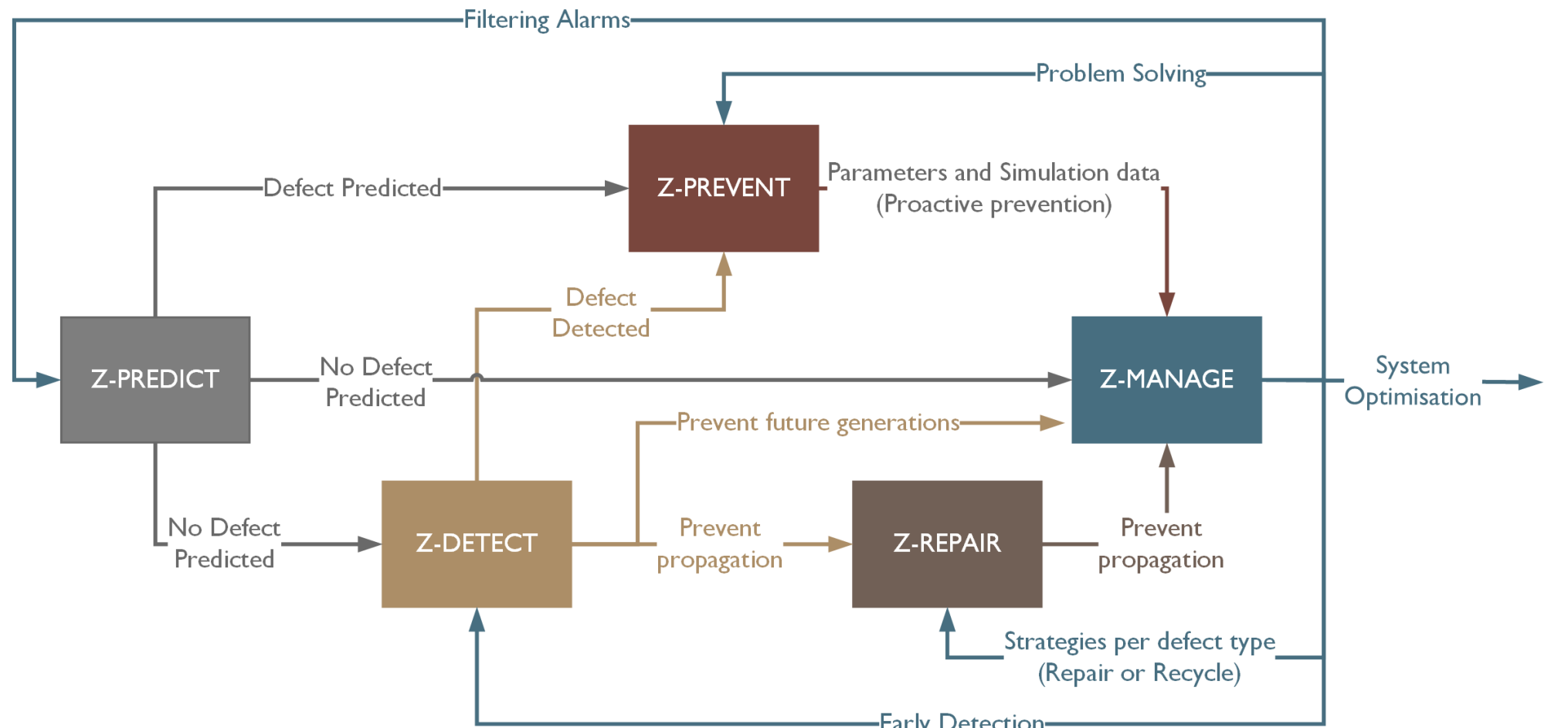
Microsemi use case

Microsemi Semiconductor Ltd, a division of the Microsemi Corporation, manufactures miniature electronic modules for medical, security and communication industries. During this use case, the manufacturing process of pcb's will be monitored and controlled. The assembly is a multistage process starting with Visual inspection of the base PCB, Glue dot dispense, Placement of the die/component, Glue cure, and Wirebond die. Z-Repair will be also implemented off-line.
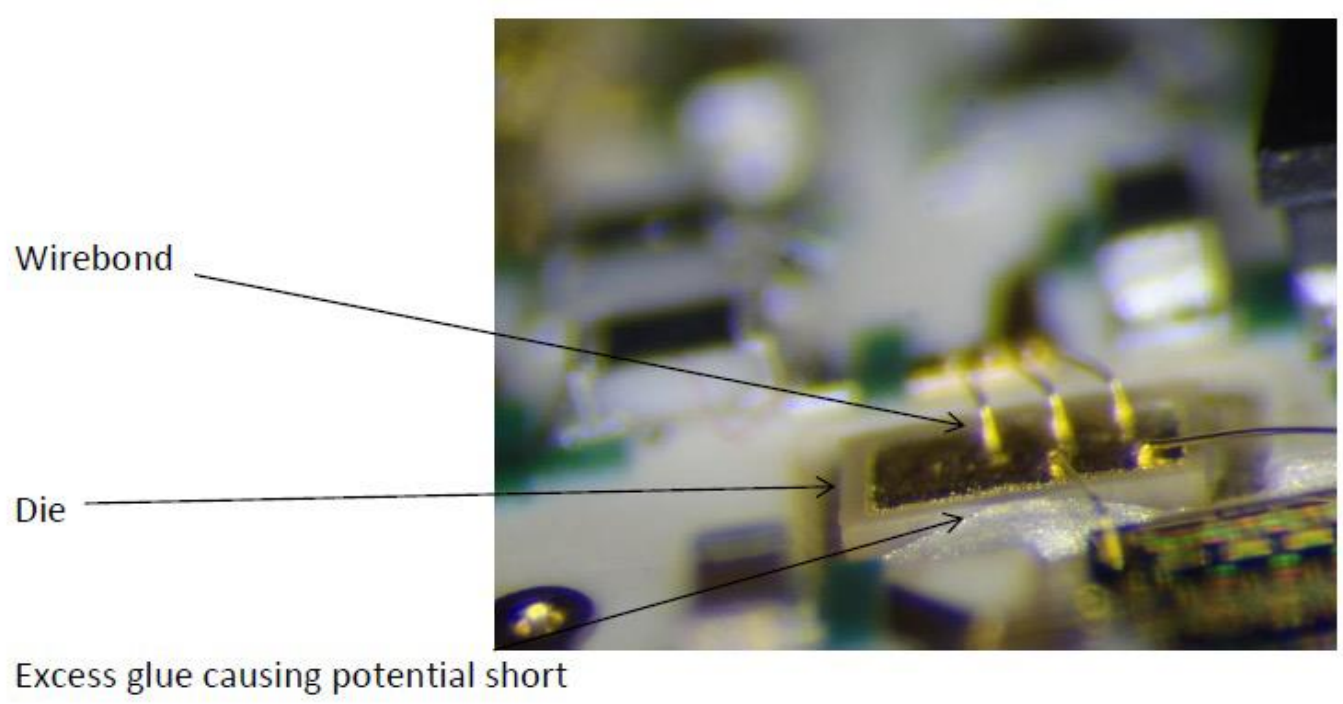

The Microsemi glue dot placement process

Outcomes

Z-Fact0r novel correlation of machine behaviour with the process performance and the produced quality will provide a vital feedback to the control loop in manufacturing systems. Key benefit of the Z-Fact0r employment will also be the reduction of the maintenance and inspection costs as well as the repair costs due to the reduced number of breakdowns due to the optimised performance. Economic and environmental benefits are expected on a EU-wide scale. Z-Fact0r will also noticeably increase the demand for highly skilled personnel, influencing society in a decisive way.

Strategies

The Z-Fact0r solution comprises the introduction of five (5) multi-stage production-based strategies targeting (i) the early detection of the defect (Z-DETECT), (ii) the prediction of the defect generation (Z-PREDICT), (iii) the prevention of defect generation by recalibrating the production line (multi-stage), as well as defect propagation in later stages of the production (Z-PREVENT), (iv) the reworking - remanufacturing of the product, if this is possible, using additive and subtractive manufacturing techniques (Z-REPAIR) and (v) the management of the aforementioned strategies through event modelling, KPI (key performance indicators) monitoring and real-time decision support (Z-MANAGE).
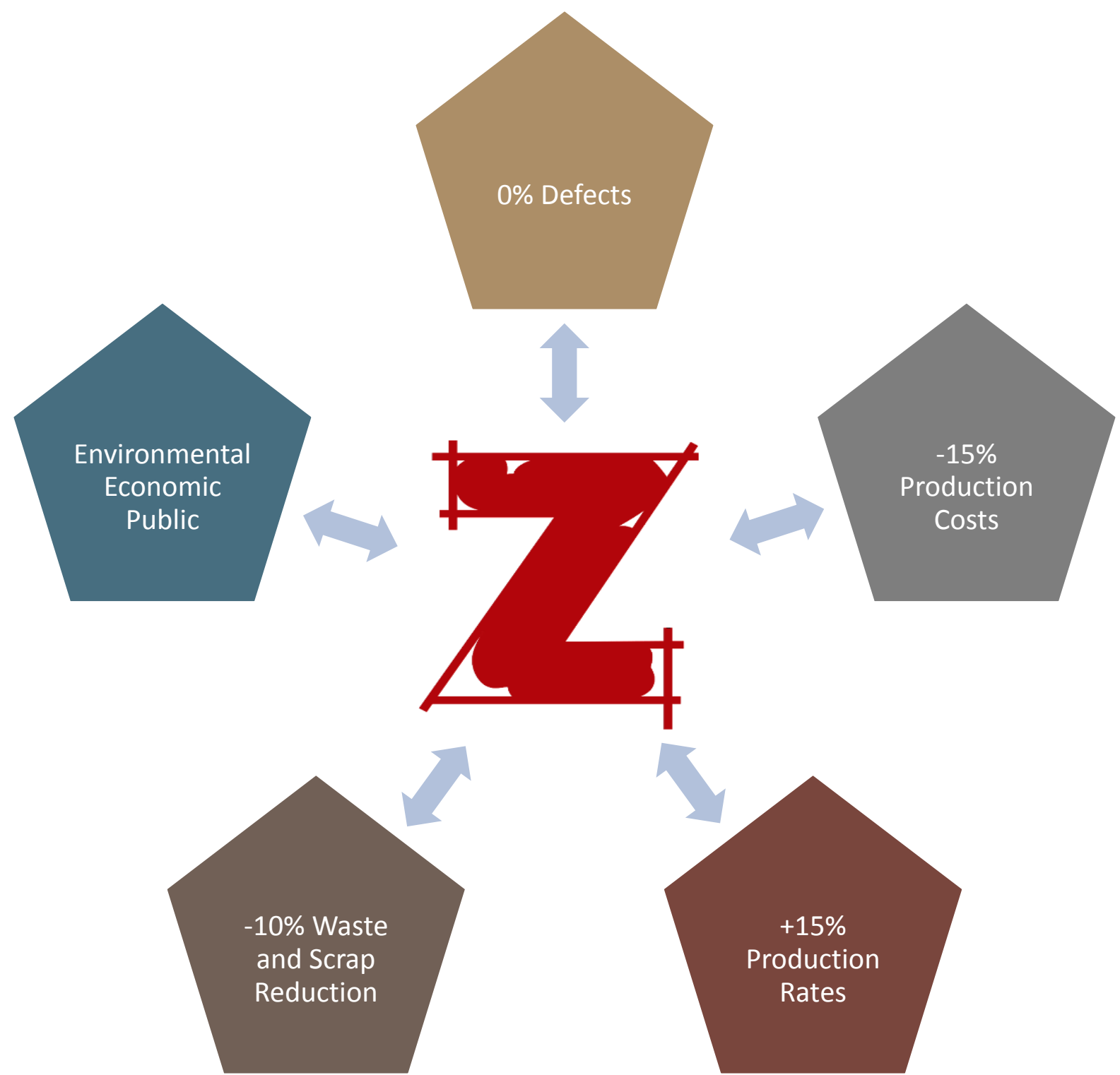

Synergies and interactions between the five Z-Fact0r strategies

Microsemi use case defect type

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