

Industrialisation Trends for Active Magnetic Bearings in the Turbomachinery Industry

ISMB 14
Linz, Austria
August 2014



**WAUKESHA
MAGNETIC
BEARINGS**

A Waukesha Bearings Business

EXPERT ENGINEERING. PROVEN RESULTS.



INTRODUCTION

Introduction

Thirty Years and Hundreds of
Heavy Industrial Applications



EXPERT ENGINEERING. PROVEN RESULTS.

Introduction

- Oil & Gas with trends both upstream & downstream from midstream
- Power Gen (notably, gas cooled nuclear)
- Size: 1-50 MW with most below 25 MW

Introduction

- Three generations of technology w/ 3rd now being introduced
 - 1st Generation: mid 1980's until mid 1990's
 - 2nd Generation: mid 1990's to present day



GLOBALIZATION OF OPERATIONS

EXPERT ENGINEERING. PROVEN RESULTS.

Global Footprint to Support Growing Markets



Globalization of Operations

- Sales
- Manufacturing in Three Locations (China, UK, US)
 - ISO 9001 & 14001 in all locations
- Project engineering
- Product development
- Commissioning & Aftermarket Service
 - Including training programs in China, Japan, Russia, Saudi Arabia, US
 - Formal Obsolescence Policy

Global Operations Footprint



Antigo / Pewaukee

- 180 Employees
- 64,000 sq. ft.



Worthing, UK

- 50 Employees
- 30,000 sq. ft.



Suzhou, China

- 13 Employees
- 12,000 sq. ft.



West Greenwich, RI

- 53 Employees
- 30,000 sq. ft.



Russia

- 7 Employees
- 1,000 sq. ft.



DIFFERENTIATION FROM OTHER INDUSTRIAL PRODUCT

Differentiation from Other Industrial Product

- Highly engineered
- Project based order volume
- Wide spectrum of types for sourcing & processing
 - Mechanical
 - Electrical
 - Electronic
 - Software
- Relatively low volume in comparison to other industrial or consumer products
- Long time spans between generations



PRODUCT STANDARDISATION TRENDS

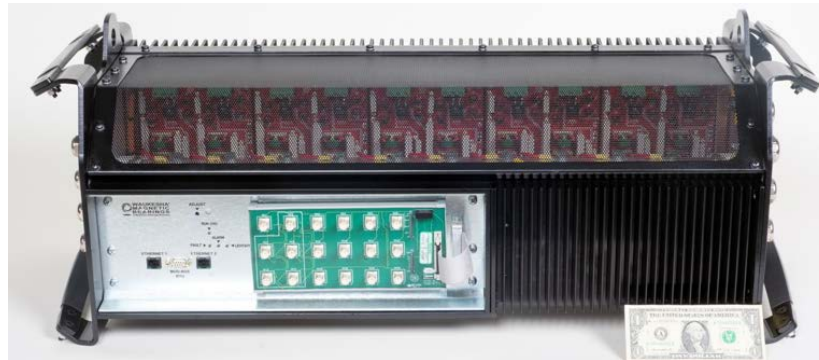
Product Standardisation Trends

- Centred on controls, not bearings



2 versions

4 versions



2 versions

Product Standardisation Trends

- Suggestion for sharing of electronics across AMB suppliers not supported
 - Seen as inhibitor to innovation
 - Costs reductions would also be impeded
 - Contrary to 'make or buy' trend



GLOBAL TREND TOWARD 'MAKE' FROM 'BUY'

Global Trend toward 'Make' from 'Buy'

- Examples D-R, GE, MDT, Siemens
 - Other OEMs have AMB technology in house e.g. KHI, MHI - there are undoubtedly others
- Rationale: Leveraging resources and related technologies that already exist

Global Trend toward 'Make' from 'Buy'

But this cycle was seen in fluid film bearing industry too

Waukesha, as a large worldwide bearing supplier, sees this trend reversing again

- Sharper focus by specialist suppliers
 - Cost and lead times
 - Aftermarket support
 - Product development



LEAN ENTERPRISE ACTIVITY

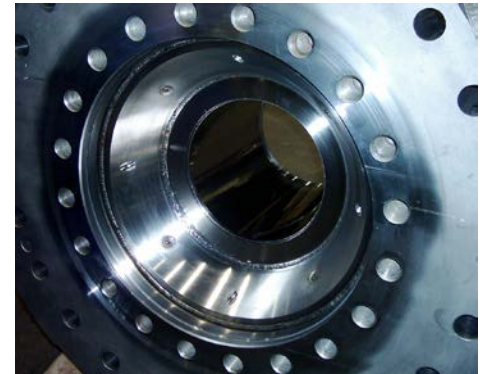
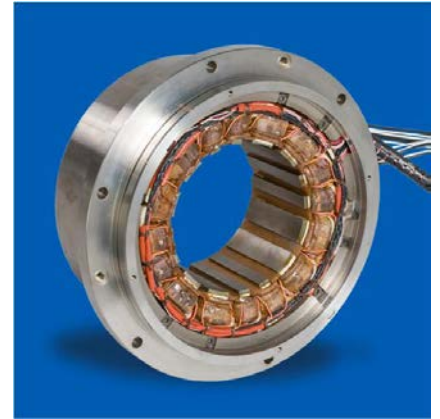
Lean Enterprise Activity

- Alignment and streamlining of supply chain with goals & values
- Six Sigma & Lean Manufacturing leading to
 - Cost reductions
 - Lead time reductions
 - While maintaining highest quality
- Continuous Improvement Program

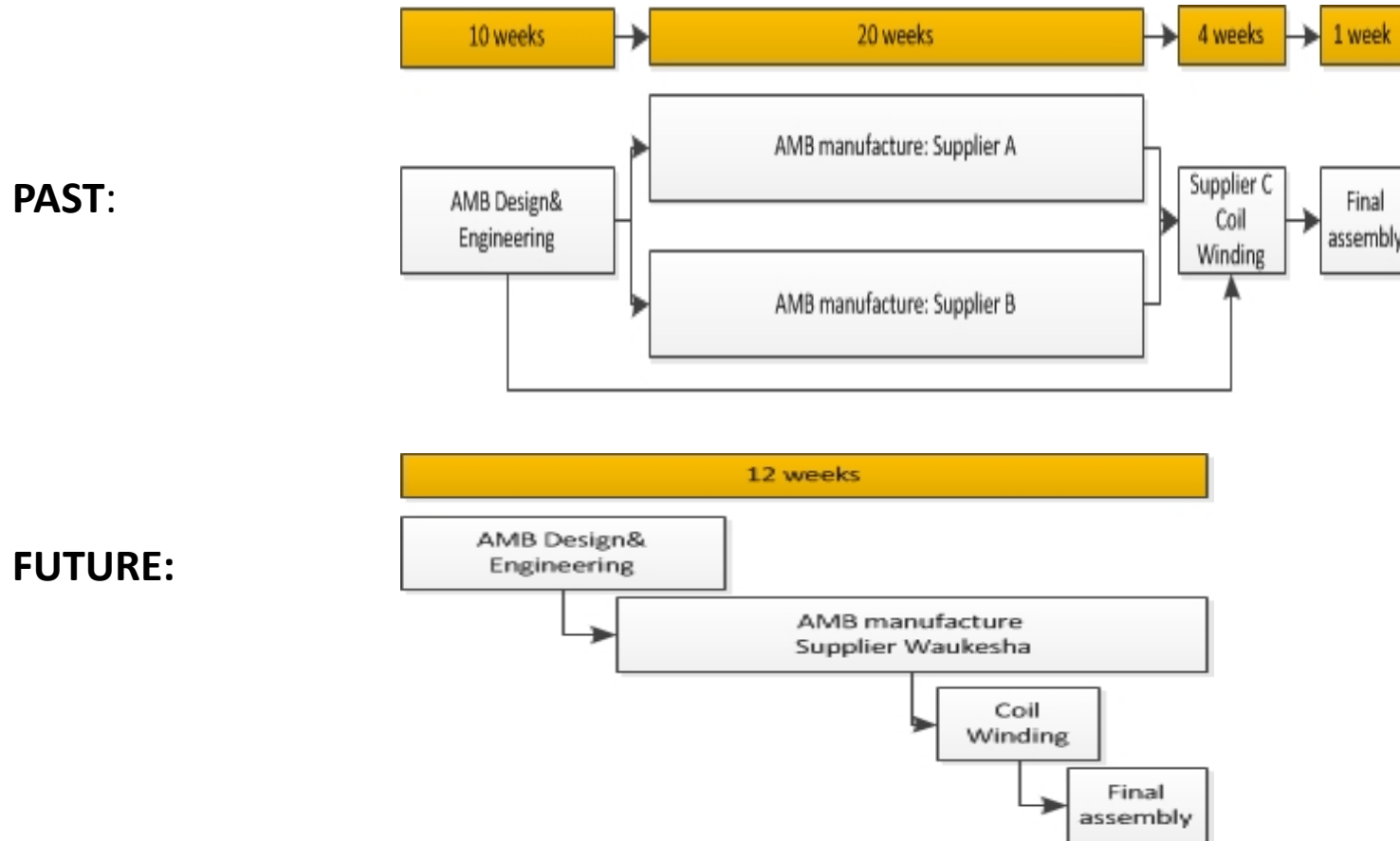
Bearing Lead Time Reduction Program

Future State

- Cross site project manager
 - Quality gates across all sites
 - Daily constraint meetings
 - First Past Occurrence to capture issues and prevent future occurrences
- Key processes brought in house
 - e.g. coil winding
- Concurrent design & manufacturing
 - e.g. staged machining



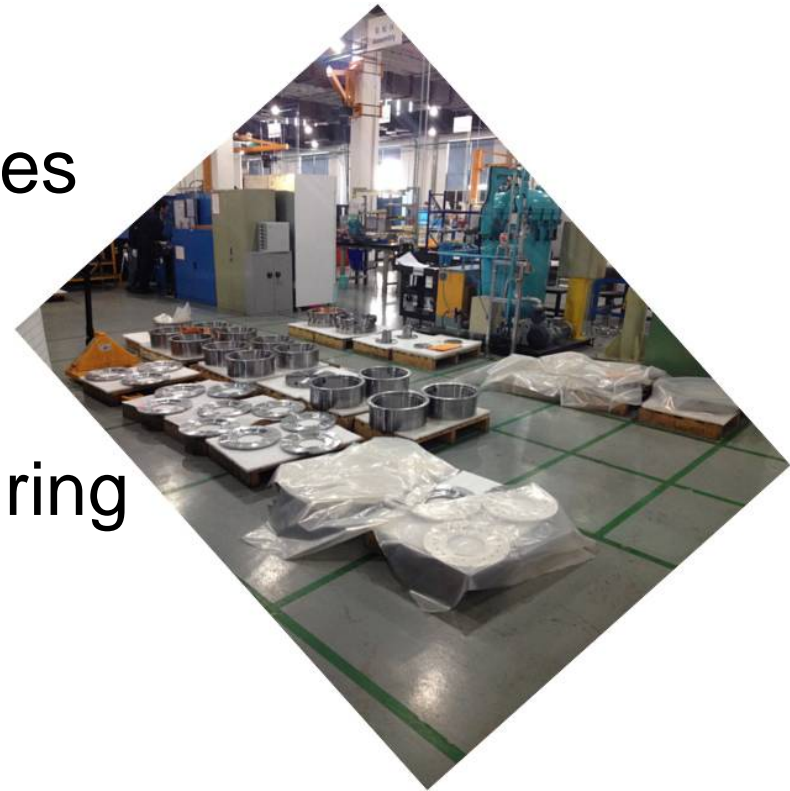
Bearing Lead Time Reduction Program



Bearing Lead Time Reduction Program

Benefits Summary

- Consistent, shorter lead times
- Increased Quality
- One Value Stream
- Engineering and Manufacturing in Synch
 - Design for Manufacture
 - Schedules aligned



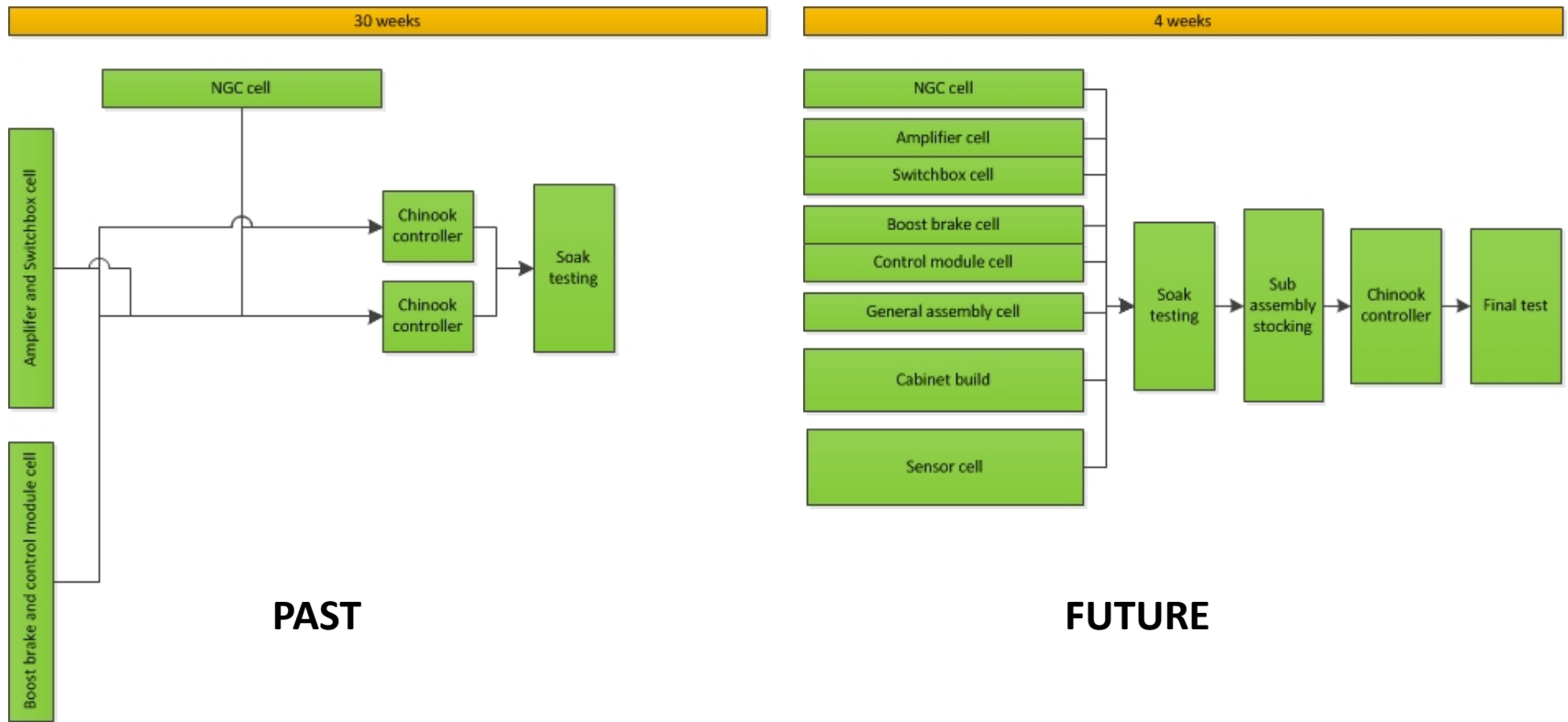
Controller Lead Time Reduction Program

Future State

- Single piece flow
- Consolidated supply base
- Demand Pulls
 - Replenishment system for consumables
 - High value items on supplier 'call offs'
- Standardized cell layouts
- Quality gates
- First Past Occurrence system



Controller Lead Time Reduction Program



Controller Lead Time Reduction Program

Benefits Summary

- Lead times: consistent, shorter and visible
- Build to stock via Demand Pull
 - Zero stock outs
- Elimination of contractors
- Increased Quality
 - 100% validation testing
 - Reduced infant mortalities
 - 5S daily audits
 - Consistent build areas, variations visible





IDEATION

