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Systems Engineering Gap Analysis for Aerospace Digitization

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Introduction

- **Etezazi Industries (Wichita, KS):** Manufactures machined parts for aerospace
- **Focus:** Addressing quality control challenges at Etezazi
- **Issue:** Inconsistent training and inspections compromise product quality and creates variability
- **Solution:** Exploring the role of Unified Modeling Language (UML) in improving processes [1]
- **Research Gap:**
  - Need standard manufacturing processes
- **Objective:**
  - Foster a culture of quality at Etezazi
  - Enhance training and minimize inspection errors

Background

- **Digital Transformation in Aerospace:**
  - Improves accuracy, efficiency, and consistency [2]
  - Improves competitiveness by enhancing training, quality, and operational resilience [3]
- **Unified Modeling Language (UML):**
  - Visual, structured method for mapping workflows
  - Optimize Quality Control measures through process gaps identification [1]
- **UML in Quality Control:**
  - Provides clarity in complex systems
  - Ideal for identifying areas of improvement

$$Error\ Rate\ (\%) = \frac{Number\ of\ Errors}{Total\ Inspections}\ x\ 100$$

$$Defective\ Products = \frac{Number\ of\ Defective\ Products}{Total\ Units\ Manufactured}\ x\ 1000$$

Methodology

A systematic application of UML was undertaken to analyze and improve Etezazi's quality control processes:

- **Process Mapping:**
  - UML diagrams visualized existing workflows, identifying gaps and areas for improvement [4]

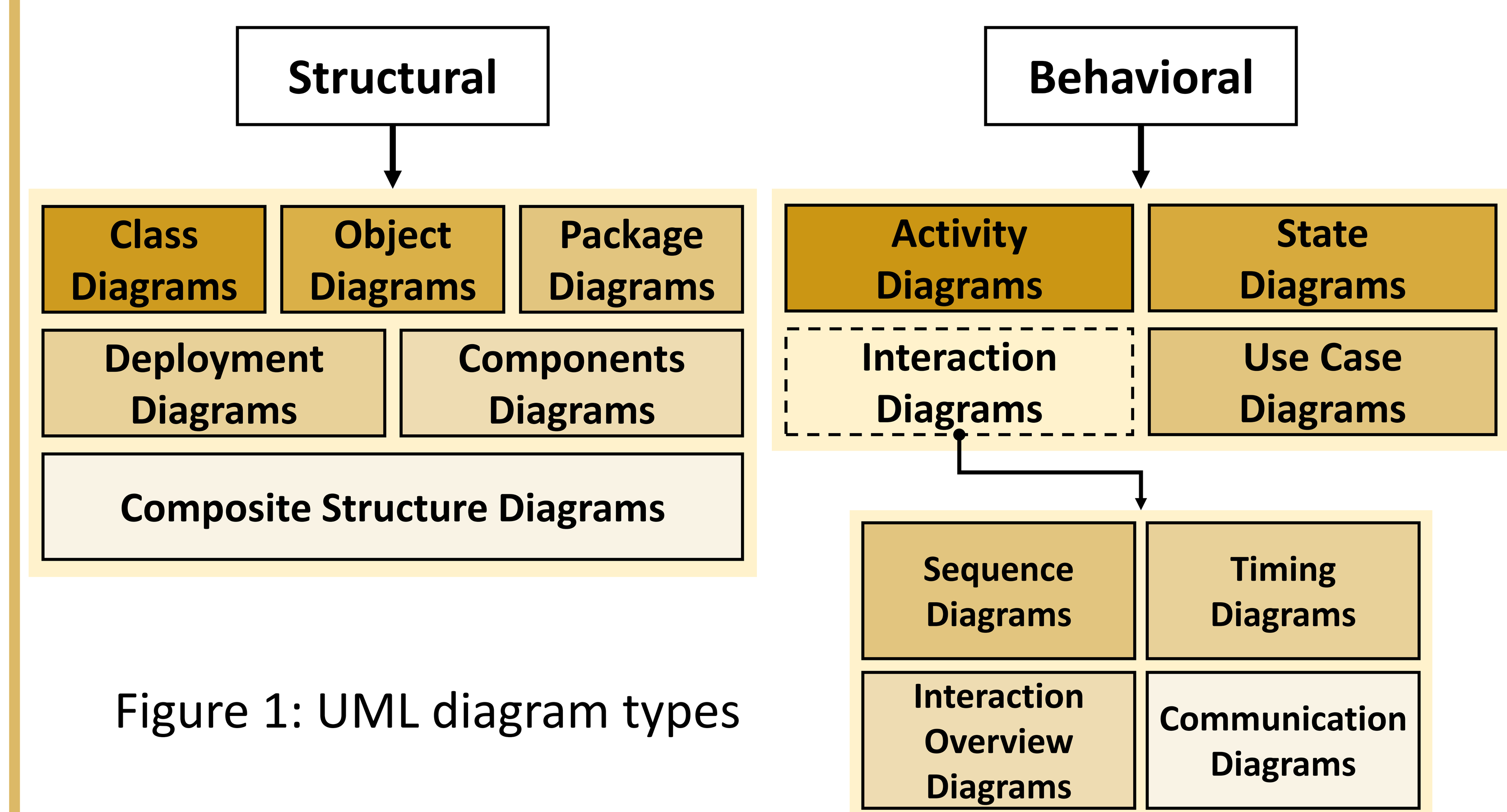

Figure 1: UML diagram types

- **Gap Analysis:**
  - Issues identified: inconsistent work instructions, outdated training, excessive manual inspection
- **Training and Onboarding:**
  - Created new training modules based on DWIs for faster, more consistent staff onboarding
- **Tool Implementation:**
  - Developed Digital Work Instructions (DWIs) to provide real-time unified guidance
  - Reduced error rates and defects through consistent and standardized instructions [5]

Results

Implementing UML-driven tools significantly improved quality control at Etezazi Industries:

Metric	Before Digital Transformation	After Digital Transformation	Improvement (%)
Time for employee training (days)	15	8	46%
Quality control error rate (%)	12	3	75%
Defective products per 1,000 units	5	1	80%
Time spent manual inspections (hours)	40	20	50%

Table 1: Digital transformation impact in quality control

Conclusion

- **UML Integration at Etezazi Industries:**
  - Improved quality control and efficiency
  - Optimized training programs
- **Future Directions:**
  - Use digital tools like VR/AR for enhanced training
  - Use automated analytics for quality assessments
- **Impact:**
  - A digitally driven quality control system ensures long-term competitive advantages in aerospace

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