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Quantifiable Service Quality (QSQ)

Design Quality Assessment
and
Improvement Methods and Tools

Ph.D. Research
Industrial Engineering
Doctoral Program

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Newark College of Engineering

Department of
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Kevin Moriarty

Bio: Industrial Engineering Doctoral Program, NJIT, MBA, BSIE

Ph.D. student a.b.d. 2020 – 2015

Assistant Professor, Undergraduate Program Director for TSM at Stony Brook University's College of Engineering CEAS 2013-present. Adjunct 2013-1997

Engineering experience; 2013 - 1974,
Senior executive technical operations (VP of Operations) 1995-2013.
> **Festo Corp VP of N. American Ops, Industrial Automation**
> **Thermo Fisher VP of Operations, Lab Equipment**

Manufacturing management 1989-95,
> **Siemens Corp Plant manager, Telecommunications**
> **Dayton T. Brown, Director of Manufacturing**

Manufacturing engineer, United Technologies 1981-1989
Civil engineer,1974-1981, US Army Corps of Engineers

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I Concept - Quantifiable Service Quality

II Maintenance & Service; Define and
describe three stages of maintenance
+ 4th generation

III Key Predictive Attributes (KPA's)
a- n...

III Modular Transform; Explanation of
4th generation of Maintenance

IV Data

V QSQ System

VI Summary

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QUANTIFIABLE SERVICE QUALITY (QSQ) A SYSTEM DESIGNED to REDUCE or ELIMINATE DOWN TIME

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Research a unique 4th generation Service Quality Method, resulting in a system of;

Quantifiable Service Quality

➤ Purpose;

- ➤ To investigate an application to quantify service quality outcomes and predict probable success and reduce equipment DOWN TIME!!

- ➤ Creation of Key Predictive Attributes (KPA's)
  - * Learning curve functionality
    - ➤ technicians experience
  - * Forecasting of outcomes
    - ➤ exponential smoothing function
  - * Etc. …

- ➤ Creation of a QSQ Index. This is the indicator of the service success standard

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Current Maintenance Stages

1- Preventive Maintenance

2- Predictive Maintenance

3- Corrective Maintenance

+ 4th Service Outcome

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➢ The QSQ approach is a method of identifying CNC operational KPA's when service is necessary and applying the unique service success prediction modular transform, know as the Moriarty/Ranky Transform (M/R T) within the QSQ system.

➢M/R T is a culmination (summation) of weighted factors given to KPA's of the given system, to generate a service outcome index value.

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➢ This research, has verified the three (3) existing types/stages of maintenance, which have been identified as generations;

➢ Preventive, Predictive & Corrective.

➢ The 4th Generation is the process of quantifying the prediction of success of any/all of the three types of maintenance in the previous generations.

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Inputs to the model:

- New equation application; Learning Curve;

>Yx = Steady State output (full efficiency),   Yx = aXb
>Where; a min percentage **(α)**, a max percentage **(β)**, and a most likely percentage **(χ)**
>are utilized to generate the Learning curve percentage (L), therefore L = **(**α + 4χ + β**)** / 6

- Newly developed Forecasting Value calculation:
  Unique Exponential Smoothing Method (UESM)

>This newly developed/enhanced forecasting method introduces a delta "Δ", factor &
>applies 50% of result to additionally smooth out the projected numerical result.

>F_{ex}= (1- α)(Last Actual Value) + 0.5Δ + α(Last Forecast)

Other KPA inputs; Maximum likelihood, Weibull Analysis, Financial factors,
>Customer Satisfaction, Value creation, Service weight factor, Service performance factor,
>Risk factor, etc.

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➤Activities:

> ➤ Creation of the Moriarty/Ranky Modular Transform (M/R T)
> ➤ Acquire CNC Lathe Data
> ➤ Patent Application
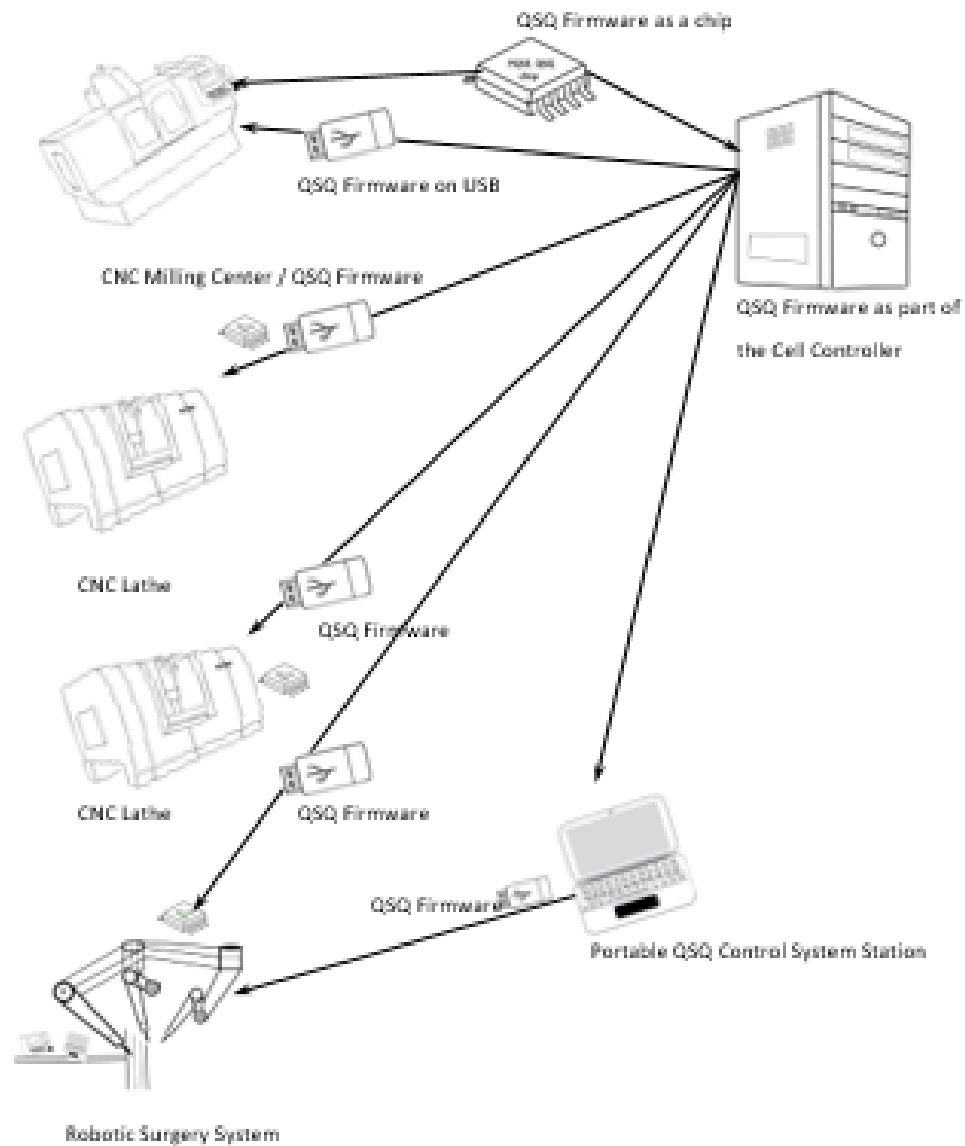> ➤ Create QSQ system
> ➤ Simulation
> ➤ Submitting papers for publication

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➤Investigation;

➤ Two (2) years of CNC Lathe Data
- Categorizing over 2000 operational lines of CNC code occurrences
- sub group creation
- incorporate into the QSQ M/R T modular transform

➤ Simulation: utilizing simulation software tools and data sets

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SUMMARY DATA

Power Up	148
Power Down	148
E-Stops	142
Failures	44
Problems	134
Servo Off	20

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QSQ Firmware as a chip

QSQ Firmware on USB

CNC Milling Center / QSQ Firmware

QSQ Firmware as part of the Cell Controller

CNC Lathe

QSQ Firmware

CNC Lathe

QSQ Firmware

QSQ Firmware

Portable QSQ Control System Station

Robotic Surgery System

➢ SUMMARY

➢Next Steps/ Further Research:

➢Refine and validate M/R T Modular Transform QSQ system math and modeling (simulation)

➢Test the system on CNC machines with additional CNC Data

➢Continue R&D & feedback loop