Energy-efficient and adaptive shop-floor Scheduling based on machine tools monitoring Ανάπτυξη μεθόδου λήψης αποφάσεων για τον χρονοπρογραμματισμό συστημάτων παραγωγής βασιζόμενο στην παρακολούθηση των εργαλειομηχανών και στην ενεργειακή κατανάλωσή τους

Motivation of the Thesis

The production scheduling needs to be adaptive and energy-efficient based on the shop-floor condition. Rescheduling is a daily issue in most of the industries including automotive, shipyards, etc.

Objectives

- Enable adaptive and energy efficient scheduling considering machine tools availability and energy consumption
- Identification of main constrains that need to be considered during rescheduling

Outcome / Results

- Literature review on adaptive and energyefficient scheduling
- Implementation of an algorithm for adaptive and energy-efficient scheduling based on machine tools status and energy consumption





Dynamic Shop-floor Scheduling: A mobile application for end-users Ανάπτυξη μεθόδου δυναμικής λήψης αποφάσεων για τον χρονοπρογραμματισμό συστημάτων παραγωγής

Motivation of the Thesis

The production scheduling needs to be dynamic and adaptive. Rescheduling is a daily issue in most of the industries including automotive, shipyards, etc.

Objectives

- Enable adaptive and dynamic scheduling. Rescheduling based on the shop-floor condition
- Identification of main constrains that need to be considered during rescheduling

Outcome / Results

- Literature review on dynamic and adaptive scheduling
- Implementation of **an algorithm for re-scheduling** taking into consideration the main constrains
- Software implementation of the re-scheduling algorithm





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Knowledge capturing using social analytics for adaptive workplaces Ανάπτυξη μεθόδου για λήψη και ανάλυση δεδομένων από την παραγωγή και τον εργαζόμενο με σκοπό την χρήση της γνώσης σε προσαρμοστικούς χώρους εργασίας

Motivation of the Thesis

The design, development and implementation adaptive workplaces based on knowledge capturing using social analytics

Objectives

- Enable adaptive design and implementation of workplaces based Social analytics that will allow to identify patterns and facts based on the worker satisfaction.
- The use of the generated knowledge in future adaptations of the workplace.

Outcome / Results

- Framework for capturing data/information by Industrial social networks
- Data analysis and generation of knowledge for adaptive design of workplaces based on worker's satisfaction



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Augmented Reality-based tools for human-automation interfaces Ανάπτυξη εργαλείων επαυξημένης πραγματικότητας για την επικοινωνία μεταξύ εργαζόμενου και αυτοματισμών

Motivation of the Thesis

Augmented reality (AR) tools for enabling interfaces between users (human operators, engineers,..etc) and manufacturing environment

Objectives

- Enable interfaces and interaction between end-users and automation
- Dynamic adaptation of the content of the AR tools based on the expertise and the profile of the end – users
- Flexibility and adaptability of AR trackers

- Development of **AR tools for enabling the human**automation interfaces
- Development of flexible and modular library for AR trackers

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Dynamic manufacturing networks design Ανάπτυξη μεθόδου δυναμικής λήψης αποφάσεων για τον σχεδιασμό δικτύων παραγωγής

Motivation of the Thesis

Manufacturing networks needs to be dynamic and adaptive. The design of the manufacturing networks considering the actual condition of the plants is a main issue.

Objectives

- Dynamic manufacturing networks design taking into account the actual condition of the network (plants, transportation, etc.)
- Identification of main constrains that need to be considered during dynamic design (due dates, etc.)

Outcome / Results

- Literature review on dynamic and distributed manufacturing networks
- Design and development of an algorithm for dynamic manufacturing networks design

Dynamic manufacturing networks design





Flexible Work-cells through Dynamic AR Instructions Ανάπτυξη μεθόδου δυναμικής εναλλαγής οδηγιών προς τους εργαζομένους σε γραμμές παραγωγής με την χρήση Επαυξημένης Πραγματικότητας

Motivation of the Thesis

Modern production lines have to be more flexible and to be connected to the shifting tasks, based on the dynamically changing scheduling

Objectives

- Connect the production line work- cell operators with the dynamically shifting scheduling
- Use Augmented Reality to visualize the tasks

Outcome / Results

- Literature review on dynamic and adaptive scheduling, work- cells flexibility and Augmented Reality
- Creation of an AR Database of work cell instructions
- Recalling of the AR instructions based on dynamically shifting schedule



AR goggles visualizations of shifting work cell tasks



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Augmented Reality-based tools for remote maintenance support Ανάπτυξη εργαλείων επαυξημένης πραγματικότητας για απομακρυσμένη υποστήριξη διαδικασιών επισκευής/συντήρησης

Motivation of the Thesis

Augmented reality (AR) tools for supporting remote maintenance though synchronous communication of the on- spot technician and a maintenance expert

Objectives

- Enable interfaces of communication between and onspot technician and a maintenance expert
- The technician may see a live feed from the technician's AR camera and positions instructions in the technicians' environment

Outcome / Results

- Development of **AR tools for enabling technician**expert communication
- Development of an interface for the maintenance expert to provide maintenance instructions







Augmented Reality-based mobile device applications tools for industrial robot Product Customization Ανάπτυξη εφαρμογών επαυξημένης πραγματικότητας για φορητές συσκευές για την παρουσίαση και εξατομίκευση προϊόντων: εφαρμογή στην βιομηχανία ρομποτικών βραχιόνων

Motivation of the Thesis

Augmented reality (AR) mobile device applications for industrial robot arm selection and customization

Objectives

- Enable the visualization of the available products and the allow the customer to add/ remove extra modules
- High- quality process simulation visualization
- Product parameter input defines the available products



Outcome / Results

- Development of **AR application for robot product** selection and movement visualization
- Parametric input allows the isolation of the correct products for each use

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Augmented Reality-based visualization of CAM instructions for machine operators Ανάπτυξη μεθόδου οπτικοποίησης οδηγιών για χρήστες εργαλειομηχανών μέσω της Επαυξημένης Πραγματικότητας

Motivation of the Thesis

Augmented reality (AR) visualization of the CAM instructions for the machine operators

Objectives

- Extract the data from the CAM software in a format that can be exploited in AR applications
- Automate the creation of the AR instructions, based on the CAM input
- Visualization of dangerous areas for the machine operator

- Literature review on Augmented Reality, CAM, safety in production lines
- Development of an automated solution of integrating CAM in AR instructions, along with safety warnings



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Collaborative product design through Augmented Reality Ανάπτυξη μεθόδου συνεργατικού σχεδιασμού προϊόντων με την χρήση Επαυξημένης Πραγματικότητας

Motivation of the Thesis

Augmented reality (AR) visualization of product designs coming from more than one design teams and evaluation of part fitting

Objectives

- Creation of a cloud platform where the designs from each design team is stored
- Callback of the designs in one application
- Use of physical mockups together with AR geometries

- Literature review on Augmented Reality, product design
- AR application that allows different design teams/ companies to evaluate how their designs fit with existing/ newly designed parts



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Design of production lines/systems using discrete event simulation Αναδιαμόρφωση γραμμών παραγωγής χρησιμοποιώντας προσομοίωση διακριτών γεγονότων

Motivation of the Thesis

Production lines and systems should be flexible. The design of the production lines/systems is a challenging process

Objectives

- Design of production lines/systems using discrete event simulation
- Identification of main constrains that need to be considered during design

Outcome / Results

- **Simulation model** preparation based on an industrial case
- Experiments for different demand profiles and discussion on the results





Predictive maintenance of machine tools based on real-time monitoring Ανάπτυξη μεθόδου προγνωστικής συντήρησης εργαλειομηχανών με χρήση δεδομένων παρακολούθησης της μηχανής σε πραγματικό χρόνο

Motivation of the Thesis

Maintenance is a core activity of the production lifecycle. Predictive maintenance approaches will support companies to avoid machine tools breakdowns and failures

Objectives

- Predictive maintenance approach based on real-time monitoring
- **Data analysis** and extraction of patterns to support predictive maintenance

Outcome / Results

- Design and implementation of the predictive maintenance algorithm
- Analysis of the monitored data in order to derive meaningful information for the status of the machine tool

Machine tool monitoring



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Collaborative product design platform for customized products Ανάπτυξη μεθόδου συνεργατικού σχεδιασμού εξατομικευμένων προϊόντων

Motivation of the Thesis

Collaborative design of customized products will support companies to produce targeted products in an cost and time efficient way

Objectives

- Design of a platform that will enable collaborative design
- User-adaptive design, and interaction with material and equipment suppliers to satisfy requirements

- Literature review on customization and personilization
- Design of a platform for collaborative design of customized and personalized products





Maintenance time estimation methods for engineer to order products

Σύγκριση μεθόδων για την εκτίμηση του χρόνου συντήρησης σύνθετων εξατομικευμένων προϊόντων

Motivation of the Thesis

Servitization and **Digitalization** of industry needs to be done following the **PSS Innovation**. Maintenance time estimation need to be predicted.

Objectives

- Engagement with Artificial intelligence, Statistical and Hybrid Methods
- Comparison of those methods in order to identify the best for maintenance time estimation for the scheduling of manufacturing systems bridging the gap of the research and practice

Outcome / Results

- Literature review on estimation/prediction methods
- Design and development of algorithms (Matlab)
- Toolkit for Mold industry



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Product Analysis, Design using Axiomatic Principles, Implementation using CAD-CAM Systems, CNC machine and 3Dprinting

Ανάλυση Προϊόντος, σχεδιασμός με χρήση αρχών αξιωματικού σχεδιασμού και υλοποίηση με χρήση CAD-CAM συστημάτων CNC μηχανής και 3Dprinting

Motivation of the Thesis

Timeless Importance of **Product Analysis** and **Design.** Use of **Axiomatic Principles** for maintaining the independence of the **functional requirements** and **minimizing the information content** of the design. Qualification of know **CAD-CAM**, **CNC** and **3Dprinting.**

Objectives

- Engage with Product lifecycle's stages
- Product Analysis and Design using Axiomatic Principles
- Learn CAD-CAM systems
- Learn how to use CNC machine & 3D printer

Outcome / Results

Literature review on Product Analysis and Axiomatic Design Practical learning of:

- CAD-CAM systems : Creation of product parts and assembly & export of G-code
- Use of CNC machine
- Use of **3D printer**



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Axiomatic Design for Product-Service System (PSS) Modelling and Evaluation Αξιωματικός Σχεδιασμός για την μοντελοποίηση και αξιολόγηση Συστημάτων Προϊόντος - Υπηρεσίας

Motivation of the Thesis

Product-Service Systems is an innovation strategy, shifting the business focus from designing (and selling) physical products only, to designing (and selling) a system of products and services which are jointly capable of fulfilling specific customer demand. For such system the conceptual design and evaluation comprise a great challenge

Objectives

- Finding of minimum number design parameters that are requested in the PSS design
- **Identification of main constrains** that need to be considered during axiomatic design (due dates, etc.)

Outcome / Results

- Literature review on PSS design and evaluation approaches
- Modeling and evaluation of PSS using Axiomatic Design method





Investigation of Approximation Algorithms for solving problems in Manufacturing Διερεύνηση Μεθόδων βελτιστοποίησης για την επίλυση προβλημάτων στην βιομηχανία μεταποίησης

Motivation of the Thesis

Through customization and personalization, the number of product and service variants have increased dramatically. The planning and scheduling of such complex production systems remains a great challenge. Several meta-heuristics algorithms have been developed through the years. These algorithms could be investigated to approximate good solution in several manufacturing problems.

Objectives

- Benchmarking of available algorithms to solve manufacturing problems.
- Identification of main constrains that need to be considered during the design phase of the problem

- Development of the approximation algorithms in Matlab
- Evaluation of the algorithms performance based on computational cost and statistical tests







Product-Service System (PSS) Complexity Modeling Μοντελοποίηση και Εκτίμηση της Πολυπλοκότητας των Συστημάτων Προϊόντος - Υπηρεσίας

Motivation of the Thesis

Mass customization and personalization together with the new trend of Product-Service Systems, transform the traditional manufacturing systems to systems of high complexity that contains numerous stakeholder. The modeling and the assessment of the complexity of such systems comprises a great challenge.

Objectives

- Design and development of accurate models for representing the complexity of the PSS.
- Estimation of PSS complexity

Outcome / Results

LMS

- Literature review on complexity modelling and assessment of conventional production systems
- Accurate models for representing the complexity of the PSS.
- The degree of complexity increment between the traditional production systems and PSS



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Information Theory for the investigation of Manufacturing Systems Θεωρία Πληροφορίας για την μελέτη των Συστημάτων παραγωγή

Motivation of the Thesis

Information Theory entropy has been widely used from many scientific fields over the year, as well as in the assessment of the uncertainty in different aspects of a manufacturing system.

The entropy model quantifies the information content that is included in sending or receiving feedback from an information source

Objectives

 Investigation on the main applications of information theory for assessing manufacturing aspects (e.g hierarchical production structure, product variety, assembly etc).

- Literature review on Information Theory approaches in manufacturing systems
- Case study that will include the implementation of Information Theory in several aspects. A real –life case study will be considered







Process planning and supply chain management in industries which provide Product Service Systems Σχεδιασμού διαδικασιών και διαχείρισης εφοδιαστικής αλυσίδας σε βιομηχανίες που παρέχουν συστήματα παροχής προϊόντων-υπηρεσιών

Motivation of the Thesis

Effective process planning and supply chain management in industries which provide Product Service Systems considering several criteria like energy consumption, cost as well as time. Following PSS Customization tendency a methodology which could provide effective and sustainable solutions to the customers is needed.

Objectives

- Algorithms and methods for supply chain management
- Calculation important decision-making criteria (energy consumption, cost and time)
- Use them and provide the most effective and sustainable solutions to the customers

- Literature review on PSS, Process planning and Supply chain management
- Design and development of an algorithm to provide the most effective and sustainable solutions









An application for the provision of the necessary services both to the customer and the OEM: A PSS Customization Approach

Μια εφαρμογή για τη παροχή αναγκαίων υπηρεσιών τόσο στον πελάτη και στον κατασκευαστή : Μια προσέγγιση συστήματος προϊόντος-υπηρεσίας

Motivation of the Thesis

Assisting customers into configuring their products and provide additional services. Handling the data from the Products, supports the companies to extract the necessary information and provide the necessary services both to the customer and the OEM. PSS customization methodology is required.

Objectives

- Handle the data from products
- Extract the necessary information and provide the necessary services both to the customer and the OEM
- Creation of Methodology for product customization, product-service customization, and service customization.

Outcome / Results

- Literature review on PSS, mass Customization, Customization methodologies
- Development of an Methodology for the PSS Customization
- Testing and validation of the methodology in a real industrial case









Design and reconfiguration of energy supply grids through simulation Σχεδιασμός και αναδιαμόρφωση δικτύων ενεργειακού εφοδιασμού μέσω προσομοίωσης

Motivation of the Thesis

Personal mobility and rapid prototyping are the Cloud platforms offer practical means to access sensor networks in near real-time design, development and support of product-service systems for SMEs, equipment manufacturers and energy suppliers.

Objectives

- Simulation & Modelling of energy supply grids
- Design energy supply grids
- Design reconfiguration methodology for supply networks
- Reduce the lead times
- Improve sustainability

Outcome / Results

- Literature review on PSS, Smart Grid, Networks
- Design and reconfiguration of energy supply grids methodology





