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Multidisciplinary Projects in an International Context

MUPIC 2019: SMART integrated Conveyor

ENGEL

TASK ASSIGNMENT FROM THE CONTRACTING AUTHORITY

THE PROBLEM EXPLANATION:

Integrated conveyors (ENGEL term HLi - see examples in Attachment No. 1) are peripherals to ENGEL injection moulding machines. They allow customers a subsequent handling with produced mouldings. In typical application the produced mouldings are being put down on the conveyor belt by an automatic handling equipment / robot. The mouldings (variety of plastic parts) are then transported to the operator, outside the moulding machine. Integrated conveyor is embodied in the injection moulding machine. It is located in the section called “HLi safety guard”.

Integrated conveyors represent the basis of the portfolio of the Department of the Conveyor Systems in the plant ENGEL Kaplice. This product has been sold for over 18 years yet without major changes. With new technologies and often stricter standards, innovation is needed in construction and design while preserving or reducing costs.

Conveyor often only serve for transporting parts from a place A to a place B. The ENGEL company now identifies a need to integrate another technological function (e.g. packaging, separation, cooling, etc.) into the conveyor.

Also, conveyor is often the weakest part of the injection cell (injection moulding machine–robot–conveyor) because the conveyor doesn’t have any diagnostic system, unlike the other cell devices do.

Some of the customers (typically the automotive segment) can’t allow an unexpected production stop caused by a conveyor failure. Integrating some "smart" functions into the conveyor could attract these customers.

OBJECTIVE:

Innovate the product (technology, design) following the specification and other implicit requirements, while maintaining or decreasing the production costs.

BASIC REQUIREMENTS:

Perform a background research of similar technical products.

Design an integrated conveyor for injection moulding machine ENGEL VC120, see example in Attachment No. 1.

Following dimensions (see table in Attachment No. 2) have to be reflected:

- Length min 1900 mm, max 5200 mm
- Width min 350 mm, max 600 mm
- The best-selling conveyor has dimensions 2900 mm length × 350 mm width.

For technical data and additional information see Attachment No. 3., 6.

For cost calculation of conveyor see Attachment No. 4.

Integrated conveyor has to allow easy access to the injection mold during services and mold replacements. Current solution allows sliding with conveyor outside from the safety guard if needed – see Attachment No. 5.

The conveyor belt can move in a continuous mode, but mostly a discontinuous mode is being used. In the discontinuous mode the conveyor drives forward one step after the mouldings are put down on the conveyor belt by an automatic handling equipment. Transport is often discontinuous for several

reasons. One of them is the temperature of the product, which is reduced to safety level due to discontinuous transport.

In some cases, the presence of a transported part can be optionally checked by an optical sensor:

- on the robot's side to avoid a collision of the parts;
- on the operator's side to avoid an accidental dropping of the product to the ground.

During your work try to consider that the drop area and the clearance area of the conveyor could be scanned by sensors and the necessary modifications in the design (cabling, sensor mounts, etc.) should also be considered.

Within the reach of the operator of the conveyor it is necessary to integrate the emergency-stop button into the device construction. vole asdf

From the "offline" conveyor create a "SMART online" device that will communicate with the injection moulding machine and in real time will be able to diagnose the current status of the critical components and at the same time predict the possible conveyor failure.

If it is possible, prefer ENGEL available technologies: MayTec aluminium profile system, sheet metal laser cutting, sheet metal bending, sheet metal welding, powder coating / painting, cutting and drilling plexiglass / polycarbonate.

Design the construction structure by an available CAD system (NX is preferred).

By designing the conveyor take into the account the final visual effect that should respond to the design of the injection moulding machine. It is also important to consider the maximum functionality, ease of operation and maintenance, lifetime and fulfillment of safety and environmental conditions.

Type of production: mass production of the same type with different dimensions, the produced volume of conveyors: 500 pcs. / year

Production costs: enabling competitiveness on the current market.

ADDITIONAL INFORMATION:

about the company and its products: www.engelglobal.com
on the project:
(for organized consultations, otherwise only to a speaker of the whole team)

- **about mechanical solution:**

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In Kaplice 19.6.2019

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TASK ASSIGNMENT FOR ENGINEERING DESIGN

OBJECTIVES:

To solve the assigned task of engineering designing of technical product in team members cooperation, document the share of your participation on team solution and prepare it as a basis for a joint presentation of solutions for the whole team.

TASK:

With respect to BASIC REQUIREMENTS OF THE CONTRACTING AUTHORITY to design innovative, highly competitive technical product.

Solve the designed technical product as a technical system (TS) to be sub-optimally suitable for all stages of its Life Cycle (LC).

Project solution should be divided into four essential phases according to the documents provided:

I. *Elaborating the Problem*
II. *Conceptual Designing - Conceptualizing*
III. *Constructional Designing - Embodying*
IV. *Final Elaborating*

The requested output is the engineering design of a rough constructional structure of TS in 3D CAD according to the documents provided. Its scope and content should provide the clear engineering design basis for the creative engineering design finalization of the complete TS constructional structure and for the subsequent routine elaboration of the documentation for manufacturing and all further life cycle stages of the designed out TS.

Requested outputs:

Check point 1:

- Elaboration the problem
- State-of-the-art (partial) (SWOT of competitive products, analysis of patents, ...)
- Potential innovation space
- Requirements specifications

Check point 2:

- State-of-the-art (final)

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- Conceptual Product Design
  (incl. conceptual alternatives, their SWOT evaluation and decision (prediction of properties and performance is an inherent introductory part of the SWOT evaluation and decision)

(intermediate report)

Check point 3:

- Constructional Product Design "First iteration" = rough (preliminary) layout
- Innovation proposals based on the (suboptimal) conceptual alternative
- SWOT evaluation of the 1st Draft proposal (update of the prediction of properties and performance)

Final Evaluation:

- Detail Product Design
- "Second iteration" = definitive (dimensional) layout
  (including SWOT Evaluation)
- Completed design project documentation
  (Technical report incl. CAD models and drawings)
- Project presentation

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TASK ASSIGNMENT FOR INDUSTRIAL DESIGN

OBJECTIVES

To make a significant contribution, in particular in terms of design, safety, ergonomics and other aspects of industrial design, to the comprehensive quality and competitiveness of the constructional design of the assigned technical product, document the contribution to the solution and prepare for a joint presentation of the solution on behalf of the whole team.

TASK:

Elaborate from the following points of view:

I. Elaboration of the Problem phase

- Contribution to the research of competitive technical products (*or comparable technical solutions, if the given product does not yet exist*) and their evaluation, focusing on the weak and risky points in relation to the design solution

- Resulting requirements for the proposed technical product (also presented as design sketches!)

II. Conceptual Designing phase

- Alternatives of conceptual product designs intertwined with concurrently designed conceptual design variants

III. Constructional Designing phase

- Proposed design of the constructional structure of the selected design & constructional variant

IV. Final Elaboration phase

- Completing a physical model of the proposed design solution and its presentation in the interim report

- Design registration of the proposed design solution, if needed

- Analysis of the weaknesses and risk points of the proposed solution in view of its initial requirements

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Requested outputs:

Check point 1:

- Design study

- competitive
- expected

Check point 2:

- Concept Draft Design Sketch
- Consultation of expected design
- Rough concept of presentation of project

(intermediate report)

Check point 3:

- Consensus concept with construction and economical optimization for the preliminary layout

Final Evaluation:

- Visualization and final design base on final design
- Final design study

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TASK ASSIGNMENT FOR MARKETING

OBJECTIVES

To make a **significant contribution, in terms of marketing research, situational analyses, communication policy and other aspects of marketing**, to the comprehensive **quality and competitiveness** of the construction **design of the assigned technical product, document your share of the solution and prepare for the joint presentation of the solution on behalf of the whole team.**

TASK:

Elaborate from the following points of view:

*I. **Elaboration of the Problem** phase*

- Marketing inquiry, market analysis, analysis of competing technical products (*in case the proposed technical product already exists in the market*) and/or other competing solutions (*always necessary if the proposed technical product does not yet exist on the market*)
- Resulting requirements for the proposed technical product

*II. **Conceptual Designing** phase*

- Benchmarking (comparison with the most competitive solution in the market)
- Resulting comments and, where appropriate, suggestions for improvement (including the possible use of proven existing solutions) to the proposed conceptual design variants

*III. **Constructional Designing** phase*

- The innovation of customer segmentation (*if the proposed technical product already exists on the market*), or customer segmentation (*if the proposed technical product does not yet exist on the market).*
- Resulting comments and, where appropriate, suggestions for improvement (including the possible use of proven existing solutions) to the proposed construction design

*IV. **Final Elaboration** phase*

- A communication plan aimed at attracting your competitors' customers (*if the proposed technical product already exists on the market*); product, communication and distribution policy based on the results of selected situational analyses (*if the proposed technical product does not yet exist on the market*)

- Resulting comments on the weakest characteristics and risks of the proposed solution in view of its initial requirements

The proposed results include three aspects: i) the analysis of the environment and the internal analysis in the design of the marketing policy; ii) the definition of strategies for the strategic mix and iii) the definition of strategies for the operational mix.

i. **Analysis of the environment and internal analysis in the design of the marketing policy**. Regarding the analysis of the environment, during the project participants must analyse the needs of the market where the company is operating, the competition main features, the market needs covered by the proposed solution and all relevant variables that can be influenced by the proposed solution. Each team must determine to what extent there is a demand in the market for the proposed solution and if competitors have similar solutions. Additionally, using the SWOT analysis as a working framework, participants should determine to what extent the proposed solution increases the company's strengths and decreases some of the existing weaknesses. Finally, each team must assess if the proposed solution allows taking advantage of any opportunity or facing any threat existing in the market.

ii. **Definition of strategies for the strategical mix.** Participants of the project must analyse how the proposed solution contributes to the differentiation and positioning strategy and the product brand strategy.

iii. **Definition of strategies for the operational mix.** Teams will determine the strategic implications of the proposed solution and how it influences the pricing strategy and the integrated communication process. It will also seek to determine how the proposed solution influences the distribution strategy and its impact on the company direct marketing.

These three as aspects must be included in the final report and the presentation and defence of the MUPIC Project.

Requested outputs:

Check point 1:

- Stakeholders identification
- Market research setting economic targets
- Market analysis with a focus on competitive or related products

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Check point 2:

- Adding product requirements based on the "market" analysis (Must have – Should have – Could Have – Won't have)
- PESTEL analysis

(intermediate report)

Check point 3:

- Cost evaluation
- Quality prediction

Final Evaluation:

- Reflecting of benefits
- Marketing proposal, product cost prediction

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TASK ASSIGNMENT FOR PROJECT MANAGEMENT

OBJECTIVES

To make a significant **contribution, in terms of project management**, **and other professional aspects** of project management, to the comprehensive **quality and competitiveness** of the construction and design proposal of the assigned technical product, to document their share of the solution and prepare for a joint presentation of the solution on behalf of the whole team.

Requested outputs:

Check point 1:

- Plan of progress
- vision
- preliminary definition of additive demands and supply to our project

Check point 2:

- Layout of the project
- work load optimization
- progress expectations

(intermediate report)

Check point 3:

- Establish proper work progress
- Design complete control structure and establish exact communication channels

Final Evaluation:

- Evaluation of results
- Evaluating and conclusion
- Suggestion for improvements