Case Study

CAD/CAM AND ADDITIVE MANUFACTURING APPLICATION WITHIN DENTISTRY FOR INDUSTRY 4.0

Keywords: *CAD/CAM, Additive Manufacturing, 3D printing, CNC, Industry 4.0, Dentistry*

Background to Case Study

CAD/CAM (Computer-Aided Design / Computer-Aided Manufacturing) is the use of computer software to design and manufacture prototypes, products and production runs. Additive Manufacturing (AM), also called 3D printing (3DP), is a general term for a set of technologies that can build three-dimensional objects from a digital file by adding material layer after layer.

CAD/CAM and AM are an essential technologies of Industry 4.0 implementation in SMEs working in the dentistry sector because they allow the digitalisation of the dental industry and the transformation of dental labs in "smart factories". They are vital components and enablers of Industry 4.0 that allows SMEs to cost-effectively manufacture unique customised dentistry objects such as crowns, bridges, caps, dentures, etc. from digital medical files.

There is an increasing need of 3D printed and CNC machined products in dental industry, in order to provide dentists and patients with medical devices such as patient-specific orthodontic models, drill guides, crowns, bridges, caps, dentures, dental implants, etc. SMEs can deliver these in a fast and cost-effective manner by taking advantage of the developments in CAD/CAM and AM technologies.

This case study presents a SME that leverages CAD/CAM and AM in order to completely digitalize its dental laboratory.

Introduction to the Case Study and it's growth within Industry 4.0.

3DSmartDent (https://3dsmartdent.ro/) is a Romanian SME working for over 12 years in the dental sector. It operates 4 dental offices, a dental laboratory, a 3D printing lab, a CNC lab and it's an importer and seller of CAD/CAM and AM solutions and materials for dentistry.

In the last years, 3DSmartDent developed a department specialised on the digitization of dentistry. This became very successful and nowadays it collaborates with hundreds of dental labs and dentists from Romania, Italy, Germany and France.

The implementation of CAD/CAM and AM solutions enabled 3DSmartDent to deliver high-quality 3D printing and CNC machining services for dentists and dental technicians all over Europe.

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The Case Study and Industry 4.0 Elements: A Pictorial Overview

Image source: 3DSmartDent

3DSmartDent implemented a completely digital workflow in its digital lab. The workflow starts with digital files obtained using extremely precise intraoral 3D scanning (scans with a deviation less than 5 microns).

Image source: 3DSmartDent

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These files are processed using CAD/CAM technology and then transformed in physical objects with the help of CNC milling or 3D printing. The 3D printing lab manufactures finished products out of materials based on resins, titanium or chromium-cobalt. The CNC lab produces structures and crowns out of zirconium, titanium and other materials.

Image source: 3DSmartDent

The application of CAD/CAM and AM supports the growth of the SME under study by allowing it to completely digitise its dental lab and, consequently, to offer high-quality services for the dental sector.

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The Element Explored within Industry 4.0 Application.

Images source: https://3dsmartdent.ro/

3DSmartDent implemented a completely digital workflow in its dental lab. This involves the following:

- *CAD/CAM technology - allows the creation of well-adapted, aesthetic and durable structures for the patient and improves the design and manufacturing of dental restorations, especially dentures, crowns, veneers, inlays, fixed dental bridges, restorations supported by dental implants, dentures (removable or fixed) and orthodontic appliances.*

- *intraoral 3D scanning - to capture digital dental records that can be further used for measurements, simulations, CAD design, conversion to 3D models to be 3D printed or CNC machined, etc.*

- *CNC milling*

- *3D printing - SLM (Selective laser melting) and DLP (Digital Light Processing) technologies*

Application Target Audience	*The results of the case-study are intended for use by SMEs and entrepreneur subjects.*

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Resources Used:	https://3dsmartdent.ro/
Further Reading:	*https://www.dentistryiq.com/practice-management/industry/article/16366877/the-emergence-of-the-fourth-industrial-revolution-in-dentistry* *Dawood, A., Marti, B., Sauret-Jackson, V. et al. 3D printing in dentistry. Br Dent J 219, 521–529 (2015).*

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