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SOCIAL SERVICES, HEALTH AND SPORTS

INTRAORAL SCANNERS IN DENTISTRY

Procurement, pilot and pilot query to the Oral and Maxillofacial Diseases clinic of Kuopio University Hospital

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<p>Abstract</p> <p>In dentistry, there have been digital programs in patients and x-ray information systems over decades. The intraoral scanner is a natural development in this structure. All over the global market`s health technology is increasing business. The intraoral scanner gives; patients insights into their dental health, improve patient experience, digital accuracy, patient-friendly impression taking, save time and impression materials and is cost cutting. As a result, there are many opportunities at the market of the intraoral scanner, employees` receptions are diverse depending on the profession and personal completeness.</p> <p>Oral- and Maxillofacial Diseases clinic and Teaching clinic oral health care employees did have pilot related to possible acquisition for intraoral scanners in spring 2018. There were two different kinds of scanners; Planmeca Emerald and 3Shape Trios intraoral scanners. After the pilot in summer 2018 employees did get a pilot questionnaire survey. The inquiry included 18 questions in the Surveypal form. Questions were about the intraoral scanners, treatment process, patient`s safety, digitalization and knowledge outside the pilot about intraoral scanners. Query result transpires that scanners, which were in the pilot, are very similar and almost equal. There is an ambition to get own scanner in a clinic and it is one part of digitalization. Intraoral scanners could connect to the treatment process and the patient`s safety.</p> <p>This Master`s thesis was carried out in accordance with the wishes of Kuopio University Hospital. The purpose was to make a market study of intraoral scanners, a pilot for equivalent scanners, to do a pilot query and procurement to the Kuopio University Hospital (KUH). The protocol for the procurement was given by KUH. The project was limited only to the intraoral scanners. There was also a part of the process, which is secret. In the future as a continuation, there is a need to a digital education material from the intraoral scanners for the employees. I think that great subject to recourse is to examine the different generation skills, mind towards intraoral scanners and age causation to digitalization. Development proposal suggestion is also that there is a need for professionals who understand the IT-regulation and procedure as well as healthcare necessity and destination.</p>			
Keywords Dentistry, health technology, intraoral scanner, pilot, pilot query			

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This Thesis has been a long and educational journey. I have learned much about procurement, pilot and pilot query but also a technical point of view and data administration as if data security. I have learned that procurement has many aspects, long tour that demands wide knowledge and continuing learning. The pilot is more than an arrangement. It also make me consider individuals personal abilities. The query needs lots of planning and responders in spirit. On the other hand, I have seen people who dedicate to work and still manage to share know-how.

I want to thank Kuopio University Hospital and Oral and Maxillofacial Diseases Clinic. Supervisors Eija Eriksson, Taina Matilainen and Tarja Ruokokoski. Many thanks also to Pirkko Kouri, Timo Tuovinen and Raimo Tuomainen for help, supporting and teaching. My family – all you did make this possible!

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1 INTRODUCTION

“Everything that can be digitized will be digitized”

Paul Krugman, 2008

Professor of Economics and Nobel Prize in Economic Sciences winner

Digitalization in social and healthcare services means that customers and patients' information will be conducted in digital form, and transferring collected data between all users in different sectors. Social and healthcare sector should be pioneers at application and implementation of the advanced technology. In this field, it will require fundamental and continuing training of the workforce. Additionally, it is important to take care of patient safety, information security and data protection. (The parliament of Finland 2018, 19-20.) ICT and digitalization are one part of Kuopio University Hospital's service structure of social welfare and health care (Psshp 2018). Dentistry in practice means both the prevention and treatment of diseases and malformations of the teeth, and the correction, and replacement damaged, or lost part of teeth (Ministry of social affairs and health 2018; Suomen Hammaslääkäriliitto 2018). In dentistry, there have been digital programs in patients information systems like WinHIT and Effica since the year 1988 (WinHIT 2018; Effica Lifecare 2018). In x-ray information systems Romexis is widely used program (Planmeca¹ 2018). The dental care professionals have high level know-how to use digital systems. Digitalization development is currently happening nationwide as in Kuopio University Hospital (KUH) organisation, including dental care. This thesis is part of the development path and topical in dental care.

Kuopio University Hospital's Oral and Maxillofacial Diseases clinic treat patients from all dental specialities e.g. Oral and maxillofacial surgery, Periodontology, Orthodontics, Cariology and endodontics. Patients are coming to the clinic from hospital or from basic health care. In specialised care, the patients are risk patients or they have mucosal diseases, disorders of the jaws, traumas or odontogenic infections. Oral cancer patients are treated in close co-operation with ENT-and plastic surgery clinics. There is also co-operation in the provision of basic education and specialist training in dental medicine and the Teaching clinic oral health care. (KUH 2018; University of Eastern Finland 2018)

This Master's thesis was carried out in accordance with the wishes of Kuopio University Hospital. The purpose was to make a market study of an intraoral scanner, a pilot for equivalent scanners, to do a pilot query and procurement protocol at Kuopio University Hospital. The project was limited only to the intraoral scanners. The multiprofessional team chose the two scanners (from sales market), and they will be introduced later in this thesis. The pilot research was

a quantitative conducted Internet-based Survey-pal- query. The query aimed to get thorough information about the intraoral scanner and how it will affect the treatment process, patient's safety and digitalization.

Briefly the intraoral scanner gives; patients insights into their dental health, improve patient experience, digital accuracy, patient-friendly impression taking, save time and impression materials and cut costs. There is a need for intraoral scanners in dental care. Patients have the right for proper and high- quality treatment. Furthermore, at the market, there are many intraoral scanners, which have very different qualities and facilities. A market investigation, pilot and pilot query helps to get the best solution and procurement. (3Shape 2018; Planmeca² 2018)

In my Master`s thesis, the following chapters present proceed of a procurement, the intraoral scanners, the pilot and the pilot query. In preliminary results and findings are separated to intraoral scanners, knowledge outside the pilot about intraoral scanners, treatment process, patients` safety and digitalization. By good preliminary planning, comprehensive need mapping and exact project inlet helps to get the best result of procurement (cf. Lampi 2013). However, based on professional confidentiality and mutual agreement with the client organization, Kuopio University Hospital, Oral and Maxillofacial Diseases Clinic, some parts of my thesis are secured information and not included in this thesis report.

2 PROCUREMENT

An objective of procurement is to select right product, including the right quality, in the right time and good price. Time-consuming work is to find a supplier, make the choice, procurement and construct collaboration. In the procurement department, it is a good to try to affect changes beforehand and to try to control them. (Iloranta & Pajuranta - Muhonen 2015, 95) Furthermore, in information systems procurement has own challenge and can affect the project timing and budget. In addition to, there is often a lack of communication and understanding. This problem is recognized on both sides, purchaser and service provider. There has been the risk that the information system that has procured will deteriorate the whole process and the other systems. (TTL 2013, 24 – 26; Kettunen & Simons 2001, 11) That is why there has been a need for General Terms and Conditions of Public IT Procurements guide. According to the guide, public procurement units are recommended to use recommended terms and conditions attached to an agreement when they enter into IT procurement. (Kuntaliitto 2018) It is important to identify the actual competitors and categorize them by assessing their objectives, strengths and weaknesses and then deciding which ones to focus efforts on competing with. This will allow the company to identify some qualities quickly and to relieve decision making (Kotler & Armstrong 2018, 543.)

Finnish organisations are at the beginning of digitalization, and it will change business (Accenture 2014, 4, 8.). Digitalization is one of the main projects 2018 in Finland by The Finnish Government. The purpose is that all public services will be digitalized as user-driven as possible by reforming procedures. Digitalization affects in every respect (The Ministry of Finance 2016; The Finnish Government 2018). It is not only in organization IT- department but also in all over organization and procurement. Procurement methods have changed over the age. Digitalization will cause revolution also in procurement (Ministry of employment and the economy of Finland 2015, 9).

Varimo said (2018) that in procurement, it`s always important to consider the clinical needs. For example, in a technical aspect; the support, costs, maintenance and replacement parts. Sometimes upkeeping comes straight from a supplier but in that case, it is crucial to name the division of work. Beginning of the `90s has been regulation for device register for medical devices. It helps to estimate costs that the device will cause. Service structure reform of social welfare and health care brings with the reform that the state or health care district does not necessarily own the device. There will be more solutions for leasing type. On the other hand, it gives more challenge to an operational level. Nowadays the health care district owns the device

and Istekki is responsible for the upkeeping and removal. Remote access and replacement part come for the supplier. This requires continuing education. (Varimo 2018; Istekki 2018)

Tuovinen said (2018) that the operation of the University Hospital requires the use of modern and safe medical equipment. In order to ensure the goals of medical specialists in the treatment of patients, KUH strives to acquire the most modern and, if necessary, high-tech equipment, also taking into account the cost-effectiveness of procurement. Tuovinen (2018) think that in the future, more and more medical devices will incorporate IT and integration opportunities into different systems. Answering these needs is an essential factor to be taken into account in the requirements. (Tuovinen 2018)

Tuovinen (2018) disclose that in practice, the modernity and usefulness of a medical device are determined by the hospital's responsible users and the requirements of the patient information being handled. Matters related to patient safety are controlled at least by regulations that meet the requirements of the law. Safety should also be taken into account in addition to legal requirements (CE approval) as well as data security. (Tuovinen 2018; European Commission¹ 2018)

In the future, hardware acquisitions will be even more complicated IT systems whose utilisation depends on the need for use and know-how. Matters related to security and cyber threats are indeed a significant challenge in the future. Concerning the overall management of purchases, the cost effectiveness of the investment must be further taken into account and, if possible, to find a "Return of investment" -model. (Tuovinen 2018)

With the Lean thinking approach, the organisation focuses to the product and services that are giving value to the customer (Womack & Jones 2003, 15) In Lean thinking some principles that are applicable to healthcare quality aims (Wickramasinghe, Al-Hakim, Gonzalez & Tan 2014, 15). Finnish University Hospitals have been actively attempting to apply Lean tools and methods. (Ruohomäki, Reijula & Reiluja 2017, 190). The official procurement protocol of Kuopio University Hospital includes (cf. Kuntaliitto 2018) 1) background documentation (Romexis), schedule (FIGURE 1.) and a clinic responsibility, 2) mainline background, terms and concept, status quo and devices that are now in clinic and their functionality. 3) Patients data process

and scientific purport. 4) Functional structure demand; ambition situation and detected transformation needs, collaboration with other systems, 5) market situation and procurement plan.

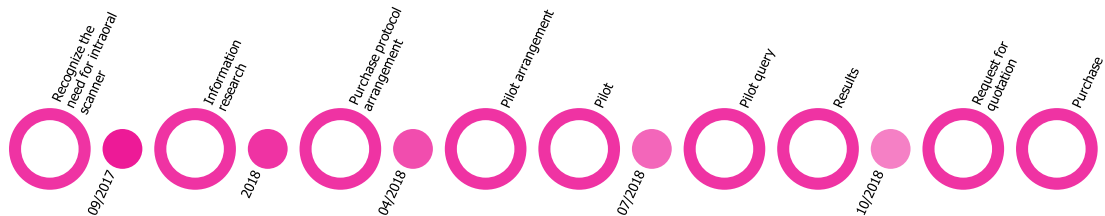


FIGURE 1. Schedule at the purchase of the intraoral scanner.

In market situation description (APPENDIX 1. Marketing study) we found out that there are only two intraoral scanners which fill the high requirements of the need and in this case, they fill only partly official procurement protocols. The pilot is a good way to get more information about the product and it is also a way to see how the device will suit in the clinic's demands.

3 INTRAORAL SCANNERS IN DENTISTRY

Into the middle of the 1970s was the most common impression material rubber-based material (slow setting and foul smelling). In the late 1970s, hydrophobic polyvinyl impression materials were introduced, and they gained popularity. In the mid-1990s, truly hydrophilic polyvinyl materials that could take accurate impressions of wet intraoral surfaces were introduced. Polyvinyl siloxane (PVS) impression materials quickly became the material of choice in conventional impressions because they were accurate. PVS is the most commonly used material for conventional dental impressions, and its properties will be compared with digital impressions. (Culp, Wong & Misch 2015 cf. Martin, Chalmers, McIntyre, Cochrane & Mossey 2014) There are many reasons to proceed into the use of intraoral scanner; dimensional accuracy, capturing details, intraoral access, long-term stability, cost, dental margins and time. Digital technology provides more efficient methods to dentistry. (Culp etc. 2015; Mangano, Gandolfi, Luongo & Logozzo 2017; Martin etc. 2014; Zimmermann, Mehl, Mörmann & Reich 2015 cf. Imburgia, Logozzo, Hauschild, Veronisi, Mangano & Mangano 2017)

In dentistry, there are devices for capturing direct optical impressions. Intraoral scanners are devices for that digital process. The device uses light source onto the object to be scanned. The light is usually a laser, or more recently, structured light. (Imburgia, Logozzo, Hauschild, Veronisi, Mangano & Mangano 2017; Mangano etc. 2017; Ting-Shu & Jian 2014; Zimmermann etc. 2015) Intraoral scanners document data in 3D formats and save that data in a digitalized form. Scanners are medical devices, software and services must fulfil ISO 9001:2008, ISO 13485:2012, HIPAA, ePHI, GDPR and CE -mark demands. (3Shape 2018; Planmeca² 2018. Cf Nylund & Ruokoniemi 2018, 6 – 10.). ISO 9000 includes quality standards which confirm the quality of the product or service (Finance Finland 2009, 7) and ISO 13485:2012 specifies requirements for a quality management system where an organization needs to demonstrate its

ability to provide medical devices and related services that consistently meet customer requirements and regulatory requirements applicable to medical devices and related services (European Commission² 2018). 3Shape Communicate is web solution (FIGURE 2.)

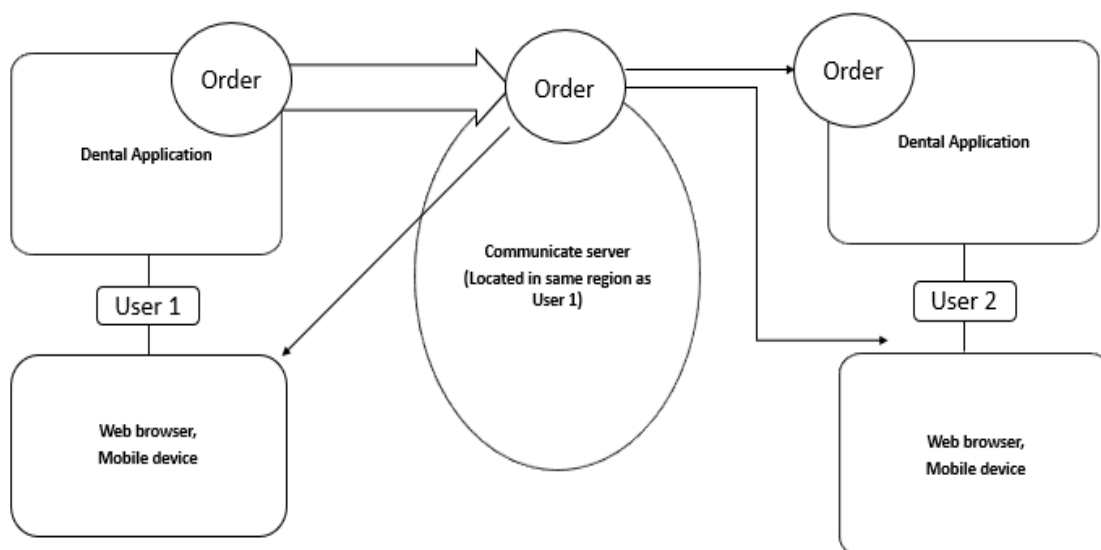


FIGURE 2. Description of the Communicate System (3Shape).

This Master`s thesis was a development project. The conceptual framework of this thesis derives from a practical approach to procurement of intraoral scanners, arrange pilot, pilot query and procurement of intraoral scanner. Intraoral scanners have been at the market short time and there is remarkable development currently happening. The intraoral scanners that were taken into the pilot fill the official quality and medical devices standards and Kuopio University Hospital`s procurement protocol. In comparison with these two intraoral scanners there were hardly any difference. In price aspect, Planmeca Emerald is more economical than 3Shape Trios. Furthermore, Planmeca Emerald has a data connection to Romexis system. The Romexis system is one of the KUH official software that the hospital has decided to use and all dental care 2D and 3D data is important to save in it.

3.1 Planmeca Emerald

Planmeca Emerald is a small, lightweight and exceedingly fast scanner with superior accuracy. It`s easy to be used and there is no need for powder. There is integrate colour scanning for natural colours. Plug- and -play solution gives the solution to share data between operators. Hygiene aspect is secured by autoclavable head part. There are USB-3 connection and data is in STL format. Upcoming scanning data is compatible with Planmeca Romexis software. There is also CAD/CAM -solutions and Planmeca ProModel -concept software. Gathered data got from

Emerald is possible to transfer in 3D-printer Planmeca Creo. The product is Finnish, which is a clear benefit in Finnish dentistry, especially in training the end-users. (Planmeca² 2018.)

3.2 3Shape Trios

3Shape Trios is a wireless intraoral scanner. There is easy exchange for battery and it allows non-stop scanning. Batteries are long-lasting. Scan speed is remarkable. There are realistic colours and accuracy of documenting is good. Trios helps communication between patient and dentist. It is ergonomic to be used. 3Shape Trios have own software for CAD and Orthodontics. The product is Danish and used language in Finnish but encompassing support is in English. (3Shape 2018.)

4 PILOT AND PILOT QUERY

In a project, a pilot study is one of the essential stages. The pilot gives information about the research object and can identify potential problems. The pilot is one way to study protocol and identify weaknesses in a study. After the pilot is appropriate to ask further details questions to get fruitful information about the pilot and around of it. (Hassan, Schattner & Mazza 2006, 70-73; Teijlingen & Hundley 2001; cf. Lampi 2013)

Oral- and Maxillofacial Diseases clinic and Teaching clinic oral health care employees did have pilot related to possible acquisition for intraoral scanners in spring 2018. There were two different kinds of scanners; Planmeca Emerald and 3Shape Trios intraoral scanners. Before pilots, all participants signed the pilot contract. There were 1) named the contracting party, 2) aim of the pilot and place, 3) price, 4) responsibility during the pilot, 5) confidentiality and 6) period of validity. One part was also the secrecy agreement.

In the pilots, there were two intraoral scanners. Both those scanners have qualities that are needed in scanners at dentistry. Scanners were selected by the precise market research and it also observe the KUH official procurement protocol. Before the pilot, there was a lot of pre-arrangement; time, place, information systems, data processor and contracts. The pilot was an arrangement in Oral- and Maxillofacial Diseases clinic and oral health care Teaching clinic with both scanners. There was a supplier or member of staff of KUH available at the pilot time. There was a need for the pilot because of the need for more information about scanners. The Surveypal form pilot query has a suitable way to get that information (cf. Hassan, Schattner & Mazza 2006, 70-73; Teijlingen & Hundley 2001).

4.1 Pilot query

A query is a technique to get information, which is relevant to the query (Sugiura & Etzioni 1999; Marenco, Li, Martone, Sternberg, Shepherd & Miller 2008, 229). Kuopio University Hospital has chosen Surveypal query as an official way to get knowledge (Surveypal 2018). Surveypal is meant to get real-time insights from e.g. scanners that we need to take action. Raimo Tuomainen said (2018); "I could say that Surveypal is an easy and user-friendly program for surveys. Working with it is usually regarded as fluent. The program is suited particularly for cardinal surveys. Especially municipal organizations have begun usually to use Surveypal, as it won the national tendering of The Association of Finnish Local and Regional Authorities. Its

strength is also its well-serving chat. Thanks to the easy program several units of Kuopio University Hospital carry out surveys independently.”

After the pilot in summer 2018 employees did get a pilot questionnaire survey. The inquiry included 18 questions in the SurveyPal form. Questions were about the respondent background (workplace and profession), the intraoral scanners (information from the pilot, framework related work, technological accuracy and quality), treatment process (developing process), patient's safety (improvement), digitalization (now and future) and knowledge outside the pilot about intraoral scanners (APPENDIX 2. Pilot query). Questions were structured on the information needed both in the clinic and the organisation.

Our clinic had the ambition to get more information about intraoral scanners and how they affect the clinical work. The pilot query was realized quickly after tests with the two intraoral scanners. One main point was to get the information which scanners were the best in use. Furthermore, there was a need from the organization point of view to know the effect for the treatment process, patients' safety and digitalization. Questions were carefully built through from that aspect.

4.2 Preliminary results and findings

Questions were sent to 71 persons, which represent the multidisciplinary end-users of the scanners. The query (FIGURE 3) was answered by 22 employees, which form nearly one third of the end-users, who expressed both their experiences and needs related to the pilot scanners. Almost half of the participants (40,9%) who answered to questions are working in Oral- and Maxillofacial Diseases clinic and 72,7% Teaching clinic oral health care. Some of them are working on both clinics. Most (40,9%) of the answers were given by Oral and Maxillofacial surgeons/ specialist dentist/ dentist (FIGURE 3). Dental assistants' answers were 36,4%, dental hygienists 18,2% and nurses 4,5% of all answers. People think that the succeeding of pilots was almost the same for all side (4-10 scale); KUH 7,4, Plandent Oy 7,9 and Straumann 7,6.

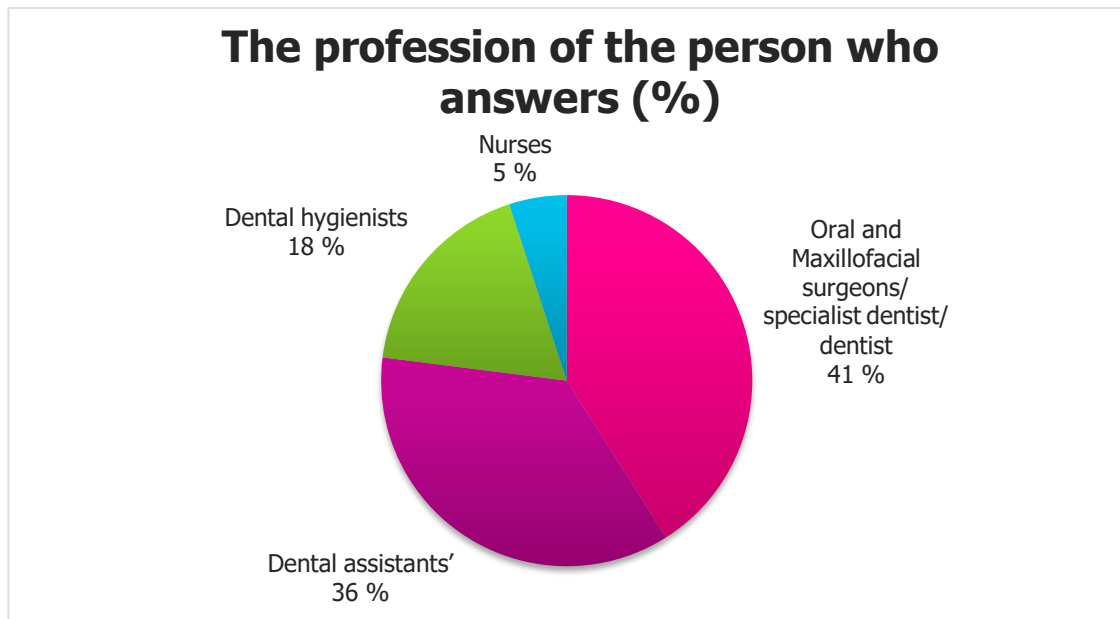


FIGURE 3. The profession of the person who answers (%)

4.2.1 The elements of intraoral scanners

The amount of the participants who took part in pilots during May and June 2018 produced 31,8% of all answers. The rest of the answers were outside the pilot or information from participants who did not have an opportunity to be involved in the pilot but wanted to give information about scanners based on knowledge they got from elsewhere. 42,9% wanted to use Planmeca Emerald scanner and 57,1% 3Shape Trios scanner. Half of the participants (42,9%) thought that they got enough information from pilot to use scanners. Partial abilities for using scanners did have 28,6% and 28,6% thought that they did not get enough information or knowledge to use scanners. All users that answered the query got the education from a supplier. People thought that learning is easy (57,1%) or very easy (28,6%). Only 14,3% think that the learning of scanning is hard. People who think that the scanning is hard answered that they need more education for scanning and in the pilot, some of them did receive only verbal education instead of hands on experience. Responders also thought that when it is decided which intraoral scanner Oral and Maxillofacial Diseases clinic will have, they must receive specific education. Before the pilot, 37,5% of the users were been using scanner before and 62,5% tried scanner first time in their life.

Interestingly, 50% of respondents will not use these scanners at they work because for example, it is not in their job description. The other 50% thought that they will use scanner always when it is possible or every now and then. All respondents thought that the use of intraoral scanners will increase in future. 40% of them thought that all patients will be intraoral scanned

in the future and rest 60% believed that the need of intraoral scanner will be necessary every now and then. Respondents of the pilot thought that the scanners technological exactness and quality are in a reasonable state; 10% thought that it was excellent, 40% thought that it was decent and rest of them thought that it will respond partly of the needing. Experience of time-saving aspect was changing repeatedly; 30% thought that absolutely there is time-saving when you are using an intraoral scanner and 20% thought that there is not meaningful saving at the time saving.

4.2.2 Knowledge outside the pilot about intraoral scanners

There was a group that did not participate in the pilot because they did have information about the intraoral scanners for example from another workplace. There was a desire to get that knowledge also into the pilot query from them. Knowledge outside the pilot about intraoral scanners was wide; Planmeca Emerald, 3Shape Trios both Dentsply Sirona and Cerec bluecam/ Cerec omnicam. All intraoral scanners have their good and bad sides. Planmeca Emerald scanner is wanted in use soon as it is possible.

" Planmeca Emerald as soon as possible. It is easy to be used, documentation to an existing information system. Open system if you think the laboratories."

Answers were also giving related to importance to the documentation system and especially because the information is saved in the existing information system.

3Shape Trios use experience was flowing but intraoral scanner which is currently in use oral care Teaching clinic is having technical problems and there is temporal slowness. It is necessary to also focus on the usability aspect of the intraoral scanners. The usability of the scanners was criticised:

"Trios, technical problems time to time, it is slow and complicated to be used."

Furthermore, 3ShapeTrios hand part is big and clumsy. Technical probabilities contain are usability part. Therefore, employees use the intraoral scanner easier if the technical external attribute is reasonable.

"I have used Trios 3 Shape older version 2014. My user experience is in principle good, there have been some problems with data saving and sending the data. Additionally, at times an oral camera is too difficult to use inside an oral cavity given its size – it's difficult to use on a patient with a small oral cavity. I have also tested the new 3Shape Trios and it's remarkably better than the old one." --- "3Shape Trios: version 2015 is clumsy and the camera head is big. An authorized slowness in the start of the software, scanning and sending data. Absolutely fantastic it is in the straight data sending to a laboratory- but it could be streamlined. I have tried the newest version in a dental event and it's much more functional."

Operating systems were compared too. Software must be self-drift and clear.

"Cerec software is overpowering and Plameca Emerald has the worst."

Dentsply Sirona is the one which gets praises that it is user-friendly and easy to use. There were many feedbacks that all intraoral scanners that are in market had development in last years and they are more user-friendly now.

4.2.3 Treatment process

More than half (60 %) of the respondents, felt that the treatment process of patients will develop to better by using an intraoral scanner. Rest of the respondents (40%) did not notice any changes in the treatment process. No one thought that intraoral scanning has a negative effect on the treatment process. Many respondents told about positive development in a treatment process.

"Opportunity of consultation between a different place of business. Intraoral scanners also save time in, for example, when ordering orthodontics appliances from the dental laboratory" -- "straight digitalization is a improvement to working environment; molding time of the orthodontic cast models can be used somewhere else and there is no more need for extra space when working with orthodontics models."

4.2.4 Patient's safety

Experience of patient's safety will improve by use of intraoral scanners. 60% of respondents did remark it so. From a safety aspect there is picked up data protection and improvement of exactness, also people experience that digital shape data will be in better safe;

"Digital information is secured better in medical report – no missing models or preservation complexity."

In addition to, the respondents also answered that intraoral scanning is an information security issue, because orthodontics cast models with patient's name are not exposed to everyone who visits in reception or storage room. The professionals also think that intraoral scanning is a more comfortable experience than invasive operation. On the other hand, 40% of the respondents felt that intraoral scanning does not have a consequence to patients' safety.

4.2.5 Digitalization

Generally, equipment linked to digitalization is something that employees want to take in use; 30% wanted to use a dental milling machine, 70% 3D printer, 10% felt that hologram could help treatment planning. Overall digitalization seems to have an influence on working in several ways. In many open answers the digitalization soothing influence raised up at the same time it will speed up and also gives clean feeling aspect;

"It makes working easier, speeds up working" ... " Visualize, cleanliness, no more duplicate material and orthodontics cast mess...makes consultation easier, time will not go to dental models' transferal and exactness gets better."

The respondents also answered that consultation opportunity and treatment planning aspects come through digitalization.

" consultations speed up; almost in real-time. This is a very good opportunity for public health. Treatment planning and orthodontics device exactness will improve potentially."

Digitalization could cause work assignment translocation, professional development and commonplace changes in work areas;

" There could come professional development and changes in routine treatments" ... " My denture working is all the way digitalized in the private sector."

As a summary, the participants produced a lot of unrestricted answers. They were informative and increase the knowledge around the intraoral scanners. Furthermore, one aspect is that the query was an excellent way to get cognizance.

5 CONCLUSION

The purpose of this thesis was to find an intraoral scanner which has the right qualities and technical conditions for the use of Kuopio University Hospital's Oral and Maxillofacial Diseases clinic. My role was to make market research, and thus to organize the pilot, to do the pilot query and to be a part of the procurement. I think that the thesis and my role was clear in the process. I see that a big part of all was to be a person between the suppliers, the clinic and the KUH organization. This helps to understand the technical property, data administration, information system and also disclose healthcare professionals' expectations. Furthermore, the protocol of the procurement process used in the University Hospital guided my work. All this has promoted my professional development and team working skills.

In the validity and reliability aspect, the data searches were conducted only from reliable electronic databases like Arto, MELINDA, UEF-Finna and Vaari (Krause & Kiikkala 1996, 72). The ethical considerations are based on the pilot query and the literature that I used. Literature sources and their notation I have used are only reliable (cf. Hirsijärvi, Remes & Sajavaara 2009, 113). At the time of the pilot query, I had no opportunity to see respondents' answers and the answers were anonymous (cf. Vilkkä 2005, 29-30). Questions and answers were in Finnish and I had to translate them in English. The confidentiality with the trade secret element was new to me, and I learnt to understand how competitive the marketing situation is in the intraoral scanners in dentistry. It is important to understand that you do not create barrier's to development.

At the very beginning of the market research, it becomes clear that there are only two possible suppliers delivering intraoral scanner to Oral and Maxillofacial Diseases clinic. Requirements for it were high. The procurement protocol was more time-consuming than I prepared. It was a challenge. However, there was a part of the process which are secret. Because of that I needed specific extract to the thesis. The pilot was a good way to get information about the intraoral scanners and the technical probabilities. However, the pilot did not cause big interest and only 22 respondents of 71 answered. Anyway, the query was the best way to get fruitful information about intraoral scanner because it was anonymous and so we got the silent voice of end users into sight. For the client the query helped the selection process of the scanner. Furthermore, an organization point of view query enlightens the treatment process, patient's safety and digitalization in dentistry.

The query result reveals that scanners which were in the pilot are very similar and almost equal. There is a need to get own scanner in the clinic and it's one part of digitalization. On the other

hand, this contains a risk. I think that there must be a willingness to give up the old model e.g. evaluate staff working manners, or otherwise we are introducing the new model to double the work and the costs in our organization in this part. It could complicate intraoral scanner deployment and be harmful to employee's work managing. This is important specifically leading viewpoint. Based on the query intraoral scanners could connect to the treatment process and patient's safety. Relative to working life query gives a lot of usable information for an organization. I got during this process good feedback for my labour input. Intraoral scanners serve the process and strategy of Lean thinking which is Kuopio University Hospital's leading managerial philosophy.

There is actual need of the intraoral scanners in Kuopio University Hospital. At first, I want to say that the procurement is worthwhile. Secondly, I recommend that the procurement of the intraoral scanner should be done by leasing. Technical development of the scanners is very quick and unpredictable. However, the scanner procured before has had many problems and by leasing, we could guarantee interminable operation. Furthermore, is important to take into account the technical compatibility of the information systems so that the intraoral scanners existence data is possible to save into hospitals systems correctly. For the client viewpoint also the cost of the scanner, training and maintenance are important factors.

This Master's thesis has given me an understanding and a different point of view to look procurement process in many perspectives. However, there are also need to think about the different fundamental reason for the process. Thesis time was long and there was a lot of professional grow during that time. It was hard to keep the whole process together.

At the working life point of view the Kuopio University Hospital's Oral and Maxillofacial Diseases clinic nurse in charge Matilainen (2018) says that working life-based thesis is a good thing for the workplace. For example, in this case, there wouldn't be possibilities to concentrate on this procurement, the pilot and the pilot query so professionally and delicately that has done in this Master's thesis. A big part of all was to be forced between the suppliers, clinic and the KUH organization. Thesis work has helped to understand the technical property, data administration, information system and also disclose healthcare professionals' expectations. Based on the honest feedback from the client site I felt that my thesis was successful and serves immediately the needs of working life; " *We are pleased for this thesis work. There has been very big work by making the market research, organizing the pilot, to doing the pilot query and in the end the procurement. Without this thesis work, we might be now in a situation that we don't have intraoral scanner purchase. Master's thesis has provided right product, the right quality, in the right time and good price.*" (Matilainen 2018)

In the future as a continuation, there is a need to 1) create digital education material from the intraoral scanners for the employees. The pilot query raises the necessity up distinctly; 2) to examine different generation skills and mind towards intraoral scanners and 3) to evaluate age causation to digitalization. Finally as a development suggestion is also that there is a need for professionals who understand the IT-regulation and procedure as well as healthcare necessity and destination.

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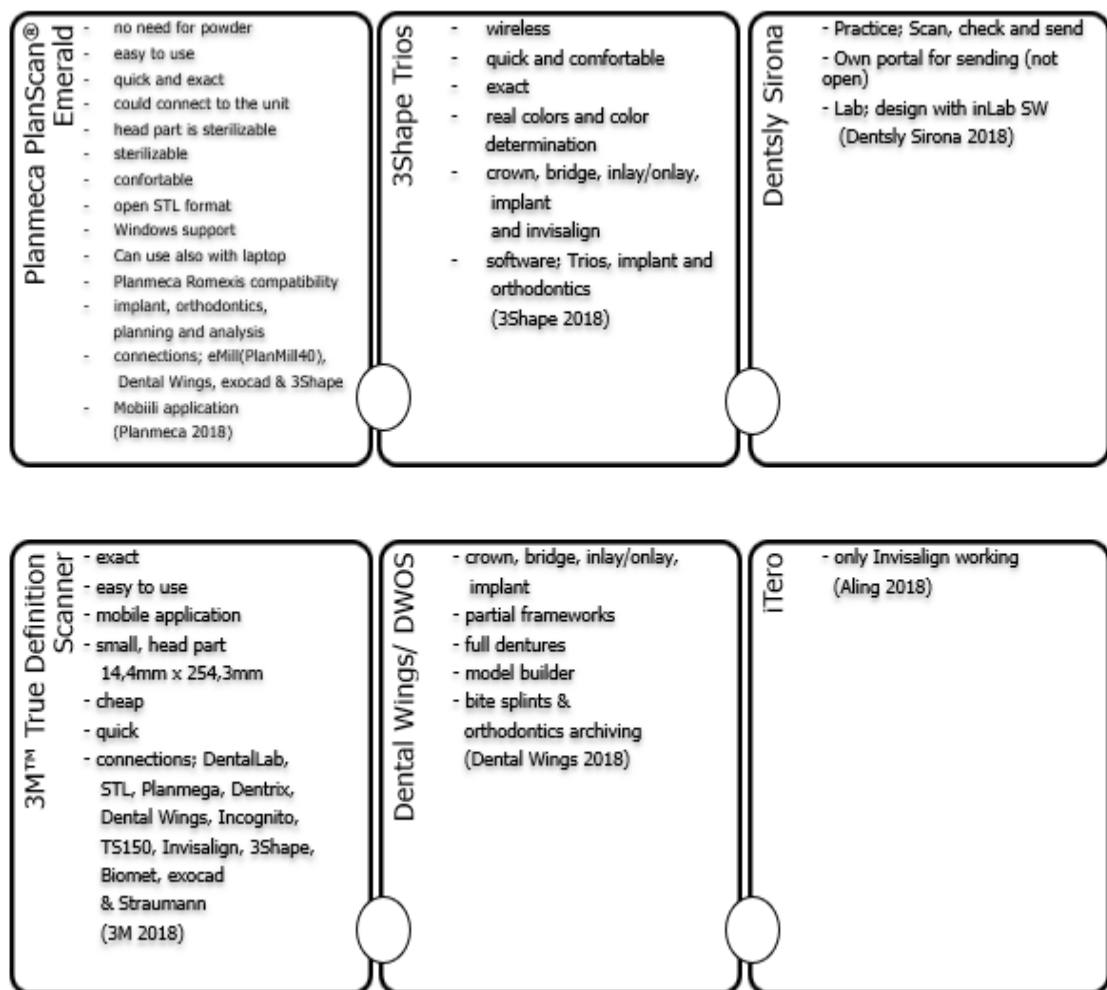
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APPENDIX 1: MARKETING STUDY



APPENDIX 2: PILOT QUERY

1. Where do you work
- Oral and Maxillofacial Diseases Clinic
 - Education and specialist training in dental medicine

2. Profession
- Oral and maxillofacial surgeon/ special dentist/ Dentist
 - Dental hygienist
 - Nurse
 - Dental assistant

3.a I have used intraoral scanner before

- Yes. Answer in free text what intraoral scanner have you used and what kind of experience you have it?
- No. Thank you for answers!

3. Did you test intraoral scanner in the pilot?
- Yes
 - No

4. What intraoral scanner would you like to use based on the pilot?
- Planmeca Emerald™
 - 3Shape TRIOS™

5. I did get enough information about pilot and completeness to the use of a scanner
- Yes
 - Only partly
 - No

6. I did get an education to use of scanners
- Supplier
 - Kys personnel

7. Learning of use of the system was
- Very easy
 - Easy
 - Hard

7.a If the learning of use at intraoral scanners was hard, explain (open text)

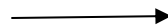
8. What else you want to say about the pilot? (Open feedback)

9. I will use scanners in my work in the future

- Always if possible
- Sometimes
- There is no benefit to use
- I will not use (Is not in the job description)

10. Estimate are the scanners beneficial to work

- I believe that all patients will be scanned in the future
- I believe that when needed/ sometimes I will use the scanner
- I don't believe that scanners will become common



10.a Why you don't believe that scanners will not become common. Explain free text.

11. Did the scanners respond you need in technological accuracy and necessity of quality?

- Excellently
- Fine
- Partly
- Badly
- I don't answer

12. When you use scanner did you notice any time-saving? (Cf. for example alginate duplicate taking)

- Yes, absolutely
- Not significant saving
- I can't say

13. Estimate developing of the care process with use of scanning
 - A better way, how? (open text)
 - Worse, how? (open text)
 - No meaning for it

14. What else digital equipment's do you want to use in work at future?
 - milling machine
 - 3D printer
 - Hologram for planning
 - Something else? (open text)

15. How do you assume the digitalization will affect your work? (open answer)

16. Could patient's safety improve by intraoral scanning
 - Yes. How? (open text)
 - No. How? (open text)
 - No meaning for it

17. Tell your opinion about patient`s safety aspect (open answer)

18. Grade pilot participating 4-10
 - KYS personnel
 - Plandent Oy
 - Straumann