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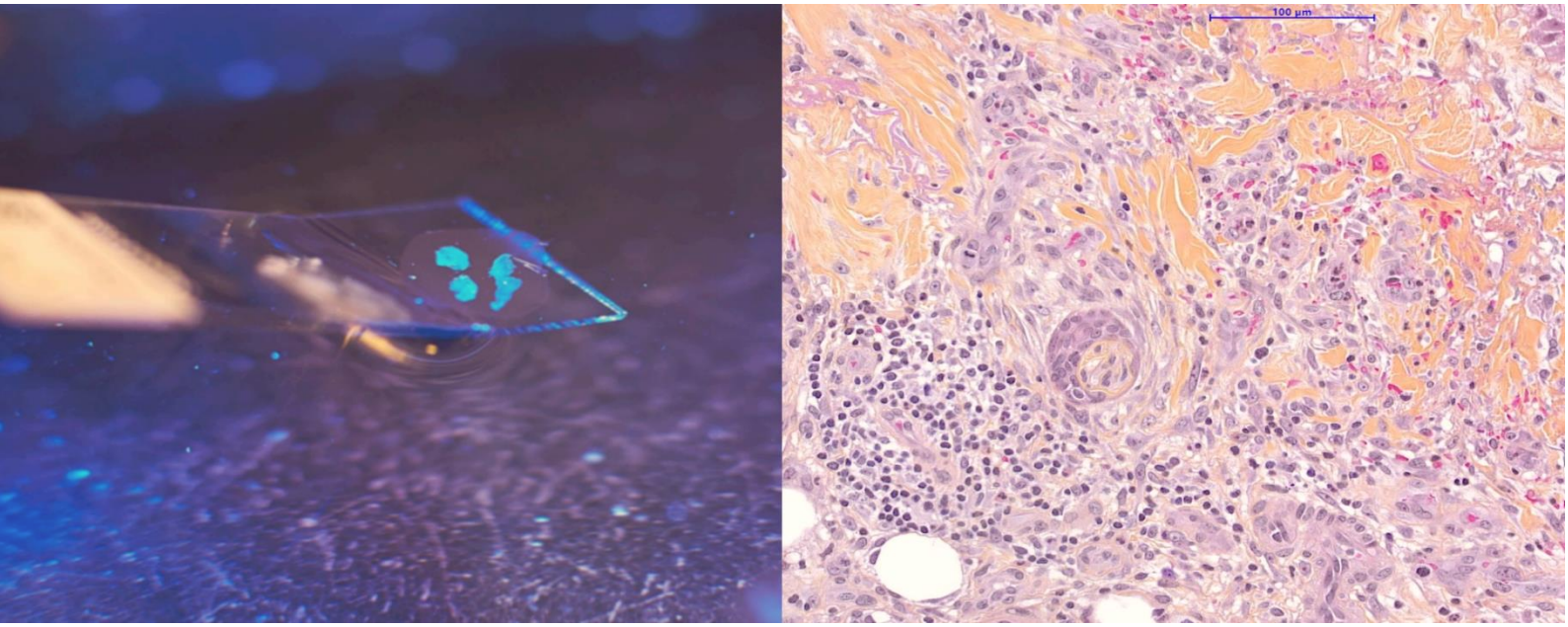
How can AI affect the pathology role?

A case study about technology and work design



BI Norwegian Business school

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Executive summary

Our term paper explores the impact of artificial intelligence (AI) on the pathology role and work design. We aimed to identify the challenges faced by pathologists due to increased workload and longer waiting times for test results and explore the future of the pathology role and the implications of AI.

The workload of pathologists has increased significantly in recent years. This has raised concerns about patient safety. Pathologists collaborate with various internal and external stakeholders, including other departments, patients, and hospitals. Interviews with pathologists indicate that the most challenging aspect of the job is the workload, while the most rewarding aspect is helping patients.

We also explored the future role of pathology and the changes that are expected to occur in the field. Pathologists expect changes in their roles, responsibilities, tasks, and competencies. They also expect changes in internal and external collaborations. The most challenging aspect of the future role is adapting to new technologies, while the most rewarding aspect is improving patient outcomes.

Like most professions, pathologists have limited experience with AI, but they expect it to change fundamental aspects of their role. They believe AI can improve diagnostic quality. However, they also see challenges in integrating AI into their work and overcoming barriers to implementation.

We conclude with an action plan for AI-driven job crafting for pathologists. The plan includes closing the trust gap, establishing collaborative efforts, empowering pathologists to influence their future job demands, and promoting peer learning and sharing success.

Overall, we believe this study provides valuable insights into the challenges faced by pathologists and the potential impact of AI on the field. It highlights the need for pathologists to adapt to new technologies and collaborate with internal and external stakeholders to improve patient outcomes.

How can AI affect the pathology role?
A case study about technology and work design

1. Organizational context

1.1. About Fürst

Fürst Medical Laboratory is a privately-owned laboratory, established in 1950. Over the years, it has evolved to become one of the largest laboratories in Northern Europe, with a workforce comprising over 500 dedicated employees. The lab undertakes daily analysis for between 12,000 to 15,000 patients, resulting in approximately 150,000 test results issued each day, a testament to the comprehensive scale of its operations (furst.no, 2023).

The laboratory's main areas of expertise lie within clinical biochemistry, microbiology, and pathology (furst.no, 2023). These scientific disciplines play a pivotal role in understanding the health condition of patients, thus contributing to accurate diagnosis and effective treatments.

Fürst has always upheld a distinct digital strategy, in which all laboratory-related software is developed by in-house developers. The rationale behind this approach is to remain adaptive to an ever-changing market without being dependent on third-party providers. This choice proved invaluable during the pandemic, with Fürst swiftly transitioning its IT solutions to address the challenges posed by a new and unknown virus.

As a result of its focus on technology and digital innovation, the company's IT department has over 30 employees who specialize in areas such as software development, machine learning, and operational management. The IT department is deeply integrated within the company's strategic management, with a Chief Technology Officer (CTO) involved in all strategic decisions. This close integration facilitates the rapid implementation of new technologies and improvements that help the laboratory maintain its leading position in the industry.

1.2. About Pathology and digitalization of the field

Pathologists can be called medical detectives, as they often work behind the scenes. Therefore, their work is often overlooked, because from a patient perspective they are not as visible as other medical personnel. A pathologist's work, however, is crucial for providing the patient and the medical team tasked with treatment, a correct diagnosis and supplemental medical information. The primary task of pathologists is to diagnose histological sections, or tissue samples, to uncover and identify diseases such as cancer and others. This requires a deep understanding of biology and disease processes, along with an attention to detail.

Setting a diagnosis mostly begins at the doctor's office. Here a doctor will, based on an assessment of the patient's health status, symptoms, history, age and gender, decide to take samples for potential diseases. Once these samples are collected, they are sent to laboratories like Fürst, for further examination. Here in the laboratory, samples go through a partially automated process to prepare them for diagnostic evaluation. The process includes several steps, from ensuring that the sample is correctly preserved, staining the tissue to highlight various cellular structures, to mounting the sample on a microscopic glass, known as a 'slide'. When the sample is ready, the microscopic glasses are manually handed over to the pathologist for examination. At this stage, the pathologist observes the sample under the microscope, looking for any abnormal cells or groups of cells that could indicate a disease.

In addition to manual examination, samples are also scanned using a high-resolution digital scanner that provides a detailed image of the sample. Digital diagnostics is becoming increasingly popular among pathologists, as it gives them the flexibility to work across different locations, including the possibility for remote work.

Each slide can contain up to 20,000 cells, giving the pathologist a wide range of material to work with. And there may be as few as 3-4 cells that are abnormal. The pathologist tries to identify any cells that deviate from the norm, or to detect areas with groups of cells that do not match the normal pattern. The number of slides generated from a sample can vary enormously. For example, a simple skin

biopsy from a mole can generate between 1 and 4 slides, while more complex biopsies, such as a prostate biopsy, can produce up to 40-50 slides.

The time it takes for a pathologist to diagnose a slide can vary greatly. It depends on many factors, including the pathologist's experience, specialization, and complexity of the sample. To provide a comprehensive and accurate assessment, the pathologist must go through all the slides and compare their findings with clinical information, which includes the patient's age, gender, symptoms, and previous medical history.

Norway is facing a significant challenge in the field of pathology. We are expecting shortage of pathologists in the future, due to a combination of multiple factors, including lengthy training period required for specialization in pathology (five years specialization), an increasing life expectancy of the population, and an implementation of comprehensive screening programs for cervical, mammal, prostate, and colorectal cancers. The implementation of precision medicine (more personalized medicine practices) places even greater demands on the level of detail of the pathological diagnosis. The scarcity of pathologists and an increasing workload can have negative effects leading to potential delays in diagnoses and treatment planning, which in turn can impact patient outcomes. To tackle this impending shortage, various initiatives have emerged that propose the integration of digitalization and artificial intelligence (AI) technologies in the field of pathology (Aukrust, 2023). Digital platforms can facilitate efficient storage, retrieval, sharing of pathology data, streamlining workflows and enabling collaborative efforts among pathologists, and AI algorithms that have the potential to assist pathologists in preliminary analysis, identifying abnormal samples and expediting the processing of routine cases.

2. Issue identification

Technology has evolved from being a support tool, to significantly impacting the way we work (Wang & Parker, 2020). Over the last decade, the field of pathology transitioned from manual and paper-based practices to an emerging digital environment. Like many other industries, the Covid-19 pandemic forced

pathologists to become more digital. The use of digital high-resolution scanning made home office and remote work possible and is used more still after the pandemic. However, the scarcity of pathologists and the rising number of cases to diagnose presents reasons to believe that patient safety and diagnostic accuracy may be compromised, posing a significant workload challenge. In response, Fürst are investigating how to reduce the scope of manual tasks by digitizing pathology using AI solutions.

In this paper, we will explore the potential influence of AI solutions on the pathology role. Our analysis will look at how AI challenges the relationship between human and machines differently from other technology. We will look at how implementation of new technology can affect work design, with a special focus on alleviating workload pressures and enhancing patient care. Lastly, we will see how the introduction of new technologies, such as AI, is affected by the individual's response to new technology in terms of digital mindsets. In the end we summarize key findings and have an action plan on what moves Fürst can do to successfully implement AI solutions for pathologists.

3. Analysis

3.1. "The standard partnership" and how it's challenged by AI

Since the inception of the personal computer, the relationship between man and computing machine has slowly progressed towards what is today often referred to as "the standard partnership". McAfee and Brynjolfsson (2017, s. 37) provide a division of work into the role of the computer *"doing all the logical, rule-based work...*" and on the other side humans "*...exercise their judgement, make decisions and interact with other people to solve problems, seize opportunities, and take care of customers*". In this setting the computer is little more than an advanced calculator requiring continued input, unable to deviate from the instructions provided by the operator. Because of the computers inability to render creative works without generous input from humans, computers have been relegated to do the "heavy lifting"; the computational work, the rendering of advanced graphics and the solution of advanced algorithmic equations. All of this has, however, been done under the careful guidance of humans.

AI can potentially challenge the standard partnership by providing the means for which computers to show some semblance of creativity. For instance, the Large Language Models (LLM) can create poetry and Generative Adversarial Networks (GAN) can create original works of art. Both models still require human input to be provided guidance of what art or text to create. In human terms this is called inspiration, and to us it often comes in the form of sensory input. Without inspiration, we are unable to create. Without input, AI-models are (thus far) unable to create.

Looking at the emergence of AI, one thing that distinguishes this from previous technological advancements is the fundamental difference in the relationship between humans and AI. Like humans, AI can possess *agency*, self-directed learning, and the ability to make own decisions (Parker & Grote, 2022). This in turn calls for a mutual relation of trust. In practical terms, every time we give input or decision-making tasks to AI, we implicitly acknowledge the intelligence and competence of an algorithm that completes tasks and thinking on our behalf. Just like the machine must depend on our sensory input to create. The relation is more mutual, and can provide remarkable outcomes, but only if we function with machines as interdependent teammates (Finn, 2018).

> *"As technology advances, one must simply be open to the fact that things change, and if diagnostics can be done in a better way for certain things... Validating and potentially accepting it." (P4)*

AI may be breaking down the standard partnership and could usher in a new form of partnership closer to master/servant. It is likely that humans will only need to tell computers what to do, as opposed to the standard partnership where we must input instructions several times throughout a process and verify the results time and again. AI now represent their own decision-making capability, and to be successful, trust is going to be vital.

3.2. AI and work design for the pathology role

This section discusses how AI can influence job demands and job resource using the J-DR model as described in the article by Parker and Grote (2022) and change work design using theory by Tims et. al. (2011).

3.2.1. The balance between job demands and resources

Rapid advancements in AI are causing disagreement regarding the numbers and exact magnitude of changes in the job market and the extent to which AI will take over certain jobs or tasks. However, there is consensus that new technologies will significantly change the overall workforce structure and will, somehow, fundamentally change the way we work (Parker & Grote, 2022). To look further into how AI can affect the pathology role, we will analyze work design factors based on input from interviews through job demands and resources model (J-DR).

According to Tims et al. (2011), job crafting involves shaping a job to fit individual preferences, abilities, and skills. To understand the potential changes that can be made, we can examine characteristics inherent in a job. The authors utilize the J-DR model to break down job characteristics in demands and resources. Job demands are the physical, psychological, or organizational aspects of a job that necessitate effort or skills, often representing a "cost" for the worker (Tims, Bakker, & Derks, 2011, s. 174). For instance, pathologists experience a scarcity of professionals in their field and an increase in the number of cases to analyze. Job resources are the aspects that assist individuals in attaining their goals, managing demands, or fostering learning. These resources can include autonomy, task significance, or social support (Tims, Bakker, & Derks, 2011, s. 174). An example of a job resource for pathologists is the ability to make independent decisions regarding diagnostic procedures.

The authors predict that if employees experience an imbalance between job demands and resources, they may want to reduce this gap by trying to craft a better personal fit and avoid potential burnout (Tims, Bakker, & Derks, 2011). One of our hypotheses is that AI can help reduce demands by assisting with

diagnosis. Due to a potential lack of trust, AI can, also represent stressors.

3.2.2. Balance between resources and demands regained with AI

Parker and Grote (2022) discuss how newer technology in general can affect work design positively and negatively through its influence on job demand and resources. They describe how factors of technology and work can be both beneficial for workers, but sometimes also represent stressors affecting balance in J-DR (Parker & Grote, 2022). As mentioned in part 3.1, AI has agency, giving it the power to make its own decisions. As a result, AI can represent different demands or resources to the pathology role than any previous technology. The agency characteristic of AI can possibly reshape the relationship between human and machines, and influence ways of working. Parker and Grote (2022) argue that we need to be cognitive of minimizing risks and maximizing opportunities new technology represent by having a mutual and effective design of both technology and roles.

As proposed by Tim et. al. (2011), job crafting techniques are changes that employee, in this case pathologists, can self-manage to make it a better fit to skills and abilities. Four dimensions of job crafting to enhance their work experience and performance: (1) increasing structural job resources, (2) increasing social job resources, (3) increasing challenging job demands, and (4) decreasing hindering job demands. Using findings from interviews with pathologists we will discuss how AI can affect different characteristics of their role.

3.2.3. Increasing Structural Job Resources: AI and autonomy

Integrating AI into their workflow can allow pathologists to make more informed decisions, prioritize critical cases, optimize their time and expertise (Tims, Bakker, & Derks, 2011). A larger amount of information can be scanned quicker with AI, and pathologists can get information much faster than before. AI can help the pathologists compare, store and analyze patterns from slides to support decision-making. In addition to increasing efficiency of pathologists, task crafting may have the added benefit of increasing job satisfaction as it leaves pathologists with more flexibility to choose which cases they want to study in more detail and

be more in control of their competency development which can increase the experience of autonomy.

> *"If we can get help in selecting the samples with 2 out of 20,000 cells and they show us the areas where those cells are located, then we can examine those 10 areas instead of looking at 20,000 cells." (P3)*

On another side, with AI making its own decisions an implication can be that pathologists are further removed from the decision-making process, replacing human judgement with machine learning. If the pathologists do not have a certain degree of knowledge on how the algorithms for decision-making work, it is possible that pathologists will feel a loss of control.

> *"…in example in the molecular pathology there is a machine making the analyzes, and you get an answer and suddenly you are medical responsible for something that a machine did" (P4)*

AI has the potential to enhance pathologists' autonomy and competency development positively and negatively. Apart from diagnosing diseases, pathologists may train AI systems, validate machine learning models, and provide quality assurance to improve accuracy (Tims, Bakker, & Derks, 2011). This can also reduce the choices for competency development. If a certain level of IT-skills becomes a job demand to use AI for analyzing slides, it can take time away from doing what they really love, and pathologists take great pride in their profession.

> *"When you become a pathologist, it's because you have a genuine interest in pathology, so I find it incredibly rewarding to have the opportunity to work in this field." (P1)*

3.2.4. Increasing Social Job Resources: Fostering collaboration and new competencies

Digitizing the field of pathology has already made pathologists able to work more remote. This is something the pathologists appreciate and hope that AI solutions can help them increase. Like many other workers, pathologists appreciate more work flexibility. Before the pandemic there were few options allowing work outside of the laboratory.

> *"What I hope is an advantage is that you can work a little at home." (P1)*

New technology has made it easier to chat and communicate with colleagues and stakeholders in the medical field, and such increasing their professional network. Pathologists can shift their primary focus from intensive analysis towards the direction of patient care or medical discussions and research.

> *"…call someone and just say 'can you look at it', and then they look at it, or you look at it together. So, I think it will be more efficient," (P2)*

By using AI-driven technology, they can streamline collaboration, share information, and obtain timely feedback, leading to improved performance and adaptation to evolving needs (Tims, Bakker, & Derks, 2011). Engaging with colleagues and patients can lead to a change in work tasks and the acquisition of new specialty competencies.

> *"What we are dealing with is increasingly patient-adapted medicine. This means more and more analysis and the like to be done. It is very rewarding to be able to put the puzzle pieces in place for the patient's treatment" (P2)*

3.2.5. Increasing Challenging Job Demands: reducing repetitive work or taking over the heavier lifts?

Replacing the repetitive tasks is maybe the most significant upside for implementing AI in the field of pathology. Using AI solutions to reduce the demand for doing the same tasks repeatedly:

> *"… To work as fast as you can. It's kind of short <time>. That's kind of how it's always been. You just must be fast, and then make no mistakes" (P2)*

We point out three large implications about this. One is that pathologists learn from doing a large amount of analysis from slides. When they analyze lots of regular slides, it is easier to spot irregularities. Making them more certain which cases seem healthy, and which are not, and will need a treatment plan or follow-up for the patient.

> *"I think that can it become very exhausting because one of the things that is supposedly good here at Fürst is the abundance of many simple, routine cell samples. Then you are constantly reminded of what the normal variation is and how the normal tissue should appear." (P1)*

Secondly, is that the pathologists have such trust in their own manual work, and they rarely make mistakes, because they see such a huge amounts of cells.

Loosing this part of their job can trigger a stressor. Making few mistakes in a pathologist's role is important, it can really be about life or death for a patient not getting the correct treatment plan.

> *"They do the job better with a microscope. But with the new ones, we require them to be able to diagnose digitally. The most important thing is still that the system is secure and correct. Because mistakes have big consequences." (P3)*

And last, there is a need for trust to the work that computers can do. Some pathologists are worried they will be held responsible for the results of a machine, not having trusting diagnosis to be set by machines alone. Who is going to sign for the medical decision that could influence on a patient's health.

> *"I rather think it depends on whether it is medically responsible for the normal samples that the machine says are normal, I don't think I would have trusted that simply, and I think there are many people who want to know that it is us who have learned up the machine, but I don't know if I would have trusted it anyway." (P1)*

From interviews the pathologists a common theme is that AI could certainly take some of the easy tasks, leaving the more complex cases to the pathologists. The pathologists are clear that if AI take all easy tasks, their job would be more cumbersome.

> *"It's also that you can't bear to just look at such difficult things all day long, hour after hour, so that would not be preferred. That the machine did everything right, and then we just had to sit like that." (P1)*

Brynjolfsson and colleagues (2018) made an analysis that most occupations in most industries have at least some tasks that could be replaced by AI, but at present no occupation can be replaced by all tasks. Which mean that mostly automated tasks will exist within a broader role alongside other tasks that will not be automated (Parker & Grote, 2022). Despite digitalization, each case still requires individual examination by a pathologist using microscopes or digital images. Although AI can provide faster and more precise results than humans, pathologists play a crucial role in quality assurance, discussion with other specialists, and planning with patients.

AI can allow pathologists to explore new research opportunities and initiate projects. Combining traditional pathology with IT-skills provides pathologists with the opportunity to train machine learning models in pathological pattern recognition. Likened to pilots who shifted from actively flying to monitoring flight systems after the introduction of the autopilot, pathologists can shift their focus from active diagnosis to managing, supervising, and training AI. Other tasks include providing more thorough patient care and quality assurance on the diagnosis conducted by AI. Ultimately this may enhance professional growth and impact (Tims, Bakker, & Derks, 2011).

3.2.6. Decreasing Hindering Job Demands

AI can help manage job demands and reduce physical, cognitive, and emotional strain on pathologists. While AI can provide faster and more accurate diagnoses, pathologists should act as safeguards to ensure accuracy. This can free up time for patient care and other rewarding tasks, but it requires trust in the technology. AI can also assist with time management and work-life balance, leading to more effective use of free time and reduced burnout risk (Tims, Bakker, & Derks, 2011). The added benefit of pathologists staying within the field may be attributed to AI in the future.

In the words of Kranzberg (1986, p. 545), “technology is not necessarily good, nor bad; nor is it neutral”. Individuals and organizations must adapt and seize opportunities presented by this transformative force. When technology is introduced, there are different potential work design options, and these should be—yet most often are not—actively considered by implementers. AI now must function as an interdependent team of equals, rather than treating AI as a passive tool for it to be successful (Parker & Grote, 2022).

3.3. Reactions to new technology, and how we accept it

This section will be explaining the Technology Acceptance Model, to understand how pathologists can accept new technology, like AI. Next, we will dive into findings from interviews to discuss evidence on reactions to new technologies with digital mindset theory.

3.3.1. The Technology Acceptance Model

Through work design theory we have seen that AI could represent significant changes to pathological work. Both in changing tasks, affecting relations and could possibly change the way the pathologist perceives their job. To successfully implement AI solutions to their work, we need to put efforts into adaptation. Especially due to pathologists' strong professional pride, and lack of trust in machines making clinical decisions. To quote an article by Weill & Woerner *"Digital transformation is not about technology – it's about change"* (2018). People need to accept technology and make active choices to adapt and use it.

The most used model to understand what leads people to accept technology is the Technology Acceptance model (TAM) by Bagozzi, Davis and Wharshaw (1992). The TAM explains how people accept and use technology based on their perceived usefulness and perceived ease of use. These two factors affect people's attitudes toward using technology and behavioral intention to use it.

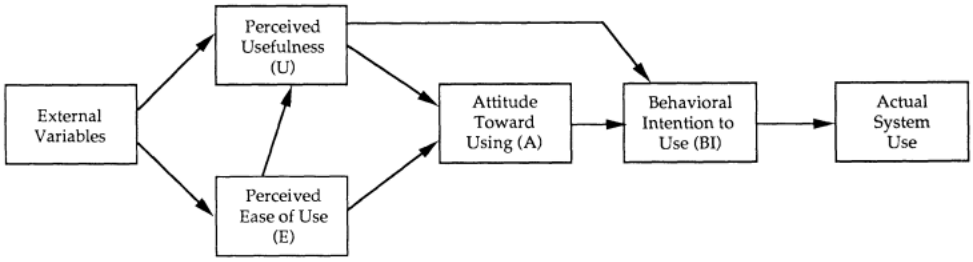

Figure 1 – Technology Acceptance Model (Bagozzi, Davis, & Warshaw, 1992)

When faced with new technology we evaluate how this solution can be useful to me, for example with AI we do know the usefulness and the ability it must process huge amounts of information in no time. However, like the case for pathologists it seems like the technology can be too useful in some cases, taking over some of the "*easy*" or "*fun*" tasks. This can affect attitude and behavior towards the technology.

In terms of ease of use, AI has not been as accessible to us on the same scale until recently. ChatGPT, a service provided by OpenAI, has in many ways revolutionized the AI experience for most people by processing large amounts of information, and using human-like dialogue, unlike other chatbot services. This

has opened people's eyes to the capabilities of AI and made it more accessible. As a result, perceptions of AI have shifted, and within pathology they see how it can contribute to process large amounts of information.

3.3.2. Digital mindsets and responses to new technologies

The ease of use and usefulness of a technology are two factors that affect our attitudes towards using technology. But - people are not that easy. To better understand these processes and typical responses to technology we will look at digital mindsets. We have tried to capture individual attitudes and beliefs towards AI or technology by the pathologists to understand how this affects perceived usefulness, ease of use and in the end adoption of new technology. By learning more about the attitudes and beliefs about new technologies it will be easier for us to increase the likelihood of pathologists accepting and adopting the new technology.

A mindset is an individual belief about the ability to change human attributes, this can influence our responses towards different tasks or situations (Solberg, Adamska, Wong, & Traavik, 2022). Digital mindsets refer to the same belief about our ability to learn and utilize new technologies (Solberg, Traavik, & Wong, 2020). Digital mindset theory helps us explain psychological processes that happen when we are exposed to change, uncertainty or challenges that are technology related. Like a pathologist having to use a new system or digital scanning pictures of human tissue to conduct their job (like many had to do during the pandemic).

People react differently when exposed to new technologies. Some want to explore it immediately, some wait, and some just ignore or refuse to use the try it. Dweck (2016) describe these reactions as different types of mindsets. These two categories are *fixed* and *growth mindset.* Fixed mindset is when people believe negatively about their ability to face situations that require new competencies or skills (Solberg, Adamska, Wong, & Traavik, 2022). One example of a fixed mindset statement can be:

> *"I think that can be very tiring <to implement new technology>, because one of the good things here at Fürst is that there are lots of simple, normal tests <that we can do manually without AI>" (P1)*

On the contrary, people with *a growth* mindset actively seek opportunities to learn and grow, gaining confidence when faced with challenges (Solberg, Adamska, Wong, & Traavik, 2022). A person's mindset is not always fixed or growth oriented, but our response is situational. Below is an example of a pathologist with a typical growth mindset, looking forward to learning something more about an unknown field and seeing opportunities:

> *"I would like to welcome technology, as it can assist us greatly, for example, if the computer can pick samples for us." (P3)*

Individual attitudes towards new technology are also affected by our beliefs about situational resources. Zero-sum mindset is when people believe that a situation has limited resources, which means that if one person gets more, another one gets less of the same resources. In example thinking that an AI machine will get more of the fun tasks, leaving only the complex cases to the pathologists. This is a competitive view on resources - more for another means less for me. Whereas expandable-sum mindset is when individuals believe that resources can be increased and are not limited (Solberg, Traavik, & Wong, 2020). The quote below exemplifies a pathologist that sees the opportunity to become more specialized if AI can take some of the workload. There is no competition, they can expand resources and opportunities.

> *"<Allow us to be> much more specialized in some diagnostic fields" (P2)*

These two theories on mindset, fixed/growth and expandable/zero-sum, combined provide a fuller understanding of possible responses to the implementation of new technology. In a matrix Solberg, Traavik and Wong (2020) define four types of reduction patterns and responses to new technology (see figure 2): *Technology Avoiders, Technology freeriders, Technology socializers* and *Technology masters*.

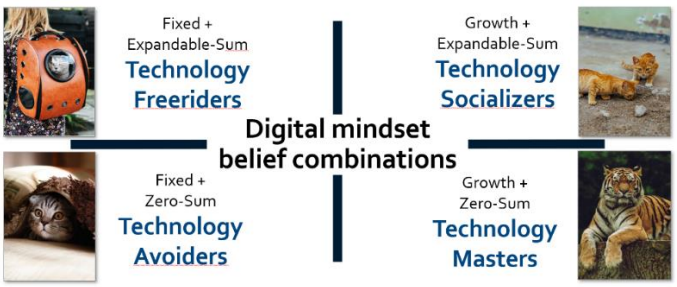

Figure 2 – Responses to new technology (Solberg, Traavik, & Wong, 2020)

These are archetypes, and such not one-sided, but it can help us see some typical patterns when implementing AI solutions for pathologists combined with analysis from interviews. Addressing different mindsets according to their responses helps us leverage on reactions and adopt technology faster.

Technology freeriders have a fixed mindset and expandable-sum thoughts about resources. They are called freeriders because they see the positive outcomes of technology, but they are doubtful about their own ability to learn or manage it. Their main effort is to get more out of less, hoping to benefit from technology without having to use it themselves (Solberg, Traavik, & Wong, 2020). Even though there was skepticism about AI or computer based medical decisions, some pathologists saw clear benefits:

> *"There are most benefits… as long as the technology works well" (P1)*

Freeriders are positive and see how technology can provide benefits, but they rely on the technology or colleagues to work for them without having to make the effort to learn new technology themselves. Technology represents something they don't master, which brings them out of their comfort zone. They hope to 'freeride' - get more time and work more efficiently based on other people's effort learning new technology.

Even though they have heard about it for long and would want to try technology like AI cell scanning, they have no intentions about taking the initiative themselves, because they see how it can bring more for less.

> *"I think 10 years <until they can use AI solutions> sounds a bit short to be honest. Because we have heard so much about it but there are never any signs of it coming" (P1)*

Technology avoiders are fixed mindset and zero-sum oriented. If a task would require them to use new technology, they would try to avoid the task. Some of our subject pathologists have this attitude towards AI solutions.

> *"I can see the learning of the machine and to look at it illustrate the test results, I guess it will not be very exciting" (P2)*

This person has no belief that new technology can help make their job easier. This person does not see it useful, nor easy to use. It is better to solve the cases manually or in the way that you are used to. Another statement from the same pathologist is perceiving other pathologists as technology avoiders:

> *"... pathologists are some of the most stuck-up specialists out there. Many of them have a very self-important attitude. I'm sure it's the same in other specialties too. I was almost shocked when I started in pathology." (P2)*

Through this statement, this pathologist projects their own mindset about technology adaption onto their colleagues. We can create a self-proficiency culture and especially if the person perceiving others has a leader position. We want people to be positive about new opportunities, and if it doesn't come naturally, we need to help these avoiders a bit more than others.

Technology socializers are the opposite of avoiders. They have a growth mindset and expandable-sum beliefs about resources (Solberg, Traavik, & Wong, 2020). This is the same pathologist about digital pathology, another subject in the interview than AI. This both represent how socializers can take on roles to help or motivate others and to learn new technology, but also the situational dependence on mindset how one person can be fixed mindset about one technology and excited about another.

> *"Digital pathology is so exciting; I have tried it and it went well… It is so much fun!" (P2)*

Because of the highly specialized nature of pathology, pathologists take great pride in their profession. New competencies can be perceived as a threat as it disrupts their established ways of working. Therefore, having technology socializers is extremely important to help others see the benefits, or get started to use AI solutions in their work. These are also good at translating the need for pathologists to IT and vice versa, so that both needs can be met.

> *"We need to get everyone on board and convince them that this technology is here to stay, and that it's important to embrace it. That will be a significant challenge, at least in the initial years" (P2)*

Technology masters are growth mindset and zero-sum, they engage in goal-oriented learning and use new technologies (Solberg, Traavik, & Wong, 2020). Based on the information provided in the interviews, it can be interpreted that some responses to digital transformation falls into the category of "masters". Here are some quotations from the interviews that support this categorization:

> *"I think there will be even more precise diagnoses. And I think it will also help with further research. You find new methods and new things." (P3)*

Although masters were not that easy to spot in the pathologists, we expect this to be due to their role being mostly around treating people's health and not commercial or about earnings, the culture is less competitive. This statement from a senior pathologist on increasing specialization can be a technology master statement. The emphasis on specialized knowledge and the continuous learning aspect is a typical growth mindset, but still their goal of why they are using technology is very one sided to be a better specialist.

Even though they themselves can be categorized as masters, they believe that many of their colleagues, in particular the older generations, have a different mindset and a more fixed/zero-sum mindset; but they hope the new generations are more adapted to digitalization. The interviews don't go into depth on this topic, but there are quotes that emphasize this perception, because the next generation of pathologists will have more benefits from knowing more technology than other pathologists:

> *"In general, things move very slowly in the public sector. It requires coordination at the national level... It is easier for the next generation, Gen Z, they are much more online and digital than most older individuals." (P3)*

To summarize, in one organization there will always exist different mindsets and such varieties of reaction patterns to new technology. Bringing in AI solutions represents a new way of working and new technology for a great many pathologists. We do not know the full picture of how AI solutions will look like yet, we have just seen the beginning, and such do not know to which degree it will

affect pathologists. However, we do know that it is for sure coming and at a rapid pace. Therefore, having knowledge about the reaction and attitudes towards technology and AI in general, and why and how people will accept new technology is important to prepare for resistance to change to helping people adapt new technological solutions. On the other hand, building a coalition of likeminded individuals to help you engage the more sceptic (fixed mindset) people will help you translate needs, seeing benefits and make the adoption process faster, more adjusted for the right needs and smoother for every party that support implementation.

4. Key insights

4.1. The trust gap: Building trust between humans and computer in the age of AI

Implementation of AI solutions to take some of the workload from the pathologists is going to change pathologists' experience of autonomy in their job. On one side AI can take some of the easier tasks for the pathologists reducing workload to focus on other tasks. On another side there is a risk that if the pathologists lack the required knowledge on how the algorithms and decision-making process works, it is possible that they can experience a perceived loss of control over the diagnostic process. When implementing AI solutions, it will be important to foster trust between human and machine so that the pathologists can continue to accept responsibility for the decisions being made.

4.2. The pathologist role will change (work design)

Pathologists take great pride in their profession. They've completed a long and arduous education prior to working as a pathologist, and this is reflected in their perception about their skills and their job. While our study has indicated that pathologists are growth-minded about digitalization, they have also proven to be reserved in their wish to participate actively in the development and implementation of AI into the field. Recent developments show a fundamental change in many medical professions, pathology included. Many big tech companies like IBM, Google and Microsoft are working on pattern recognition

AI's which are likely to improve diagnosis. Because of this many pathologists believe their role will have to change over the next years, but in our interviews, they demonstrate that they are often unwilling to commit to a timeline.

4.3. Varied perceptions about new technology

It is a common belief, even among pathologists, that most practitioners in the pathology field have a fixed mindset regarding new technology. This was our assumption going into this assignment believing we would meet mostly technology avoiding reactions to AI. Our limited subject base has, however, challenged our understanding as pathologists have proven to be more growth-minded, and even excited to try out some of the emerging technologies. Pathologists have also indicated a lack of initiative to participate in the development of the technology or its implementation and would rather have the solution served to them. This also indicates that while they have a fixed mindset, they also display an expandable-sum mindset, making them technology freeriders.

5. Action plan: AI-driven job crafting for pathologists

An action plan can ensure that Fürst properly address these key findings. This action plan, like our analysis focus on the individuals, driving transformation starts with the people.

5.1. Closing the trust gap: test involvement and transparency

One of our key findings is that pathologists do not have enough trust in the decision-making process made by machines/AI-solutions, to accept responsibility for decisions being made by machines. Therefore, we would involve pathologists in testing AI solutions. This can foster transparency and involvement amongst pathologists by promoting explanations of how algorithms work, their limitations and biases. Allowing the pathologists to test solutions in safe environments will both have pathologists understand the machine better, but also allow them to validate and align solutions with needs and requirements to make correct decisions. This can establish a sense of ownership.

- Responsible: IT department
- When: Q3 2023

- Risk: Prioritizing the time from both pathologist side and IT-side. Possible quality risks if too many seniors are distracted. Early testers can be overwhelmed with a high workload at the same time

5.2. Closing the trust gap: digital pathology training

Trusting is often about knowledge. Building knowledge to technology in general is important for pathologists to see how technology can replace some of their manual work, enhance professional relations across sites and streamline processes. Therefore, one action can be mandatory "digital pathologists" training. training pathologists to reach a certain level of technological competence. Having general knowledge of technology will help both understanding new technology and see perceived usefulness easier. It will also be easier to collaborate with external and internal stakeholders in a digital environment.

- Responsible: HR and IT department
- When: 2024
- Risk: Prioritizing the time to upskill, reduced efficiency for a period

5.3. Pathology role change: Establish collaborative efforts

Affecting the future of pathology isn't up to a single organization, but Fürst can be a major player in the design of tools and processes by making a directed effort toward establishing strategic partnerships early. Collaboration with academic institutions can give Fürst the chance to inject their own tools and processes into the curriculum of pathology, giving them a chance at shaping the future. Collaboration with other medical institutions gives Fürst a chance to gather invaluable data for their own research efforts and establish a greater foothold within the field of pathology.

- Responsible: Executive team, marketing team
- When: now
- Risk: Pushing too hard to inject own tools and processes can be seen as a marketing ploy, rather than an initiative to enhance pathology as a profession

5.4. Pathology role change: Empower pathologists to influence their future job demands

Pathologists are some of the most highly educated professionals in the world and sit on a throve of knowledge and experience. No one is better suited to influence the future of pathology. To retain as many existing pathologists as possible while simultaneously laying the foundation for the future of pathology, it makes sense listening do those who do the job today. Present current pathologists with a limited number of future scenarios including various degrees of digitalization and AI involvement in diagnosis. Conduct structured interviews to map out which tasks will be necessary in the future. Include questions to ascertain expectations of collaboration and relationships, and to try and understand cognitive perceptions of the future of the role. and use the feedback from work groups to map future tasks, as well as get a feel for how the cognitive perception of the future pathology role will be among current and future pathologists.

- Responsible: Academic institutions
- When: H2/2024
- Risk: Future scenarios are still uncertain, may produce imprecise or inconsistent data

5.5. Varied perceptions on mindsets about new technology: Peer Learning

Pathologists, while receptive to new technology, often refrain from its active development and implementation, subject to a fixed/expandable-sum (freerider) mindset. Therefore, fostering a growth mindset for proactive engagement is essential. To facilitate this, regular internal sessions where AI-proficient pathologists share their experiences can be arranged. Those who have successfully integrated AI into their workflow can present their experience, highlighting the benefits and challenges. Such a setting not only promotes peer learning but also fosters companionship in incorporating AI into diagnostic processes.

- Responsible: Medical Director / AI proficient peers
- When: Within 6 months after successful testing with AI tools
- Risk: Expressed lack of interest stemming from a resistance to change

5.6. Varied perceptions on mindsets about new technology: Share success

Regularly share success stories of pathologists who have successfully adopted AI in the diagnostic process. This could be done through various communication channels like intranet, meetings, or other platforms. A pathologist who successfully used AI-tools to enhance diagnostic accuracy can share their experience, from the initial challenges they faced to the eventual benefits they gained. Real-life stories can be very powerful, demonstrating the practical benefits of adopting new technology and encouraging others to follow. This can also be done within the profession on a national level. As it might help recruitment of other pathologists that are interested in the technology and have a mindset that could further enhance the process. This will help mitigate reluctance and passive behavior among pathologists towards the development and implementation of new technology in their field. By fostering a growth mindset, the aim is to encourage pathologists to be more proactive and engaged with the introduction of AI. This will not only help them adapt to changes and utilize the new tool effectively, but it will also lead to a better development phase as they provide valuable insights from their experience in the field.

- Responsible: Medical Director/CTO/Managers/Project Leads
- When: Start in parallel with AI tool trials
- Risk: Lack of success stories early on. Pick the low hanging fruit

6. Conclusion

The future of pathology leans towards an increase in digitalization and use of AI. This will likely change the primary tasks of pathologist from a “doer” to an “operator”. Once AI driven analysis has a greater precision than human, it’s likely that the field of pathology will see a transformative shift. The current generation of pathologists, especially those early in their career, are likely to have a unique opportunity to affect how the field of pathology will look through job design. By being proactive in their demands, and requesting the necessary resources, they can set the stage at this pivotal moment in the history of medical science.

Limitations and future research ideas

The interview material for this study is derived from a limited number of informants, which indicates that findings should be reflected upon as observations and do not represent statistical significance. Furthermore, our study based on the diagnostic method employed by Fürst differs from the diagnostic material used in public institutions. Which means that some findings will be specific and not general for the entire industry. Our focus was on the individual experience of AI. Its impact on an organizational level, in example for organizational learning processes, holds great potential for future research opportunities.

References

Bibliography

Aukrust, Ø. (2023, May 27). *Dagens Medisin*. Retrieved from Slik brukes kunstig intelligens i diagnostisering av kreft: https://www.dagensmedisin.no/slik-brukes-kunstig-intelligens-i-diagnostisering-av-kreft/567344

Bagozzi, R., Davis, F., & Warshaw, P. (1992, Vol. 45 No. 7). Development and Test of a Theory of Technological Learning and Usage. *Human Relations* , pp. 659-686.

Dweck, C. S. (2016). *Mindsets: The new psychology of success.* New York: Random House.

Finn, E. (2018). A Smarter Way to Think About . *NY Times*.

furst.no. (2023, 06 01). *Om Fürst*. Retrieved from Fürst: https://www.furst.no/om-furst/

McAfee, A., & Brynjolfsson, E. (2017). *Machine | Platform | Crowd.* New York: W. W. Norton and company inc.

Parker, S., & Grote, G. (2022). Automation, Algorithms, and Beyond: Why Work Design Matters More Than Ever in a Digital world. *Applied Psychology*, pp. 1171-1204.

Solberg, E., Adamska, K., Wong, S. I., & Traavik, L. E. (2022, November 11). When managers believe technological ablity is fixed. *Human Resource Management Journal*.

Solberg, E., Traavik, L. E., & Wong, S. I. (2020, 4). Digital Mindsets: Recognizing and Leveraging Individual Beliefs for Digital Transformation. *California Managemen Review*, pp. 105-124.

Tims, M., Bakker, A., & Derks, D. (2011, March 3). Development and validation of the job crafting scalE. *Journal of Vocational Behaviour*, pp. 173-186.

Wang, B., & Parker, Y. (2020). How does the use of information communication technology affect individuals? A work design perspective. *Academy of Management Annals*, pp. 695-725.

Weill, P., & Woerner, S. (2018, June 27). *Digital Transformation Is Not About Technology—It's About Change*. Retrieved from Chief Executive:

https://chiefexecutive.net/digital-transformation-is-not-about-technology-its-about-change/

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Appendix - Questionnaire

Intro and warm-up In this section, we would like to provide a brief introduction to the key responsibilities of a pathologist and the relevant demographics that we believe are important for further study. This serves as a warm-up for the upcoming interview to help the informant feel comfortable in the setting.	
1. Presentation of the interviewer and the study. The interview will take around 40 minutes per informant. a. Provide a brief overview of the research question, focusing on the integration of artificial intelligence (AI) and the need for job adaptation among pathologists. b. Ensure confidentiality and explain that their insights will contribute to understanding the future of job roles and digital implementation for pathologists. 2. Name: 3. Age:	
About the pathology role In this section, we aim to uncover the pathologist's thoughts on their current role and tasks. We want to explore their approach to performing their current duties, the collaborations and relationships required to carry out their work, and their perception of the job. Additionally, we want to uncover how technological tools contribute to or hinder their tasks today, as well as the pathologist's attitudes towards these tools.	
1. What role do you currently have, and what is typically your area of responsibility as a pathologist? 2. What are the most important tasks and routines you perform during a workday? Please rank them if possible. 3. In recent years, your workload has significantly increased, and waiting times for test results are growing longer. Could you reflect on the challenges related to workload and any potential impact on patient safety? 4. Which internal stakeholders do you often collaborate with? (Other departments, specialties, management) 5. Which external stakeholders do you frequently collaborate with? (Patients, hospitals) 6. What is the most challenging aspect of your job as it is today? 7. What is the most rewarding aspect of your job as it is today?	

8. Which digital tools do you use to generate test results currently? 9. What is your relationship with technology as part of performing your tasks today? 10. What are the advantages and disadvantages that technology brings to the execution of your tasks?	
Future role of Pathology In this section, we aim to uncover the pathologist's thoughts on their role and tasks in the future, as well as the changes they anticipate happening. We want to explore their perspective on how future tasks will be performed, the collaborations and relationships required to carry out their work, and how they perceive the job in the future. Additionally, we want to uncover their attitudes towards potential changes that technology may bring to the role in the future.	
1. How do you think the field of pathology will look like in ten years? 2. What changes do you think will occur in the pathologist's role and responsibilities? 3. What changes do you think will happen in the tasks and competence requirements for carrying out these responsibilities? 4. What changes do you think will occur in internal collaborations? 5. What changes do you think will occur in external collaborations? 6. What do you believe will be the most challenging aspect of the pathology role in the future? 7. What do you believe will be the most rewarding aspect? 8. What changes do you think technology will bring to your tasks? What advantages and disadvantages do you see with this? 9. Do you have any concerns regarding underestimation of your expertise when it comes to the potential opportunities' technology can bring to your role and responsibilities?	
Implications of AI on the pathology role Here, we will attempt to uncover the pathologist's thoughts on how artificial intelligence will impact the field of pathology.	
1. Do you have any experience with the use of artificial intelligence? 2. Do you currently utilize artificial intelligence in your job? 3. What experiences have you had with the implementation of digital technologies, including AI, in pathology practice in general? 4. Do you believe that technology like AI can change fundamental aspects of your role as a pathologist? Why or why not?	

5. What are your thoughts on enhancing digital competence in the field of pathology, and what impact do you believe this will have on the field in the future? 6. Do you have any thoughts on the impact of AI on improving patient safety, opportunities for increased accuracy, and streamlining pathological workflows? 7. What advantages and challenges do you see in integrating AI processes in the field of pathology? 8. What barriers or limitations do you see in implementing AI-driven processes, and what do you believe will be important to overcome them? 9. What kind of support, such as training, do you think pathologists will need to adapt to and use digital technologies, especially AI?	
Finish Thank you, wrap-up and next steps.	
1. Summarize the key points discussed during the interview. 2. Ask if there are any additional insights or concerns the pathologist would like to share regarding future job adaptation and digital implementation for pathologists. Thank the pathologist for their time and contribution to the interview.	