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The new hype in the e-commerce industry

A case study in Sweden to investigate challenges perceived by software development teams

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ABSTRACT (MAX. 200 WORDS):

The growing number of users and the changes in customer behaviour over the last few years caused new hype in the e-commerce industry. This imposed pressure resulted in some technical disruptions in those systems. Software development teams responsible for creating and maintaining these systems, in their turn, were affected by the sudden shift to remote work. The current study aims to investigate specific challenges of the e-commerce systems, including issues connected to the software application, security, supply chain and customer support integrations, from the perception of the SDTs of those particular platforms. For these purposes, the analysis of current literature focusing on e-commerce software development practices has been considered to discover the typical issues of e-commerce in the interconnection with software development. A case study was conducted with a large enterprise in Sweden and in the scope of the study, a set of seven qualitative interviews were organized. The findings of the research resulted in the identification of major challenges in different aspects of e-commerce. The research also sheds light on the best practices and new insights gained by SDTs, which work collaboratively and continue to fulfil and develop new business requirements.

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List of abbreviations

- API - Application Programming Interface
- B2B - Business-to-Business
- B2C - Business-to-Consumer
- B2G - Business-to-Government
- C2C - Consumer-to-Consumer
- C2G - Consumer-to-Government
- CRM - Customer Relationship Management
- DDoS - Distributed Denial-of-Service
- EI - Enterprise Integration
- EU - European Union
- GCP - Google Cloud Platform
- IBM - International Business Machines
- ICT - Information and Communication Technology
- IDE - Integrated Development Environment
- IM - Instant Messaging
- SCM - Supply Chain Management
- SDT - Software Development Team
- UI - User Interface
- VPN - Virtual Private Network
- WFH - Work from Home
- WTO - World Trade Organization
- WWW - World Wide Web

1 Introduction

The introduction is dedicated to the background of the research area which acted as a motivator in the study. Following the background, the research problem is described and the research question is given as an orienting direction of the inquiry. The current chapter ends with an interpretation of the purpose and delimitations of the study.

1.1 Background

The rapid rise of e-commerce over the last five to ten years emphasizes its role as a valuable asset for companies as they shift to an increasingly online world (Babenko, Kulczyk, Perevosova, Syniavska, & Davydova, 2019; UNCTAD, 2020). The development of e-commerce systems allows businesses to streamline their online processes and reach customers efficiently. Moreover, e-commerce development is a process of designing, creating, testing, and maintaining online stores (Ullah, Alauddin & Zaman, 2016). E-commerce organizations continuously introduce new technologies in their businesses to remain competitive in the market (Babenko et al. 2019).

In a way of pursuing business objectives, organizations with large teams face the critical task of effectively coordinating their collective efforts. A perfect example of the dynamics involved in team-based work can be found in software development teams (Faraj & Sproull, 2000). A software development team, or SDT for short, can range from just two individuals to several hundred. They are considered separate units within a larger organization, with their own management and social structure, all working towards a common goal (Goodman, Ravlin & Argote, 1986; McGrath, 1990). Members of these teams possess a range of skills, from programming to quality assurance, technical expertise to knowledge of the application domain, and management experience to interpersonal communication skills. It is important to note that software development is not just about the technical aspects but is also heavily influenced by social dynamics (Carmel & Sawyer, 1998; DeMarco & Lister, 2013). Seventy percent of software is being customized internally by the IT departments of the organization or by external service providers (OECD, 1998).

In 2008, Lazarica and Surcel, quoted in their article cited from IBM: *“Software is the world's most critical industry and will be for years to come. Yet, most companies are spectacularly unprepared to create the Software that will redefine how they interact with customers, or that will help deliver their goods and services in new ways.*” – affirm Mike Devlin, Chief Executive Officer, IBM, and Paul Levy, CEO, Rational. Since then, companies have been well prepared, and software has played a significant role in every business. Large-scale organizations, on the way connected to the digitalization of their business processes, invest more in software development to be able to reach their end customers directly through electronic commerce platforms (Bloch, Pigneur & Segev, 1996). In an organization, the software development team's work process often develops typical routines, priorities, and approaches through dialogue and discussion, producing vital new insights (Dybå, 2003).

E-commerce software development is essential to modern business, especially in the digital age. Those teams must understand business needs and technological capabilities to create an efficient e-commerce system tailored to the needs of the business (Tupia-Astoray & Andrade-Arenas, 2021). With a reliable e-commerce system, businesses can maximize their sales opportunities and provide customers with a convenient shopping experience that keeps them returning for more (Ullah, Alauddin & Zaman, 2016). The software development team is responsible for the technical aspects of an online store, such as its performance, scalability, and security (Dinesh & MuniRaju, 2021, Tupia-Astoray & Andrade-Arenas, 2021). In addition, the e-commerce SDT often communicates and collaborates with the top management representatives, managers, and other departments to ensure that the system meets its business needs (Ullah, Alauddin & Zaman, 2016). Hence, e-commerce developers need to create systems that allow merchants to manage their products, pricing, inventory, customers, orders, payments, shipping, and more. E-commerce software development also includes creating shopping tools for customers, such as product search, filtering, cart management, and secure checkout to fulfil business requirements (Ullah, Alauddin & Zaman, 2016).

1.2 Problem

Even though e-commerce has a rich history, starting with electronic data transactions in the 1960s and the first online retail transaction in 1994 (Simakov, 2020; Lufkin, 2020). The significance of e-commerce and digital shopping is becoming a driving force in the growth of modern trade in the recent decades (Simakov, 2020). However, this development has been speeded up and became increasingly in focus during the last three years. Due to the forced remote or hybrid work during the time, because of Covid-19 or coronavirus pandemic, many countries and companies, such as Swedish public health authorities, recommend that employees work from home (The Public Health Agency of Sweden, n.d.). In addition, many people chose or were forced to do online shopping rather than going to the stores, as countries and companies enacted containment measures to reduce its spread. This was a new hype in e-commerce, to manage companies' software development teams working in their home offices, either totally remote or in a hybrid setting.

While the e-commerce demands dramatically increased, those systems experienced a huge number of requests. With the account of a restricted number of staff members and stock availability, the risks connected to the system and data integrity, system scalability, as well as security were highered. Taking into account the logistics problems, the pressure was also put on the delivery and return services of the system (Patil, 2021). The production, distribution and transportation of the products have been impacted negatively by the lockdowns (Galhotra & Dewan, 2020).

Similarly, many companies were forced to make changes before they were ready, which caused an inconvenience (Karlsson & Skötte, 2021) and, in many cases, huge challenges for the software development teams. Some were how to survive in the new situation, meet the demands at the right time, and take care of their personnel and employees. At the same time, the digitalization of work environments had to evolve rapidly for businesses to survive while working remotely and adapting to the new situation to make sure that all parts of the company are functioning well (Abu-Rayash & Dincer, 2020). Added to that, it has been and remains a place where innovations are implemented actively, and innovations for improving customer experi-

ence are tested and implemented to meet the higher demands (Simakov, 2020). This development boosted the software industry due to increased demand for remote-working capabilities (Abu-Rayash & Dincer, 2020). Although this situation was comfortable for developers, it has been a massive readjustment and challenges for the employees (Karlsson & Skötte, 2021).

The countries located in Scandinavia are on the frontline of technological development, especially in terms of Information and Communication Technologies (ICT). Studies show that businesses located in the Nordics are in the leading positions of e-readiness (Hagsten, 2022). However, not many studies have been conducted to investigate the software development of e-commerce businesses in Sweden. A survey to investigate the overall statistics of e-commerce popularity showed that even small businesses need to develop and handle e-commerce systems as a part of the IT infrastructure of the firm (Torsten Eriksson, Hultman & Naldi, 2008, Hagsten, 2022). At the end of the aforementioned studies the authors suggested to investigate the challenges which may come after the integration and adoption of e-commerce. Moreover, Hagsten (2022) pinpoints the necessity to investigate the particular period of the pandemic to understand the variables on which the ICT infrastructure of the company had relied on.

1.3 Research question

The preliminary research showed that there is a lack of studies with a focus on software development teams of e-commerce systems. Moreover, the interconnection of technical issues caused by the new hype in online shopping during the lockdowns, higher the interest to conduct research on this topic. Below is the research question which will be investigated in the scope of the current study:

“What were the challenges experienced by the e-commerce software development teams during the sudden shift to remote work caused by the Covid-19 pandemic? How do the insights gained contribute to new working processes?”

1.4 Purpose

The current study focuses on the different aspects of e-commerce to find out the detailed challenges from the perception of the software development teams. This master’s thesis mainly focuses on investigating how the SDTs adapted to the new work environment and continuously maintained the e-commerce system. The knowledge gained by the SDTs aims at providing valuable insights to companies by allowing them to predict and prioritize the problems when developing their online business.

1.5 Delimitation

This study has specific limitations, focusing solely on investigating e-commerce from a non-business perspective. Additionally, it does not include analysis of specific teams such as Logistics or Customer Service. The current study investigates a large enterprise in Sweden, operating in Helsingborg. Moreover, the main focus of the study is on employees who have worked at the company for more than three years since the sudden changes in working routines happened at

the beginning of 2020. The participants were chosen to have a decent experience working with the development of e-commerce systems.

2 Literature review

This chapter comprehensively explores the literature on e-commerce and software development team practices. Additionally, delve into the relevant literature encompassing Agile methodologies and software tools. Tackles the impacts of the new routines on both the e-commerce industry and the software development teams and their connections. Lastly, developing the theoretical framework of the e-commerce development model.

2.1 E-commerce

The terms “E-commerce” and “online shopping” are sometimes used interchangeably or together in the same meaning, but it is important to highlight that e-commerce is a wider concept. It involves not only “buying and selling”, but also doing the whole business electronically, with the use of telecommunication technologies (Babenko et al. 2019). In addition to utilizing network technology, electronic mail, database technology, and other non-computer technology such as payment and delivery techniques, e-commerce is a subset of e-business. Since it encompasses customer services and a partnership between corporate partners supported by electronic media as a method of transaction, e-business is thought to be more expansive than a traditional business (Fauzi, Al-Khowarizmi, & Muhathir, 2020).

E-commerce business benefits both businesses and customers in many ways. Firstly, the prices of products and/or services are lower, since managing an online store is cheaper and there is no need to hire staff or rent a physical store. Secondly, unlike offline shops, online stores are accessible 24 hours a day, and customers can spend unlimited time browsing and investigating to get their desired products and services. Moreover, geography does not matter anymore. For instance, one can easily order something from the US, while living somewhere in Asia (Susmitha, 2021).

One of the first e-commerce companies is considered to be CompuServe. It was founded in the 1960s and released its first online platform to offer Internet connectivity services. Starting from the 1990s, the industry of e-commerce started to develop together with the launch of the WWW. Current large e-commerce market leaders like Amazon, PayPal and Alibaba were established during that period of time, in 1995, 1998, and 1999 respectively. In 2000, retail players came into the e-commerce business and the first one to do so was Walmart. Easy access and the widespread presence of the Internet have made the sector of Business meeting the needs of customers popular and common among users (Campisi, Russo, Tesoriere, Bouhouras & Basbas, 2021).

2.1.1 Types of e-commerce

Based on these references (Tarasewich, Nickerson & Warkentin, 2002; Babenko et al. 2019; Norian, Jama, Eltaieb & Adam, 2020) there are six major models based on the economic relations of the businesses and their interactions with each other:

- **Business to Business (B2B)** - this kind of relationship between two or more businesses is described as the process of providing other manufacturing companies with goods and services, meaning that the terms “seller” and “buyer” are both related to organizations
- **Business to Customer (B2C)** - This is the most common type of e-commerce when the customer is the end-user of the system the goal of which is to provide products and/or services
- **Customer to Customer (C2C)** - A relationship type where both the “buyer” and the “seller” are physical persons and not legal entities. C2C e-commerce platforms usually do not exist as standalone systems, but rather than with an intermediate service, for instance, online auctions where on both ends of the system are customers using the online board
- **Business to Government (B2G)** - The “seller/buyer” relationship between businesses and the government of the country. For instance, the construction companies which build the road infrastructure or living areas are considered to belong to the B2G sector.
- **Consumer to Government (C2G)** - This direction is mainly used in the processes to connect consumers and the government. For instance, the process of declaring the taxes to the governmental portals is C2G
- **Mobile commerce (m-commerce)** - In 2002, the definition of Mobile e-commerce (also known as m-commerce) was defined as a process of buying and selling goods and services, making various transactions through wireless communication networks, so-called mobile devices. The concept of Mobile devices had aggregated wireless phones, laptop computers and personal pager devices, etc.

E-commerce is an opportunity for large companies to enhance competition in the global market (Grandon & Pearson, 2004). Tan and Teo (1998) suggest that businesses are also inclined to adopt digitalization and provide customers with extensive information access to reach a broader market. Thus, e-commerce is a ground-breaking framework to improve global competitiveness and promote business (Susanty, Handoko & Puspitasari, 2020; Ha, 2020; Joana & Castro, 2021). Furthermore, it allows businesses to reach customers faster, reducing costs and increasing profits. As a result, e-commerce has become a world marketplace for businesses; digital platforms offer unprecedented opportunities, lower fixed prices, higher competitive advantages, and broader product placement on the web instead of in the physical stores (Susmitha, 2021).

People from the countries of the EU have been using online options for shopping much more compared to the rest of the world, hence the European e-commerce market is one of the largest and fast-growing markets in the world (Jędrzejczak-Gas, Barska & Siničáková, 2019).

2.2 Software Development Teams

A software development project is a highly complex socio-technical endeavour. The process of developing software requires people to interact with each other and with both the technical

methods and technologies used to perform the work (Brooks, 1974). Consequently, and analytically, the social features of software development pertain to how people interact, behave, and organize. And about the technical features of software development revolve around the use of production methods, development techniques, and technological advances (Guinan, Coopriker & Sawyer, 1997). Working in the development of software that involves development teams, collaborating and performing a variety of tasks, including planning, programming, testing, analysis and implementation, aiming to design and develop new software products to achieve common project goals (Hoda, Noble, & Marshall, 2013). Moreover, developing software is one of those kinds of activities that can be done regularly in a distributed manner. According to McDonough, Kahn and Griffin (1999), for this purpose, communication technology is used to support interaction with the dispersed group and co-located teams including Instant messaging (IM), email, shared calendars, remote control software, audio/video conferencing, and any other technology that allows teams to work on a single project.

Communication and collaboration technologies provide support to teamwork, such as idea generation, problem-solving information exchange, effort clarification, dispute resolution, and decision-making (Andres, 2002). The demands of persons for aural, visual, and tactile communication are supported by sharing knowledge via voice, document, image, and shared operational software. So, when immediate feedback or dialogue is required, synchronous media like the phone, IM, remote access, or webcast are used. When timing is not crucial, asynchronous media like email or web-mediated file sharing are used. Due to the teams' ability to customize their toolkits to meet their objectives, this flexibility and control over tool selection may be a key element in their success (Andres, 2002; Martins, Gilson & Maynard, 2004; Thissen, Page, Bharathi & Austin, 2007).

Furthermore, Booch (2018) states that software development methodologies like Agile are also proven to be important in the software industries to enhance the teamwork. The mass shift radically changed many software development teams to stay at home during the Covid-19 pandemic, which leads SDT to work remotely. But this current pandemic is not the first time software industry companies have faced radical changes. A significant crisis hit the software industry in the 1960s, often called "*the software crisis*" (Booch, 2018). According to Wirth (2008), as software development became more complex, due to high traffic in the use of the internet, especially accessing e-commerce systems, were behind schedule and needed to be more reliable, leading to the software crisis. In order to address these challenges and reduce obstacles in the future, it was recognized that software development techniques were inadequate, and these techniques might be updated to a more methodological approach. The author also states that programming became more structured during this time period and became a discipline rather than just a craft. New ideas and crises led to the development of structured programming languages (Wirth, 2008). While action attempts have been made to overcome the software crisis, such as developing new high-level object-oriented languages and developing methodologies, the crisis persisted into the end of the 20th century (Glass, 1994). The Snowball Convention in Utah in 2001 was a response to the frustration caused by the never-ending crisis. On the occasion of this meeting, seventeen representatives from various software development processes met and tried to resolve the crisis, and as a result, "*The Agile Manifesto*" was created (Abrahamsson, Salo, Ronkainen & Warsta, 2017; Karlsson & Skötte, 2021).

2.2.1 Agile Software development

Unlike other industries, software companies are highly dynamic, as they must constantly adapt to the rapidly changing market, new customer needs, and technology changes (Pikkarainen, Haikara, Salo, Abrahamsson & Still, 2008). In order to face that challenges, agile methodologies can be adapted in software teams that have been using agile project management to manage software development projects (Drumond, n.d.). The agile methodology is “*based on iterative development, where requirements and solutions evolve through collaboration between self-organizing cross-functional teams*” (Shrivastava & Date, 2010, p. 10); also, flexible and adaptable approaches are offered in order to respond to the ever-changing trends in software development. These are the values agility emphasizes presented by Abrahamsson et al. (2017):

- a) Prioritize individuals and interactions over processes and tools
- b) Working software over comprehensive documentation
- c) Customer collaboration over contract negotiation, and
- d) Responding to change over following a plan

Also, it encourages teamwork, adaptability, and continuous improvement of the project. As it is stated in Miller (2001), Agile software processes have the following characteristics from a fast delivery perspective, which can shorten the life-cycle of projects:

- a) Developing modular processes
- b) Rapid verification and corrections enabled by iterative development with short cycles
- c) Iteration cycles range from one to six weeks in duration
- d) All unnecessary activities are removed from the development process
- e) Adaptable to emerging new risks
- f) incorporating incremental steps into application development
- g) It minimizes the risks by using a convergent approach
- h) A focus on people over processes and technology, i.e., agile processes. and
- i) Working collaboratively and communicatively

This mechanism allows team members to monitor their progress and identify potential bottlenecks to solve problems more quickly and accurately (Miller, 2001).

Moreover, the user requirements of a project evolve, and agility allows the software teams to work efficiently and effectively and incorporate those new requests during the project life cycle (Alzoubi, Gill, and Al-Ani, 2016). Usually, a lack of visibility into project status can be a problem in the geographical dispersion of individuals in SDTs (Shrivastava & Date, 2010). Especially during the pandemic, many organizations came up with these struggles since almost everyone works remotely. It is feasible to identify possible issues from the initial stages of the project using agile methods, even though in on short in-person interactions and where the development is done in cycles. In addition, agile principles positively influence internal communication since they allow teams to stay on top of short-term goals (Badiale, 2020).

A key aspect of agile software development is communication and collaboration inside and outside the development process; informal and spontaneous communication should be encouraged (Yagüe, Garbajosa, Díaz & González, 2016). Agile tools are supporting to make this process more effective. These tools also boost the visibility and transparency of a project among the teams, thereby reducing project failures and enhancing accountability. Organizations con-

sider the Agile method and tools to be potent assets to boost efficiency in their work collaboration. Consequently, adopting agile tools and methods can improve software quality and adaptability to meet customer needs (Yagüe, Garbajosa, Díaz & González, 2016).

2.2.2 Collaboration Tools in the Software development teams

According to Jackson, Hoek, Prikladnicki and Ebert (2022), tools are essential for keeping the teams aligned, whether remote or in-office. Dozens of tools help simplify communication, knowledge sharing, task management, software development, and other processes. The pandemic, followed by the dramatic shift to work from home, has put collaboration tools at the forefront of software development efforts more than ever before (Jackson et al. 2022). In most large organizations, software projects are coordinated with business requirement teams. In order to create a software product for the organization, clients, and customers, the software development team collaborates with internal business teams and external market teams. Because of Covid-19, the use of such software has suddenly become indispensable. For some, it means primarily coordinating with team members via Microsoft Teams or Slack. For others, it means extensively using Miro or GitLab for complex development projects (Jackson et al. 2022).

Software engineering faces fewer technical challenges than many other professions due to decades of experience working in distributed teams. There are several tools that have become even more important over the past few years, such as task management, collaborative coding, and chat (Jackson et al. 2022). In particular, videoconferencing, the first concept of video conferencing was developed in the 1970s as an extension of audio devices such as the telephone. With the computer revolution, this came into its own in the eighties and nineties. However, it was only after the Coronavirus pandemic of early 2020 that video conferencing became widely used (Clifton, Carroll, & Wheeler, 2022). In general, integration became a key focus with communication tools being integrated more closely into tools for managing artifacts and tasks.

Communication Tools

Primary technologies tools include chat, videoconferencing, and social networking. With chat tools, team members can exchange messages in real-time or asynchronously for various purposes. For instance, getting help or discussing features and rectifying bugs), tools such as Slack and Google Chat have become mainstream. Videoconferencing tools, such as Zoom, MS Teams, and Google Meet, complement the chat tools by providing teams with a visual meeting experience; these meetings can be scheduled prior. In addition to offering communication facilities, social networking tools are primarily used for establishing communities and identifying “who is who” within an organization (Jackson et al 2022).

Artifact Management Tools

The virtual whiteboard software tools, diagramming tools, and shared document editors are all designed to assist small teams of developers produce content together using these software tools. Integrated Development Environments (IDE) focus on a single developer coding on a desktop. However, new enhancements encourage online collaborative work, such as pair programming or authoring test cases directly via the IDE. Tools for knowledge sharing, such as Confluence, enable teams to manage a central resource where all kinds of information can be shared (Jackson et al. 2022).

Task Management Tools

With planning and project management tools like Asana and Trello, tasks can be easily created, managed, and tracked, and development artifacts can be stored in repositories. The task management technologies include plans and projects, repositories, and status dashboards. Key development statistics are displayed on status dashboards to provide an overview of the team's progress. An open-source framework or a commercial tool can be used to measure flow metrics, which are all essential for the teams (Jackson et al. 2022).

According to Mehta, Mehta and Bindal (2022), it is necessary to incorporate learning in software development teams when using updated software collaboration tools. It involves creatively assimilating a team's internal knowledge resources (the skills, knowledge, and abilities of individual team members) and enriching it by selectively absorbing valuable external knowledge resources and competencies available outside the team. This includes learning, cooperative learning, and collaborative learning and even soft skills. Team learning has been defined in terms of the rate of improvement within a team, the outcome of team coordination, and the group process. (Faraj & Sproull, 2000; Petkovic, Thompson, Todtenhoefer, Huang, Chia, Liu & Shan, 2019; Mehta, Mehta & Bindal, 2022).

2.3 The new hype in the e-commerce industry

2.3.1 Collaboration in remote work

Software development teams have implemented various methodologies and tools to enhance communication and collaboration to keep the teams connected to their work. However, they adapted to the sudden shift in their work routines caused by the Covid-19 pandemic, transitioning from a co-located team to a remote team and working from home offices have brought challenges. They have faced a variety of different challenges that frequently hinder them from achieving successful outcomes (Frust, Reeves, Rosen & Blackburn, 2004). For instance, remote work, trust, communication, and social interactions were already known to be obstacles for off-site virtual teams (Scherling & Lind, 2021), but the lockdowns have intensified these challenges for all members to stay connected with their teams. In addition, Miller (2001) explains that, while communication tools can certainly be useful for fostering team connections, it is important to note that overreliance on these tools can also lead to feelings of isolation and disconnection, especially for remote workers. This, in turns, can have a negative impact on team morale and productivity, potentially leading to issues such as burnout, conflict in different ideas and other issues (Miller, 2001).

Remote Work

According to McKinsey (2021), due to pandemic limitations, organizations were forced to adapt their workflows and business strategies, which included rapidly preparing employees for remote work caused by the lockdowns and social distancing requirements. What sets Covid-19 remote work apart from traditional remote work is that almost all employees across different companies had to work from home on short notice. These abrupt and widespread shifts posed early challenges for unprepared companies. Generally, remote work entails flexible, profes-

sional arrangements that enable employees to carry out their responsibilities from remote locations outside of the company (Olson & Olson, 2003). Nevertheless, this unplanned remote work was the early periods of the pandemic, which were the times of adoption to new circumstances, uncertain situations, and chaos. This initial drop in performance is associated with the unpreparedness of the companies for the disaster (McKinsey, 2021).

New challenges require adjusting business processes, changing standard work patterns and routines, poor ergonomics at the workplace, connectivity problems, and isolation (Larson, Vroman & Makarius, 2020; Ford, Storey, Zimmermann, Bird, Jaffe, Maddila, Houck & Nagappan, 2021). In addition, other challenges in E-commerce systems were acknowledged when these were overcome or minimized (Butler & Jaffe, 2021; Uddin, Alam, & Serebrenik, 2022). Therefore, analyzing the software development issues caused by the new circumstances in a sequential manner could provide sufficient guidance for companies that aim to shift to remote or hybrid work in a post-Covid-19 setting (Molino, Ingusci, Signore, Manuti & Giancaspro, 2020).

Furthermore, researchers and practitioners in the fields of information technology and computer science are familiar with the use of information systems and technologies for remote and distributed work. The impact of remote work on SDTs have been studied extensively, including efficiency comparisons between remote and co-located teams (Boell, Cecez-Kecmanovic & Campbell, 2016; Charalampous, Grant, Tramontano & Michailidis, 2019), adjustment of business strategies to remote work (Buffardi, 2017), and challenges of remotely distributed teams (Olson & Olson, 2003). The number of papers about distributed and remote work has been increasing in recent years (Vallon, Estácio, Prikladnicki & Grechenig, 2018), partly owing to Covid-19 pandemic.

Communication Challenges

Bin and Shmailan (2015) state that qualitative communication is vital for software development teams, especially those incorporating Agile methodology. While task-oriented online meetings play an important role in delivering software products, informal meetings, interpersonal connections, and random chats naturally generate innovative ideas and encourage collaboration (Saks, 2006). The study found that good relationships within a team positively influenced task accomplishment (Bin & Shmailan, 2015). As part of these short meetings, creative insight is shared, project status is exchanged, the following steps are coordinated, potential issues are discussed, and a sense of teamwork is developed (Arunprasad, Dey, Jebli, Manimuthu & Hathat, 2022). The lack of unplanned face-to-face meetings caused by the pandemic remote work reduced productivity, team cohesion, and quality of collaboration between employees (Butler & Jaffe, 2021; Uddin, Alam & Serebrenik, 2022). There has been a slowdown in the workflow due to above mentioned asynchronous communication (Butler & Jaffe, 2021; Uddin, Alam & Serebrenik, 2022).

2.3.2 Disruptions of technical capabilities

The Covid-19 pandemic hit the industry of e-commerce during the first month of lockdowns. High demand caused many disruptions in the services. Big Basket, one of the largest online grocery shops in India, announced on March 25th of 2020 “*We are currently experiencing unprecedented demand. In light of this, we are restricting access to our website to existing customers only*” (Susmitha, 2021, p. 1164). Another online service provider, Grofers also came up with a similar message of stopping to deliver to some locations due to the increased capacity.

One of the challenges for online retailers during the Covid-19 pandemic was the increase of scalability and infrastructure of the system to ensure customer satisfaction (Dinesh & Muni-Raju, 2021).

Global e-commerce companies have been affected by the spread of the pandemic. The impacts were both in terms of revenue and market value. The demands for goods and issues with supply chain management have been noticed in many global e-commerce industries (Abdelrhim & Elsayed, 2020).

World Trade Organization (WTO), published a report on May 4, 2020, highlighting the role of e-commerce during the pandemic. According to WTO (2020), the B2C and B2B sectors experienced a surge of demand, for the reason that customers were more likely to purchase household essentials, food and medical products. This high demand affected the times of delivery thereby leading to some cancellations of orders. Apart from delivery issues, there have also been challenges with cybersecurity, increased bandwidth and product safety. Private merchants, as well as governments, adopted new standards like inducing the capacity of the network, reducing the transaction cost of payments, and improving transportation services and logistics. The lockdowns also brought to a halt many manufacturing businesses, which resulted in the lack of some items in the market. Disruptions in international as well as local transportation resulted in not only issues with deliveries, but also the shipping costs increased (WTO, 2020).

According to Dumanska, Hrytsyna, Kharun, and Matviiets (2021), due to the pandemic, the transactions done by e-commerce and m-commerce have shifted from buying luxurious and hardly accessible products to buying basic things for everyday needs and this tendency is likely to continue further down the line. Given the fact that the accessibility of mobile communications is also increasing, the trajectory of purchases will also improve (Dumanska et al. 2021). The usage of mobile phones in doing online shopping has been increasing since the year of 2019 (Dinesh & MuniRaju, 2021). In 2019, the percentage of the users who visit the e-commerce systems through mobile was estimated to be 67 percent. This number have been growing since then and reached 72.9 percent by 2021 (Dumanska et. al 2021).

2.4 Theoretical framework

2.4.1 E-commerce development practices

There are certain obstacles connected to the development of e-commerce systems. Firstly, the technical barriers associated with building a reliable infrastructure and solution that would cover all business aspects and provide a truthful service. Other issues are related to integrating the new or updated software into the existing ones without breaking the integrity (Babenko et. al 2019; Jędrzejczak-Gas, Barska & Siničáková, 2019).

Every e-commerce system represents a specific business, thereby there are certain operations which are usually performed before the development of the system (Akhmetova, Baimukhanbetova, Belgozhakzy, Alikbaeva & Tulebaeva, 2020). According to Akhmetova et al. (2020) the operations for the technical development of the software consist of:

- Meeting the potential group of suppliers and customers to understand the suggestions and demands
- Forming a customer support group to lead the customers through the whole journey of sales
- Preparing databases for keeping the data
- Implementing the functionality of purchasing the products
- Integrating with external service providers for making payment transactions
- Ensuring the delivery process to the end customer, etc.

According to Ullah, Alauddin and Zaman (2016), the most common features of e-commerce systems include allowing the users to log in to their accounts, see and edit their personal information, including the delivery address and payment options, search for a specific product, make an order and track the shipping. Additional properties like paying in cash when the order comes or any other narrow characteristics are specified accordingly with the system design itself.

The development of the e-commerce system starts with planning. As in other software development strategies, the planning includes (Ullah, Alauddin & Zaman, 2016):

- a) Defining the Use cases of the system and in respect to that design the services like the Registration page, search algorithms, shopping cart and the billing system.
- b) Defining the Architecture pattern allows the developers to follow certain rules when designing the system.

When the planning phase is over, the development process starts. Ullah, Alauddin and Zaman (2016), state that, the development of such systems are often divided into two parts: *Front End* and *Back End*. The development of Front End comprises the parts which are visible to the user, namely the home page, product list, shopping cart details, etc. The Back End encapsulates the whole functionality and logic of the system, all the calculations and searches are being done here, linking to the database, integrations with other third party service providers, etc (Ullah, Alauddin & Zaman, 2016). System infrastructure technologies are evolving rapidly, particularly virtualization in the cloud, offering new opportunities and challenges in software development. A long way from traditional virtualization, bare metal hardware provisioning to the cloud, to container technology, and now cloud events, the software architect has a wide range of IT infrastructure tools upon which to design and deploy the software in optimized configurations (“*price, performance, scale, etc*”). Technology hype and maturity cycles seem to have accelerated, with physical infrastructure undergoing decades of growth to years of growth virtualization/cloud to months of growth containers, microservices, and cloud events. This new technology hype added to today's business trend to boost its functions in the e-commerce systems (McGrath, Short, Ennis, Judson & Brenner, 2016).

2.4.2 Development stage model

The stage model for e-commerce development was proposed by Rao, Metts and Monge in 2003 in their peer-reviewed article in the Business process management Journal. It is a well-cited article with more than 500 citations. Stage Models suggest that the development of a system is an iterative way of redesigning it, starting from the simple capabilities to more complex features over time (Alonso-Mendo, Fitzgerald, & Frias-Martinez, 2009).

In Information Systems, the first stage models appeared in the 1970s. Nolan (1973) in his paper highlights that every single stage has its own applications, facilitators and barriers. Each stage individually represents a certain level of maturity in terms of the use and management of Information Systems in the tasks related to support and contribution to the business. Maturity models in IS research are used to demonstrate the patterns in the development of organizational capabilities. It is a conceptual model and usually portrays a series of stages which are required to form the logical flow of the adoption process. In both IS research and practice, maturity models have become an essential topic for discussion. In the recent years, many researchers and practitioners have developed many of these maturity models. The prior idea in Maturity models is that the sequential progression benefits the organizations. Companies, investing in their IS capabilities are adopting maturity models to structure their business processes (Poepplbuss, Niehaves, Simons & Becker, 2011).

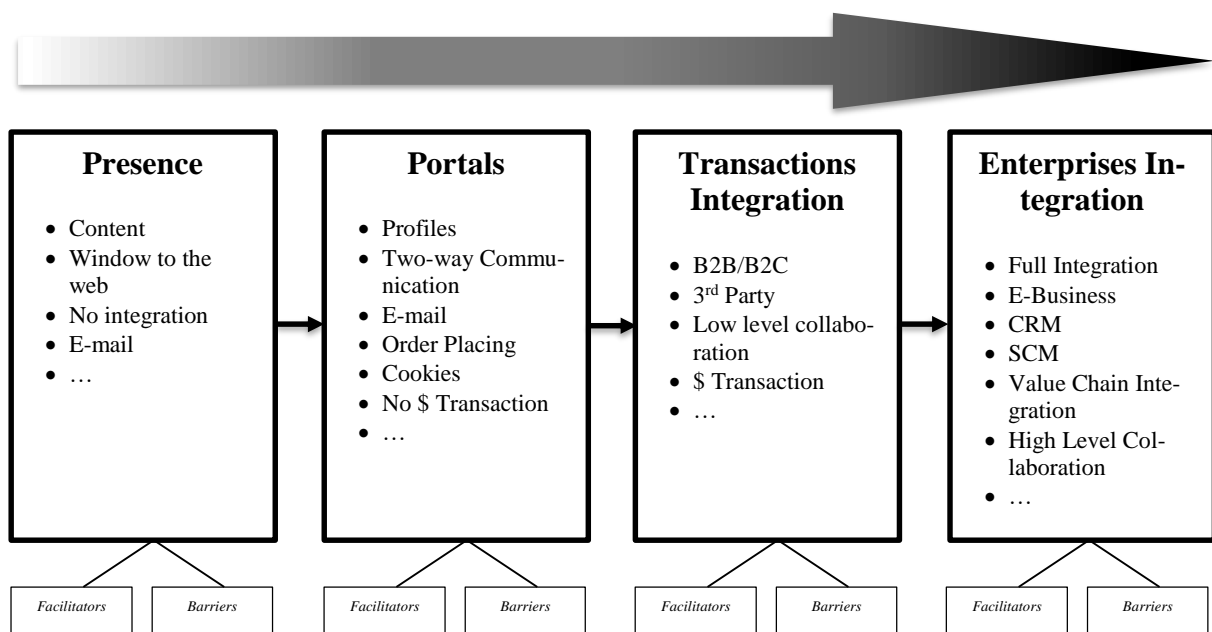


Figure 2.1. E-commerce development stage model

According to Rao, Metts and Monge (2003), the development stage model allows a company to enter the development process at any stage, making sure that the issues of previous stages are already addressed. At each stage, there are facilitators and barriers related to that specific stage, promoting positive and negative impacts on that particular stage accordingly. The factors whose impacts are beyond the control of the organization, so-called external factors, are usually classified as barriers, otherwise, they are called facilitators (Figure 2.1). The summary of each stage of the model is presented below:

a) *Presence*

The development of the e-commerce system starts with the initial steps of the organization towards making a digital environment. An announcement is being made on the official website of the company providing information about the products and services that they can sell. There is no functionality on the website, nor any integration with other systems, this stage is purely informative. The facilitators of this stage include processes from the creation of the website to the renovations in the mindsets of the organization's managerial levels. Enhancing strategic motivations for the use of the Internet as a way to do business is a critical factor in this stage. To handle issues in the competitive environment a proper investment should be made into the

organization's planning to make sure the customers will be attracted and interested in using online means of commerce. The barriers of the first stage include the technological capabilities of building a proper web page, and changes in managerial levels to accept the new strategies and financial investments. However, there can be hired new managers, and e-commerce consultants, to organize the movement not only in terms of business and technology investments but also to train and educate the staff (Rao, Metts & Monge, 2003).

b) Portals

The second stage in the development of e-commerce is the introduction of profile usage, order placing and other two-way communication. The major difference between the current stage and the previous one is the capabilities of the system to handle B2C and B2B processes. Order placing availability allows customers to be more engaged in the system. The information regarding products is synchronized with the inventory data. The primary facilitators of the Portals stage are internal organizational changes, investments and usability of the system. Not only the sales department of the company is connected to the platform, but also other departments, to ensure the system handles the increased traffic. Additional investments are being made to ensure the hardware and software capabilities can carry the high volume of usage. Internal changes involve restructuring the sales department so that physical and online orders are being treated equally. However, the degree of integration within the organization is described by the level of technological development (Rao, Metts & Monge, 2003).

c) Transactions integration

At the stage of Transaction integration, new features like paying for order is added. The requirement for making the financial transactions is the technical capability of the system to be integrated with different payment services. This require a selection of competitive payment systems, extension of the IT technologies as well as the financial investments to insure the B2B processes work smoothly. The e-commerce business faces some challenges while being on the stage of Transactions integration. The barriers include the financial systems, since the abilities of customers to pay through bank account or another external service provider are different in developed and under-developed countries, provided the e-commerce system is international, there might be impossible due to the lack of compatibility. Secondly, there are some legal regulations from the governments like taxes and policies which are also required to be strictly as in offline commerce. Privacy and Security are also a major concern, since all the transactions require personal data as well as payment details and it is the responsibility of the organization to make such integration secure (Rao, Metts & Monge, 2003).

d) Enterprises integration

The author also states that, in the stage model of e-commerce development, Enterprises integration (EI) is the last phase, after which a fully functioning e-commerce system is ready to be used. At this stage the system is fully integrated to the internal systems, inventory, payment systems. Moreover, the IT infrastructure of the company is technically enhanced and ready to start the online business. There is a high level of cooperation between suppliers and customers, meaning that the B2B and B2C processed are fully integrated and the processes of Customer Relationship Management (CRM) as well as Supply Chain Management (SCM) have a natural flow.

At this stage all the aspects of e-commerce working all together serve all the needs of the business. However, this increased level of integration has its own obstacles which are more technological issues. The availability and diffusion of technology, international standards of trade and transaction processing, network complexity and other global issues rise (Rao, Metts & Monge, 2003).

2.4.3 Software Development Teams in E-commerce Systems

Tupia-Astoray and Andrade-Arenas (2021) discuss that nowadays, large businesses are already involved in the production and marketing of products and have single sales channel, whether physical stores have been affected by the current crisis that is happening due to the pandemic. The lack of virtual sales options has made it difficult for them to offer and market their products, hindering their ability to continue operating during the pandemic. In this way, the designed prototype of e-commerce system met the requirements of the organizations. Where it was based on the agile methodology as a software development framework for the realization of the project. The use of the marvel design tools allowed the creation of web applications. Obtaining as a result, design models according to an e-commerce system complying with the development procedures established by the software development team (SDT), which gives a fresh idea and a productive approach to start implementing e-commerce within the sales processes of each business area to make them connected (Tupia-Astoray & Andrade-Arenas, 2021).

Technological advancements have become a cornerstone for all industries, but e-commerce faced several challenges that have pushed it to the forefront (McKinsey, 2022). The industries are now reshaping with the several elements which involves in the growth of e-commerce, “omnichannel”, changes in customer behaviour, “hyper-personalization”, and difficulty in the supply chain which caused by the pandemic. These shifts have heightened the pressure on SDTs to handle online sales with technologies (McKinsey, 2022).

In order to fully leverage technology, e-commerce businesses must radically transform their IT infrastructure. In addition, as discussed above in the (section 2.1.3) that the author Ullah, Alaud-din and Zaman, (2016) stated “*Defining the Architecture pattern allows the developers to follow certain rules when designing the system.*” In this regard, McKinsey, (2022) explain with six key components encompassing technology architecture and the operating model, representing a comprehensive approach (Figure 2.2). The structure of software development teams incorporates with interconnected components that are present in e-commerce systems.

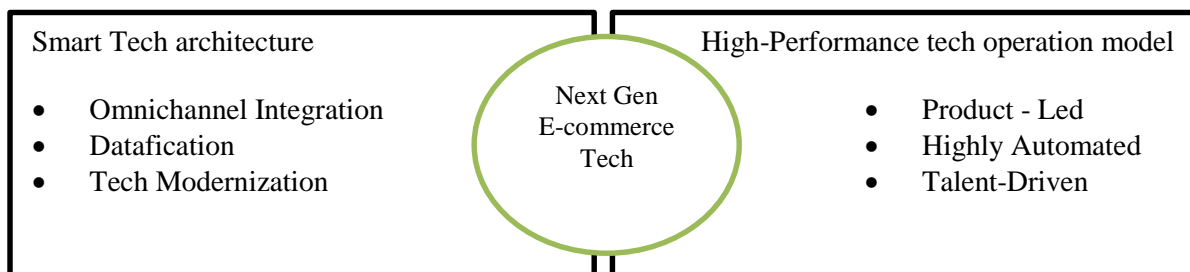


Figure 2.2. E-commerce technology architecture (McKinsey, 2022)

Technology architecture

McKinsey (2022) states that in the future, e-commerce architectures will be fully omnichannel, highly modular, and data-powered.

Omnichannel integration. Omnichannel is defined as a omnichannel commerce is becoming increasingly popular, with customers expecting to be able to buy online and return to the store, or buy online and collect from the store, buy online and have it shipped to the store, or buy in-store and have it shipped directly to home (Gallino & Moreno, 2019). Leading large companies have delivered a unique, smooth customer experience through multiple channels by shifting to an integrated commerce architecture. Omnichannel integration involves combining all customer touchpoints to share features such as wish lists, booking appointments, and making payments (McKinsey, 2022).

Datafication. Data fragmentation across different systems and infrastructures in traditional architectures can make it challenging to reuse and scale analytics use cases. However, cloud-based data platforms offer automation and reuse through a set of protocol-defined processes (McKinsey, 2022).

Tech modernization. The architecture of traditional commerce relies on outdated applications that limit adaptability and upgrades, leading to higher expenses. By transitioning to a modular, microservice-based approach, businesses can enhance flexibility and scalability (McKinsey, 2022).

Operating model

McKinsey (2022) also mentioned that software technology can significantly increase operational performance by embracing agility and building the right workforce.

Product-led organization. Large organizations have mostly set up an “*agile digital factory*” that combines business and technology resources to handle their e-commerce operations. However, the entire IT infrastructure is transformed to meet a consistent efficiency, flexibility, and speed baseline. A product-led organization supported by technological solutions, develops and manages business functions, including e-commerce checkout, demand forecasting, and warehouse management. The products are developed by cross-functional teams consisting of various software professionals such as engineers, developers, designers, and architects. Business product owners lead these teams to ensure that the focus remains consistent on achieving business outcomes (McKinsey, 2022).

Highly automated software delivery. While digital and software companies have already adopted advanced engineering practices and automated software development, the E-commerce industry is still in the early stages of implementing these practices. However, adopting these practices will be vital for achieving high-performance software delivery (McKinsey, 2022).

Talent-driven transformation. Large organizations outsource business application maintenance to external partners through their IT departments. However, as technology becomes a more important aspect of business, having a skilled in-house team of engineers is essential. Not only can an internal team protect the company's intellectual property, but it can also greatly enhance the delivery performance (McKinsey, 2022).

Considering new technologies in the development of e-commerce as well as the impact of the situation connected to the pandemic inspires to study the perception of the SDTs. The current research focuses on five distinct aspects of e-commerce, and their barriers appearing at each level of the development stage model to identify the challenges experienced by the SDTs due to the new hype of e-commerce. The aspects are:

- ❖ Mobile application of the e-commerce system
- ❖ Integrations with Payment systems
- ❖ The synchronization of the system with the inventory and the database
- ❖ Shipping and Delivery integrations
- ❖ Customer support services.

3 Research Methodology

Throughout the Research methodology section, it is described how this thesis was conducted from the beginning of the research idea and approach. The following section further details the case data collection process, methods, and analysis techniques. To clarify the entire methodology process, also the motivation behind the methodology choice is explained.

Research methodology is the core process in the research thesis since it provides the framework for collecting data and conducting research. The qualitative approach is the most appropriate for the current research. This study mainly focuses on an outlook into the future of the new hype of e-commerce systems, which was caused by an uncertain phenomenon with research questions containing “what and how” SDTs are ready for this kind of future uncertainty.

3.1 Research philosophy

Research philosophy is a significant aspect of every research; it provides the framework for the scientific research of the thesis or analysis, leading to a robust and credible research study. For this, proposed research, aimed to investigate how e-commerce software development teams experienced the challenges during the new hype in large enterprises. To find answers to this questions, researchers wanted to understand the subjective experience of SDT’s answers collected from relevant interpretive paradigms (Goldkuhl, 2012). Next, to gain deeper insights into a particular issue of the pandemic, this research principle served as a foundation for detailed investigation. Also, the idea behind this case study was that researchers study current, real-life cases that are in progress to gather accurate information preserved by time (Creswell, 2013). Usually, a case study helps to analyze a single point in a complex situation, and to understand the case, several questions about impacting variables also needed to be considered (Simons, 2014). In the beginning, researchers started with shared ideas, and later, researchers tended to use the scientific approach to describe the subject of interest in detail to enhance the reading more comprehensively. Interpretivism makes it easier to get a clear picture of the views of various subjects engaged in the research (Goldkuhl, 2012), which helped to build a research context in which there are several perspectives and understandings in a social setting. Therefore, the philosophy of this research relied more on interpretivism, which emphasized the subjective nature of reality and the importance of understanding what people mean by what they experience in fact.

Qualitative research is more commonly associated with interpretivism (Goldkuhl, 2012). The interpretive paradigm, as discussed above, would enable researchers to consider different factors, such as behavioural aspects, based on the experiences of the participants. Data collected from the participants help the authors to describe reality, given the assumptions and beliefs of the interpretive researcher (Alharahsheh & Pius, 2020). Accordingly, interviews with potential participants who were all relevant to the research were conducted. Hence, interpretivism was the right option for this research.

Moreover, working with interpretivism is moving from collecting data to presenting it, analyzing it, and finally comparing it with the rest (Patton, 2015). This case analysis helped to study the perspective of SDTs from the interviews regarding how they handled the challenges in e-commerce systems and in several aspects based on the e-commerce stage model. In addition,

Goldkuhl (2012) stated that the social world of people, which depend on the study, is full of meaning, constructed on subjective, shared meanings and knowledge. Therefore, it is essential to understand how SDT members interpret and make sense of the challenges they faced that was analyzed and got information from the interviews that contribute relevant knowledge and meaning to this research. Also, the gained insights into the impact of the pandemic on SDTs and identified strategies to support them in the future. In addition, interpretivism lend itself well to the exploratory nature of this research topic. Further, Bhattacharjee (2012) explains that an interpretive approach is recommended when a research subject has a specific context to theorize.

3.2 Research approach

As a way of addressing the research questions, the analysis obtained from the scenario of the new hype of e-commerce with more focus to the SDT who supported the e-commerce system from behind. Qualitative research drawn from the interpretivist paradigms, sought to deeply understand the research subject of the SDT (Denzin & Lincoln, 2011). The most common qualitative approaches demonstrate how each approach is linked to specific data collection and analysis types (Creswell, 2013, Tomaszewski, Zarestky & Gonzalez, 2020). As the experiences and views of the SDT in the e-commerce systems were analyzed, a qualitative research methodology was taken as a basis for this study. Kaplan and Maxwell (2005) stated that qualitative research aims to comprehend underlying situations and issues by analyzing the interpretations and perceptions of people subjected to certain environments. Since the authors in the study were looking for an in-depth analysis of one particular organization to study the perception of the SDT and the challenges experienced in the e-commerce systems, a case study was the most suitable choice for this qualitative research (Creswell, 2013). The authors wanted to understand the obstacles of the SDT and bring up their work process in large enterprises in an unforeseen situation. To address the research question, data was collected by conducting semi-structured interviews with the SDT through a qualitative research method (Schultze & Avital, 2011). More details information regarding the analysis of the data from the collected information is presented below in section 3.3.

According to Creswell (2013), the first step in conducting a case study was identifying a specific case. The key points of the case were described within certain parameters, such as a specific place and time. As part of this research, the identified challenges of the SDT and how they handled the technical issues in e-commerce systems by working remotely would be assessed further. This case might be a concrete entity, such as an individual, or a small group in an organization, to investigate the particular time of the situation (Creswell, 2013). Patton (2015) stated that this context-based qualitative study would provide rich knowledge and insights into this field in terms of their respective experiences and opinions. Additionally, Patton (2015) and Recker (2013) stated that understanding the viewpoint of research participants adhered to the inquiries made through this approach, where they will be making a qualitative contribution to the topic. This involved evaluating how things work, the effects of certain aspects and their consequences, and tallying what works and what does not in every area of the study (Patton, 2015). The purpose of qualitative analysis was not just to collect data but also to record findings and develop better ideas for identifying key patterns of information for the research (Patton, 2015). As a result of these steps, substantial data was gathered about their respective interpretations, and a comprehensive picture of the proposed research topic was framed.

3.3 Data collection method

The method used to collect data for this particular research was conducting interviews. According to Klein and Myers (2001), in the field of Information Systems, interviews are the most common data collection method for qualitative interpretive research. To collect the subjective view of the respondents about what were the challenges they were faced with during the pandemic and to how they overcame those and to what extent they feel it was beneficial or not, interviews were believed by the researchers to be the key in gathering the data.

The type of interviews was planned to be semi-structured, as they allow an interview to be more flexible and hence, more informative (Patton, 2015). Semi-structured interviews allowed the interviewer to change the order or even remove some questions according to the individual being interviewed (Recker, 2013). The participants were chosen with the help of one of the most widespread techniques in qualitative research, *snowball sampling* (Parker, Scott & Geddes, 2019). The participants were asked to recommend their colleagues to take part in our research. Overall seven respondents participated in the interview process. The overview of the interviews is presented in the Table 3.1.

Respondent	Role	Type	Date
Respondent 1 (R1)	Senior Software Engineer	Face-to-face	11.04.2023
Respondent 2 (R2)	Senior DevOps Engineer	Zoom	14.04.2023
Respondent 3 (R3)	Product owner	Zoom	14.04.2023
Respondent 4 (R4)	Senior Software Engineer	Zoom	14.04.2023
Respondent 5 (R5)	Data and Analytic Leader	Zoom	17.04.2023
Respondent 6 (R6)	DevOps Engineer	Zoom	17.04.2023
Respondent 7 (R7)	Engineering Manager	Zoom	21.04.2023

Table 3.1. Overview of the interviews

The interview guide, presented in Appendix 1 was developed accordingly with the highlighted aspects of the research questions in the scope of theoretical framework. The questionnaire was visually divided into three distinct sections: Demographic factors, Main questions and Concluding part. *Demographic factors* consist of four questions were aiming to bring up the statistical information regarding the roles and tasks of the participants in the team, as well as to identifying the changes in their working routine caused by the pandemic. The section of *Main questions* was for answering the categories regarding the technical challenges of the research questions. There were two questions about each and every aspect (Mobile application, Payment system,

Database/Inventory synchronization, Supply chain integration and Customer Support Services), identifying the “what” and “how” factors, making this particular section of ten questions. The last, *concluding part* aimed to sum up the interview and highlight the insights gained by the members of the development teams. Due to the diversity in the roles of interview participants, there were some skipped questions since the interviewees sometimes did not have much information regarding that particular aspect.

Interviews were mainly conducted online via the Zoom conferencing application, with an exception of one interview which was face-to-face. In both ways, with the signed permission of the participants, the interviews were being recorded for further analysis. Apart from the asking questions and waiting for the answer, the interviewers were also taking notes. Although the chosen topic was being investigated in Sweden, the language of the interviews was chosen to be English, since it was the common language for the authors of this research. In the stage of getting into contact with the candidates, they were informed about the language of the interview and the language have never been a barrier for the communication.

3.4 Data analysis

Following the data collection phase, the most important stage was the data analysis (Recker, 2013). As it has been mentioned above, the data collection was going to be via semi-structured interviews. The material for the analysis were the transcripts of the interviews. Creswell (2013) suggested a sequence of actions which are needed to be done during the data analysis. The first stage, *preparing and organizing the data*, was the process of transcribing the interviews and structuring accordingly with the questionnaire. The second, *coding stage* helped to arrange the data into more general and meaningful concepts and themes. The final stage was dedicated to the *representation of the analysed data*, namely visualizing the concepts through figures, tables or in the form of text discussion (Creswell, 2013).

3.4.1 Transcribing

Transcribing is the process of converting interview files into text (Creswell, 2013). The tools for recording the interviews were either the external voice recorders of the mobile device or the recording capabilities of the Zoom communication tool. In both cases, when the interview was finished, the audio recording was transferred from the device to the online platform for transcription, PinPoint. This tool is developed by Google to help academic researchers and journalists to analyze large documents of text (PinPoint, n.d.). To ensure the trustworthiness of the transcriptions, the documents provided by PinPoint were investigated separately and the answers to each question were extracted and copied to the interview.

3.4.2 Coding

According to Recker (2013), there are several techniques for analyzing qualitative data. Current research mainly used coding as a technique for analyzing gathered data. Coding is the most widespread way of analyzing; it has the advantage of reducing the amounts of data and categorizing it into meaningful groups (Recker, 2013). In the process of categorizing, tags or themes are assigned to the words, phrases, and sentences of the text, thereby making a conceptual group of the information. Although there were three most common ways of coding: open, axial, and

selective, open coding had been chosen. *Open coding* allows researchers to uncover the concepts from the data, and several concepts are grouped into more general ones (Recker 2013). Coding aggregated some parts of the text into small categories by preliminary developing a short list of tentative codes (25-30) and matching with the text segments (Creswell, 2013). Defined Themes and Codes are presented in the table below.

Themes	Sub-Themes	Codes
Transformations in the working routines and in tools	Work routines Tools	Office setup Concentration Social interaction Meetings Communication tools Collaboration tools Knowledge sharing tools
E-commerce software application		Backend Troubleshoot Online internet traffic Scalability Cyber attacks New requirements
Payment Service providers		Third-party Integration New requirements
Database and inventory		Synchronization Item availability New requirements
Shipping and delivery		Delivery planning Check-out journey Customer distrust New requirements
Customer support services		Behaviour changes Intermediate team Multilayer Unawareness
Insights gained		Asynchronous communication Soft skills Higher load

Table 3.2. Data Coding

Creswell (2013) stated that the data analysis and especially the coding can be done manually by highlighting or extracting the themes from the text, but using software tools may add additional value and make the findings more reliable. Computer software for qualitative research analysis has been developed since 1980s. These tools act like an aid to the researcher in the process of analyzing. On the one hand, the computer programs help to organize and store the files for easy access, also it allows the researcher to look deeply into the data. On the other hand, using a tool requires some time to learn how to use the technology (Creswell, 2013).

NVivo was chosen for this study to help to manage and analyze the data that came from the text of qualitative research.

3.5 Ethical considerations

The current study was based on a qualitative research method, and semi-structured interviews have been used to collect the data. Ethical considerations are the most important aspects of interview-based research (Patton, 2015). Ethics is a branch of philosophy responsible for morality issues, and it touches on the aspects of right and wrong, good and bad. Those considerations are related to participant involvement, data collection, analysis, and the writing of the thesis itself. Since Information systems are defined as social science, the major ethical principle is to secure and assure the confidentiality of participants (Recker, 2013; Orb, Eisenhauer & Wynaden, 2001). As it has been mentioned above, a Case Study has been chosen as a research approach for the current inquiry. The case itself was a large retail company in Sweden and the participants were the representatives of e-commerce software development teams. Due to ethical reasons, the name of the company is not mentioned in the final version of the master's thesis, as well as it was removed from all the transcriptions of interviews.

Prior to the data collection, there was a certain process to follow apart from forming the interview questions. It started with finding contact information and making connections (Creswell, 2013). During the first weeks of the research, a connection was established with the Human Resources (HR) manager of the company. An email with detailed information about the purpose of the study and a request to provide contacts for interviewees was sent. After getting confirmation from HR, information regarding the study, the Consent form which needed to be signed before the interview and the interview questions were sent out to the participants. The Consent form is a document developed by the authors of this study (Appendix 2). The form indicates that participation in the interview is voluntary and ensures that no sensitive data would be published or used in the analysis (Creswell, 2013). Having the signed consent from all the participants allowed to record the interviews and later analyse the content. For confidentiality reasons, the names of the interview participants would also remain hidden from the text. Provided request from the participants, the analysis could have been shared also with them. After the transcription phase, the recordings are kept in the cloud platform and are accessible to both researchers. Regarding the quality of the master's thesis, it would also follow ethical norms. Both authors cross-checked the coding to be secured from the wrong representation of the collected data. In order to avoid plagiarism, both authors followed up on the text and double-check the quality of it to ensure that there is no statement without proper referencing or reasoning (Recker, 2013).

3.6 Validity and reliability

According to Leung (2015), the clarity and appropriateness of a research questions are essential to achieving high-quality research and including sampling, data collection, and data analysis. In further evidence supporting the claims, the coherence of data, interpretation, and conclusions, as well as the extent to which the thesis contributes, stimulating the researcher to research, be innovative, adhere to ethical principles, and be relevant and essential to the research (Recker,

2013). This master's thesis presents validity, reliability, and generalizability to develop a coherent picture. "*Qualitative research analyzes and recognizes patterns among words without compromising their richness or dimensionality; validity in qualitative research means "appropriateness" of the tools, processes, and data*" (Leung, 2015, p. 325). This made the research questions valid for the desired outcome, the choice of methodology appropriate for answering the research questions, the sampling and data analysis appropriate, and the results and conclusions valid for the sample and context.

In quantitative research, reliability referred to the exact replicability of the processes and the results. Collected data were extracted from the interview resources, and researchers should have verified their accuracy in form and context with constant comparison (George & Apter, 2004). After collecting the data through interviews, an analysis has been done to ensure that it is accurate, high-qualitative, and valuable for its purpose (Patton, 2015). Efron and Ravid (2018) stated that, the same literature review requires reliable, diverse and trustworthy sources. The scope and analysis of the data included should have been as comprehensive and inclusive (Patton, 2015). The interconnection of the existing literature, the theoretical framework and the findings was presented in the form of the discussion in the Chapter 5.

4 Findings

This chapter gathered insights from seven individuals who were part of the software development teams working on e-commerce systems in large organization. The data has been analysed with the methodology presented in Section 3.4, the codes and themes were given in Table 3.2. A representation of the data, following the structure of the theoretical framework, is described in subsections 4.1- 4.7 and the summary and visualization of the findings in subsection 4.8. A more detailed information of the analysis of each respondent can be found in the Appendix 3.

4.1 Transformations in the working routines and in tools

In the recent few years, there have been significant changes in the way of work and the tools used to get the job done. With the advent of new technologies, streamlining of work processes changed, particularly during the pandemic, it never increased like before. To determine how the work routine changed in terms of the SDT's communication and collaboration with other team members and stakeholders in the organization were interviewed to gain more insights. The findings include communication and collaboration among the teams, challenges in the home office work routine, social interaction, communication tools in work, and new improvements.

4.1.1 Work routines

The respondents in the teams reflected that everyone was working in the office. Suddenly it was to work from home (WFH), which made it a bit difficult to adapt to this chaotic situation at first (R2, R3). The primary problem was moving to a home office, sitting separately in each person's home, not having a proper office setup, working from home all day, and avoiding the office altogether, which made it hard to concentrate on the work and find the structure needed to complete it. Secondary is the lack of social interaction with colleagues and time to follow up with the people. In a traditional workplace setting, team members could turn to each other to ask questions. Nevertheless, online meetings must be scheduled in a remote setting to communicate or discuss with one's teammates. No physical meetings, stand-up meetings changed when the talk was needed. It is either a pre-scheduled or ad-hoc meeting, leading to the new routine communication of virtual meetings and virtual fika. Lastly, there were challenges with respect to VPN (R3).

Even though they experienced difficulties that lasted only a few months, the teams began relying on online communication tools. *“Now we see that we don't really need to be in office, so in that way, we end up with hybrid”* (R2). In time, teams became more efficient since SDT already worked in Hybrid with geographically scattered teams. The IT field was fortunate to work remotely, even before the pandemic; unlike a coworker who physically works from the store, further investments in the digital transformation of the organization gave a hand to their remote work during the pandemic. Hence the software development team managed pretty well with these new routines (R5, R6, R7).

4.1.2 Tools

As part of the SDT's response to the pandemic outbreak, the team explored various remote work tools to stay connected. Identifying those tools and how effective those tools were in helping in their work to solve the tasks. SDT uses a number of tools to enhance productivity and efficiency in work. All the respondents seem to have similar answers on communication tools, and others are different according to their role.

During the remote work, SDTs started relying on tools for online communications (R1). Usually, SDT needs many discussions with colleagues, business partners, stakeholders, decision-makers, etc. Microsoft Teams and Slack are widely used to communicate effectively between teams in order to boost asynchronous communication, and the Microsoft Teams are used more than Skype. Skype allows with some limitations, whereas the MS team opened up opportunities for people and recording meetings for some missing members can use later. Another widely used tool for team chat is Slack, which started to be used more and more for sharing information with each other not only within the team but also throughout the organization to get help from everyone (R2).

Miro boards and diagramming tools were used for team discussions as collaboration tools. In a conventional manner, SDTs were using a whiteboard to draw stuff, which made it easy to understand in team discussions. Moreover, this method is suitable and needed in work, especially as a software engineer. The immediate change in this way of discussion, watching remotely, and it was not easy when someone was talking and could not follow other information, but then Miro was a great tool to be used (R2).

In the workplace, there was an increasing use of knowledge-sharing tools during pandemic times, particularly for documentation through a tool called Confluence (R4). More collaboration essentially happened via documentation. This tool is efficient for publishing team culture and findings. It was a more efficient alternative to writing in the file system. Confluence was often used for creating and maintaining a shared knowledge base while also allowing for discussion and collaboration, making it a valuable tool for connecting with colleagues and sharing ideas.

The reflection of the respondents about technological tools was programming, and monitoring tools, which software developers mainly use. The team manager confirmed that implementing the Agile ways of working and other respondents for the teams reflected that maintaining tickets and retrospectives made it easier with Jira boards, and the team could better understand and track each other through Sprints. Then GitHub Screen, which was used anyway, but was much more useful during the pandemic. Regarding the programming tool, teams working mainly with Java programming language have IntelliJ as their idle tool. As for the monitoring tool, Grafana was monitoring the application and creating alerts through Slack (R4) and Microsoft App Dynamics to monitor the end-to-end customer journey (R7). In further, the team also uses Google Cloud Platform (GCP) quite often.

In order to handle the new situation, SDTs started relying more on modernized tools instead of their previous in-house tools. *"We need to catch up with the trends industry standards. We need to Kill the Darlings, so to say most of the in-house things we kill them and we started to work with these modernized and standardized tools that helped us a lot compared to what we were previously. So with an agile mindset, everything worked fine"* (R7).

4.2 E-commerce software application

The whole e-commerce application is a huge system where everything is interconnected. The backend application, holding the business logic, is being used by the web UI, Mobile and other applications as well. If there were any issues rising in either web or mobile systems, they were usually the same and connected to the application running in the backend (R4, R5). The mobile application development team faced the kind of challenges as other SDTs (R5). In the e-commerce system there is a mobile first approach since in the majority of markets mobile application is used very widely. There is an attention towards the mobile web representation of the e-commerce system. It is responsive and flexible enough to fit any mobile screen and the users who do not have the separate app on their device can easily use the web version (R1).

In the application, the troubleshooting was being handed over to the tools designed for monitoring tool like *Grafana dashboard*. When an error encounters in the application, backend service starts to separately collect the statistics. Once the exception frequency rises till some point, the error is exported to the Grafana dashboard. The dashboard is integrated with the Slack channels and alerts are being sent regularly. After receiving the alert, some members of the team identify what the issue is about and create a Jira ticket (ticket is the task which assign to the SDTs to fix the issues) to pass to the planning meeting. R4 mentioned that there are two types of exceptions: checked and unchecked exceptions. The former ones are expected issues that may happen when the application is used, the latter ones are unforeseen bugs which require additional work to find out where the problem comes from. According to R4, most of the problems were on the *checked scenarios* (R4).

Traditionally customers were physically going to the stores to buy products and the e-commerce was not used that much before. In the last three years, people started to shop more online (R2, R7). The stores were closed in the most locations due to the pandemic, however there were some markets with open stores but people were not visiting them that frequently. Companies in general were forced to find different way to reach their customers. Before the pandemic, the share of e-commerce was very low compared to the store sales (the numbers switched from 10 to 70-80 percent during the first phase of the pandemic). The sales compared between the online and in-store options went like a *“hockey stick”* (R5). *“Behavior of the customers has probably also changed for good. There is much more online visitation”* (R5).

The online internet traffic increased considerably at the beginning of the pandemic. The e-commerce application is located behind an API gateway which has quota, a limit of hits per month. Since the internet traffic intensified the quote expired and SDT had to reset and increase the numbers (R1). Before the pandemic the system was getting on an average 150-200 requests per second, then suddenly that number went up to 400-500 requests per second (R2). *“We were having too much traffic. Probably. This is how people will work or this is how people will shop”* (R4). This unplanned situation with the surge of hits brought the challenges to the development team. The primary task was to make sure that the infrastructure can carry that kind of load (R2, R7). *“Me and my team again spend some time trying to figure out how we can scale our systems in a better way so that we went dissipating it to go even higher and without having any impact on the end customer”* (R2).

The backend application runs in the cloud, which makes it easier to scale up the system. An advantage of cloud systems is also the automatic allocation of resources. The process of moving toward Cloud technologies started before the Covid-19 pandemic, from 2018 and these modernization investments helped a lot in the organization. Before that times the system was being

run on physical servers and they used to have data centers in different parts of Sweden and another parts of the world as well. (R4, R7).

The high demand caused cyber security issues to the system. There were also some DDOS (Denial of service) attacks which had been identified and prevented (R1, R7). As a prevention of the security threats, an improvement was planned to decouple the system into the corresponding markets to make sure that the impact on any failure of one component will not trigger huge business issues to the whole system (R6, R7).

However, apart from having a surge of challenges, new requirements were still coming from markets and customers (R2). In the past three years, a new framework has been created. The framework allows SDT to do experiments with the fraction of the traffic, customers, and markets. The experiment allows the team to decide if new things are really needed to be added to the system, what will be the consequences and how to do so without disrupting the business (R5).

4.3 Payment Service providers

Most of the payment options are external payment providers integrated with third party organizations like Visa, MasterCard, Klarna, Swish, etc. These integrations, the intermediate working parts are called *Payment Service Providers* (or *PSP*) (R2, R4, R7). The process of payment goes through a special Gateway (R3). The e-commerce system creates a payment session through the PSP with all the information, including the card details of the customer and the particular order details (R4). There is a service-level agreement with these third party organizations to rise a ticket when an issue happen, and if the issues are critical there should be solved within a concrete amount of time, 4 hours for instance (R4).

During the times of pandemic lockdowns, the issues mainly were because of the surge of customers buying within the e-commerce platform. A lot of flow was put on both the systems. Either the e-commerce system, or the PSP were not able to cope up in the demonstration to approve the payment (R2). Provided having issues on payment page, the e-commerce backend does not receive any error and the third party organization is responsible for handling technical disruptions (R3). The issues can vary from being connected to the bank or the PSP or the customer details (R4).

In the pandemic times the numbers of transactions increased by multiple times, the PSP needed more time to process all the information. If before the pandemic, there were 5 problems a day, now that number reached 10-15 (R5, R4). Because of the high demand on the system and pressure on the third party payment provides a new functionality, "*Pay Later*" was introduced allowing customers to place the order but do the payment later (R5).

There is an integrated *Reconciliation process* into the working routines. When there is something wrong with the system (suppose a timeout) then an error message is risen to the customer but the money is already credited from the account. For this uncertain situation, a message is put in the list of reconciliation. In order to smooth the reconciliation process and reach out to the customers faster, new solutions have been provided (R4).

4.4 Database and inventory issues

The rise in online shopping led to an immense surge in shipping and delivery volumes and maintaining databases and inventory. This has posed several challenges for e-commerce SDT, who have had to modify their systems to tackle these problems.

The inventory system includes both in-store and warehouse inventory, which is managed centrally at Distribution Center (R3, R4). Order management system and distributed management take care of all aspects related to inventory once an order is placed—e-commerce system goes for an availability check before making the payment, so as soon as from the card page then, ask for the customer's zip code, will figure out whether have stock (R4). The system conducts availability checks on all goods listed on the website, and when an item is sold, but is not subtracted immediately from the inventory due to the high load on the e-commerce system. One of the other issues in synchronization between the frontend and the backend. Everything with the front end was event-based microservice architecture (R7). More or less, all the transactions were real-time, and the updates were real-time because everything was in the cloud. A way to know and get more accurate time information, but on the other hand, when the systems in the backend which are connected to inventory, that is not real-time. These two things were not synchronized. From then, SDT started to make efforts in making these two areas to be synchronized, and as a result, had great success and resilience working with these mismatches. *“We started with new products and, modernization in the inventory systems as well so that we are at the same level and we are having a movement to cloud and more real-time information that matches these two areas” (R7).*

An important issue during the pandemic was item availability, and the reasons were multiple orders (R2). Products from multiple locations, due to the lockdown, the goods could not move from one country to another, and the whole supply chain got hit (R2). Item availability impacted the entire supply chain, with many empty shelves. Hence, a new feature, namely availability solution of *“selling unavailable products”*, have been introduced (R3).

4.5 Shipping and delivery

The global logistics issues highly impacted the delivery service of the e-commerce system. The supply chain around inventory could not give more working details (R2). Usually, the organization plans the delivery before even the customer pays. In the checkout journey, items are in the cart, then click the checkout button straight it takes the zip code page. Delivery partners check the possible time and schedule the delivery. Delivery planning is upfront in the system, due to unforeseen situations, the number of orders were huge, which caused many problems (R4). Items might not be in stock for delivery because of the shortage of some materials. So, the organization carefully handled to avoid legal compliance in delivery and refrained from giving customers over-promise as much as possible which may have created distrust in the customer. All these new behaviors of customers and new situations. It was a big struggle for the coworkers and the countries to cope with this demand.

By considering the above issues, the SDT added a new *“click-and-collect”* option to the delivery plan. Parallely, in the store, the organization introduced a new *“Locker solution - contactless pick-up”*. An online customer looking to pick up items from a store might select a delivery slot during ordering. However, pickup from the store could present challenges due to limited

human capacity. Despite the organization's effort to ensure a smooth process for customers, estimating the volume and type of orders for the day and determining the necessary number of workers to prepare and hand over the order had become difficult since the sudden change in the number of orders (R7).

4.6 Customer support services

Recent changes in the customer behavior increasingly highered the importance of customer support services. These support teams act as an intermediary between end customers and the software development teams of the organization. The customer support service specialists collect the actual feedback, bring the issues and the needs of the customers to the development team (R1, R2). Which range from being unable to updating the user profile, and login errors, to more specific ordering-related problems directed to SDT to be fixed (R1, R4).

During the pandemic, the service desk had tons of calls regarding customer packages and other technical errors of the e-commerce system. Typically, the organization has multilayer support for these issues and some are not related to the software development. There is a help desk for the first level of support and the second level of support then, if the problem is related to the SDTs, it goes to the actual teams that work on the specific systems. The customer service center created a ticket for the issues, which are handled by the developers. For the customer center team members, it was not easy to understand which software teams the issue might belong to and it went in the long loop before the ticket ended up with the actual team that could fix the bug: *“few days before ending up with the team that actually can fix the issue.”* (R2). Another challenge for customer support was now being aware of the ongoing new digital improvements of the system, and almost impossible to be in synchronize with everyone; this was a big challenge during that time (R7). Apart from having issues, SDT has developed new business requirements based on the customer service teams that are also probably a part of the pandemic (R1).

In order to address these issues, new technological solutions for customer service teams were developed to help them in their work. Moreover, new Teams chat was created to involve customer support teams and the SDT. It allowed SDTs to put updates about ongoing issues to increase transparency and visibility towards the customer support team, and be involved digitally for 24/7 (R7).

Additionally, in order to reduce the crowd and improve customer service and respond to the need for efficient communication and preparation for the customer support team, new feature was proposed. It is an ability to design an interior using drawings and documents, and schedule an appointment with a store representative. The system is handy for ensuring a good layout of the interior. Before the appointment, it is important to ensure that both parties are prepared. This can be facilitated through the e-commerce system, enabling a connection between the customer and the designer (R1).

4.7 Insights gained from the new circumstances

The most common insight given by all the participants is the *asynchronous communication*. Before the pandemic, corporate emails had been used a lot (R2). With the start of the pandemic, they began to rely on the tools like Microsoft Teams, Slack, and Miro, and the way they communicate changed (R1, R2, R3, R4, R5). The communication boundaries are now more open with members of other teams, compared to the previous times (R4). An effort had been made towards educating people within the organization to use these tools effectively (R2). If, for instance, there should be a gathering of all staff to make an announcement, now it is much easier with these tools (R4).

The whiteboard tool, Miro, was very useful since the team was using physical whiteboards for discussions, it took SDT some time to get used to this tool, but now it is widely used in the team (R2). The board and the alerting systems are integrated into the Slack channels, and new capabilities of the tools were configured to reduce the timing of issues coming to the developer (R4). More peer-programming and online review sessions were done (R3, R4).

Before the full remote work, one could ask a question to another person while standing in front of each other and get back the answer immediately. Now they had to frame a concise and brief question and wait for the response. The aforementioned tools were integrated into the work routines earlier. However, the dependency on them increased over time (R1). Now everyone is used to “putting in the simpler words” the messages and communication easier (R2).

From the perspective of out-of-work team activities, R1 shared some applications like Scribble or Geofinder, which were used by their team to do some gaming activities. Even though with use of these many tools to support their work effectively. There was some challenges R5 pointed that finding challenges is not problem rather than solving these challenges together.

New routine changed the mindset of workers and added new soft skills like working and collaborating from remote and deliver a good outcome (R2, R4). Nowadays, the employees are used to working in a hybrid mode, all the communication and collaboration techniques are so integrated now that they cannot imagine working in other ways, the culture of the company changed (R4). Now when the hard times are over and the teams are already fully adapted to the changes, there is a feeling of being a bit more prepared provided unforeseen circumstances happen again (R3).

The provisioned digital investments done before the pandemic and the created infrastructure made it easier for the team to handle. However, the high load was not expected. The cloud solution also provided the possibility to make the right configuration and scale the system. From a more technical point of view, there have been some refactoring of the code. This improved system was now able to process high loads and could attract more customers to buy new products quickly (R2, R4). “*Make sure we can perform better and quickly even if the load is higher*” (R2). The very beginning of the Covid-19 pandemic was blurry for many businesses, the company also did not know how the business will continue (R1). “*Now we have a plan for business continuation, so even if we are not able to move away from our house, as long as the Internet is there, communication lines are open*” (R1).

4.8 Summary of findings

The findings regarding different parts of e-commerce as well as the transformations in the working processes of software development teams can be summarized into more general categories: *Communication and Collaboration challenges* and the *E-commerce challenges*. Communication and Collaboration challenges involve the remote work, connectivity issues, work process disruptions, lack of social interaction and the new work environments to which the SDT got adopted over time. The e-commerce challenges are more complex, since the findings indicated to two categories: *System challenges* and *Support challenges*. The System challenges here represent the increased internet traffic, security threats, inventory synchronization issues and the delivery problems which lead to the distrust from the customers.

Nevertheless, the challenges which appeared during the new hype of the pandemic also resulted in the development of new features of the system. The challenges connected to the payment system integrations brought up the new “Pay later” functionality. Issues with the Shipping and Delivery resulted in the “Pick-up lockers” and “Click-and-collect” solutions. The synchronization issues with the Inventory and the item availability issues as well led to the development of “Selling unavailable products”. Lastly, on the customer support layer, the feature of “Design interior” has been developed to effectively manage the physical interactions with customers. Below is the diagram showcasing the summary of the findings.

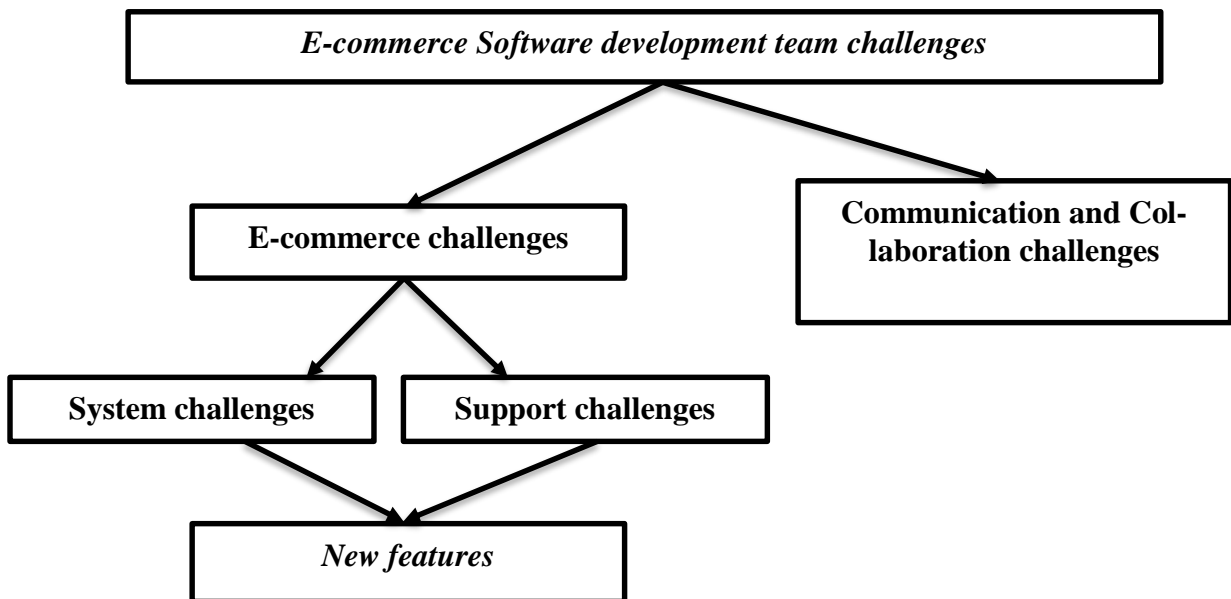


Figure 4.1. E-commerce Software development team challenges and new business requirements based on the findings

5 Discussion

The current chapter is dedicated to a more in-depth analysis of the findings presented in the previous chapter. The analysis includes drawing lines between the literature, theoretical framework and the collected data.

5.1 System challenges

According to the findings, one of the major issues connected to the pandemic times is the rise in the numbers of users. The average requests to the system per second increased for 2-2.5 times. Investigations of the changes in the behavior of customers has been under the attention since the start of the pandemic. Prior research and statistics shows that the lockdowns changed the trends of shopping and people started to shop online more. The UNCTAD report captured that more than 50 percent of customers started to use online systems for shopping more frequently compared to the times before (UNCTAD, 2020). In another report presented by the WTO, it has been stressed that the high demand of the systems brought issues to other aspects of the e-commerce system.

The issues of “*Increased internet traffic*” in the currently investigated case plays a key role to other issues as well, since the experienced surge of customers exposed other challenges to the development department of the company.

As a result of high demand among users, the development team was faced with an issue to make sure the system handles all the requests and does not have delays in response. The whole system follows the frontend-backend architectural pattern; these two parts are connected through API gateways. The applications of the backend in most cases are run in the cloud. The majority of the respondents mentioned that the digital investments towards moving the applications to the cloud were done before the pandemic. The primary task they had to fulfil was to configure the system and scale it up in a sufficient way. A similar issue was mentioned by Dinesh and Muni-Raju (2021), in their paper they state that one of the major challenges for the representatives of the online retail industry was increasing the scalability of their systems to make sure the customers continue to use it.

The stated attacks on the system brought concern among the SDT regarding the security of the system. As it has been presented by R1, several DDOS attacks were prevented. WTO (2020) also mentioned in their report that there have been some challenges regarding cybersecurity as well as product bandwidth. According to the e-commerce development stage model, the issues connected to security and privacy are usually solved in the “Transaction integration” stage, since on that stage the payment options are added, hence people provide their personal details (Rao, Metts & Monge, 2003). Throughout the interview process, it has been mentioned that as a consequence of the cyber-attacks, improvements have been made. In order to guarantee the security over the whole system, a decision has been made to decouple the system into each market segment, meaning that any attack in one particular market will not impact the whole system further down the line.

Issues with item availability disrupted the whole supply chain management of the organization. High numbers of orders and internet traffic caused the synchronization issues to the inventory

which in turn is centralized. Throughout the process of e-commerce development, the connection between the actual stock and the service is established on the second stage of Portals. Further in the development, according to the model, after the last Enterprise Integration stage, the Supply Chain Management (SCM) of the system is fully utilized (Rao, Metts & Monge, 2003).

The delays and disruptions in the transportation system caused delivery and shipping challenges to the system. The customer support services were the first instance that a customer is getting in touch with. Rao, Metts and Monge (2003) mentioned that the high level of collaboration between the suppliers and customers is made in the Enterprise Integration stage as well, the Customer Relationship Management (CRM) has a natural working relationship. However, there can be some barriers existing in that stage, global issues in particular (Rao, Metts & Monge, 2003). The new hype of e-commerce indirectly prescribed modifications in the shipping and logistics methods (Campisi et. al 2021). There were some companies announcing the unavailability of delivering goods to certain locations (Susmitha, 2021).

5.2 Support challenges

Time issues due to the multilayer organizational structure resulted as a lack of communication between different departments bringing delays to the time when a customer support specialist brings the actual problem from the customers to the development team which is responsible for solving. The multilayer structure of the organization prevents the quick functional responses. Rao, Metts and Monge (2003) connects the competence of the internal staff of the organization to the CRM services and calls them a critical facilitator to the Enterprise Integration stage of the development.

As aforementioned for the previous point, the promoters of the successful integrations and thereby a ready-to-be-used e-commerce systems, are the qualifications of the internal staff and their ability to work interconnected. Luckily, in the current investigated case there has been some improvements to soften the communication and collaboration barriers between the technical and support teams. To resolve the issue of awareness, there had been created some channels through the communication tools to acknowledge the support team with the new or upcoming solutions (Rao, Metts & Monge, 2003).

5.3 Communication and collaboration challenges

In terms of communication and collaboration challenges due to the changes in their work routines, during which the SDTs began to incorporate authority recommendations such as WFH in order to control the spread of infection by maintaining social distancing and by avoiding physical connections. This section discusses key challenges of the e-commerce SDTs initially encountered to cope with the work project.

Even though software teams are used to working virtually, the pandemic made the co-located team work from home, where they were previously working in the same physical office. These new changes significantly affected the way of communication and collaboration among the team members (Jackson et al. 2022). Hence, the remote work practices were difficult for them to cooperate. According to Arunprasad et al. (2022), during the remote work, members of the

team must stay connected, interdependent, and willing to interact in the virtual meeting and other group work. By doing so, members of the team by themselves put extra effort to be dedicated and engaged in the team collaboration to stay connected with the work process. According to Saks (2006), SDT members should be fully present or focused when doing and performing their job. Sometimes, even though team members concentrate and focus on their work, the network connectivity problems made them disconnected from the team. Added to that some other factors might make it harder for members to feel disengaged during the pandemic including isolation, social distance, a high expectation of support from organizations, and the lack of dedicated workspaces (Larson, Vroman & Makarius, 2020). Apart from these, members require motivation, skills, knowledge, and networks to overcome these challenges in these stressful situations (Molino et al. 2020).

In the environment of the remote work, participants in the interview admitted that they did not have a proper office setup. Moreover, they were isolated in their home offices and avoided going to the office, which made it harder to concentrate on the work (R2, R3). The several studies have shown that ergonomic workspaces and work environments contribute to employee productivity, efficiency, and provide satisfaction. With the spread of the Covid-19 pandemic, the traditional workplace completely changed overnight. The main challenge highlighted by the SDTs is that the home office set-up was not well-equipped as in a physical office (Butler & Jaffe, 2021; Uddin, Alam, & Serebrenik, 2022).

The other increased concern regarding the challenges of the SDT was social communication. Due to the lockdown, people stopped going to physical offices, so it was tough to meet other people physically. This led to a lack of social interaction. Articles have revealed that software companies and developers prefer working together in the same location. This is owing to several benefits for the employees, such as SDTs are communicating easily and are able to coordinate with other colleagues in the office. These social interactions facilitate an environment for creativity, faster learning, idea-sharing, and transparency in the work process (Ford et al. 2021).

Another challenge was Internet connectivity or improved VPN access from home, and as mentioned in this interview, one respondent mentioned, “*there were challenges with respect to VPN*” (R3). According to the Pandemic Programming study, upgrading home internet connectivity is highly recommended. This is especially important for enterprises that use custom-built software and virtual private network (VPN) modules to access remote clients and employers. These services need to be scheduled and provided on a shift or custom time basis in order to maintain credibility and meet goals. Therefore, having a reliable internet connection is vital for the remote work (Arunprasad et al. 2022).

As it has been mentioned in Chapter 4, the e-commerce SDTs started using online communication tools. According to Jackson et al. (2022), several tools have become more central in the recent years, including task management, collaborative coding tools, and chat. In chat, for example, videoconferencing, tools have been improved in terms of “user-friendliness” which includes the ability to quickly share a screen and converse directly with a remote, enhancing the user experience.

According to (R2), it was more about educating the team members on how to use tools efficiently. Team-level intellectual resources are typically lacking in software teams, which must integrate personal knowledge to create new team-level capabilities (Mehta, Mehta & Bindal, 2022). Further, the same participant stated that it is not only about tools but also about soft skills

and how to collaborate and communicate when teams are not sitting physically in one place and still able to share ideas and discuss issues. This is especially challenging as it relates to teamwork and soft skills such as organization, project management, teamwork ethics, practices, skills to communicate and collaborate, as well as the ability to effectively use the required tools for the software development (Petkovic et al. 2010).

The software development teams are usually in the physical office. Teammates time to time could easily share the questions and feedbacks with each other about tasks. Despite this, online meetings might be scheduled remotely to communicate or discuss with colleagues. Meetings might have been pre-scheduled or ad-hoc (R3). The use of asynchronous online communication led to delays in answering questions, which caused a stop in feedback collection and product development (Butler and Jaffe, 2021; Uddin, Alam, & Serebrenik, 2022). A further challenge was about solving the problem together and the fact that finding issues was not a problem, rather than solving it together (R5). While the potential for producing innovative outcomes is high, the potential for conflict and stagnation could be even higher (Bin & Shmailan, 2015). Therefore, this created a disruption in the work process. On the other hand, apart from the above-mentioned challenges, the e-commerce software development team led their way in developing new business requirements for the organization.

5.4 New Features

As a consequence of the pandemic situation and the challenges that e-commerce software development teams were faced with, the findings indicated that new features were desired to be developed (Figure 4.1).

The business landscape evolved, and customer expectations changed (Tupia-Astoray & Andrade-Arenas, 2021). E-commerce was in need of adopting new features according to recent business trends, and challenges faced in the business world (R2). In that way, the organization introduced several new features. The first new feature for customer payment was “*Pay Later.*” In order to smooth the reconciliation process and reach out to the customers faster, new solutions have been provided (R4) in e-commerce sites so that the customers can make their payment later, even after the product reaches out to the customer, to enhance the customer experience. This solution came in response to the high demand for the system and pressure on third-party payment providers (R5).

Another feature the software development team added was the new “*click-and-collect*” and “*Locker Pick-up*” options to the delivery plan in the e-commerce system. The next feature, “*sell unavailable products*” has been introduced since the pandemic taking pre-orders to fulfil the customer needs (R3). The last feature was developed for the customers to book an appointment with the designers in order to bridge the gap and extent of the connection between the customers and the designer (for interior home design). These new features proposed as a consequence of the new hype of e-commerce are in line with the suggestions of Tupia-Astoray and Andrade-Arenas (2021) and Huang et al. (2019). It clearly shows that, at the moment, e-commerce is becoming a technological solution to various business problems within companies related to their sales processes or business management. In the era of new technologies, the efficiency of processes will constantly improve. It is, therefore, necessary for companies to implement an e-commerce solution in order to increase and automate commercial

management as well as to take on a new business direction and provide a solution to their problems (Tupia-Astoray & Andrade-Arenas, 2021).

6 Conclusion

At the beginning of the research study an inquiry has been proposed to investigate the narrow aspects of the new promotion of e-commerce systems from the perception of their own software development teams. The research question was:

“What were the challenges experienced by the e-commerce software development teams during the sudden shift to remote work caused by the Covid-19 pandemic? How do the insights gained contribute to new working processes?”.

Following the empirical data collection, the key findings were summarized to discover the answers to the research questions. Found challenges have been categorized into two major categories, one connected to more technical challenges of the e-commerce systems and the other connected to the challenges of the SDT members. These challenges were unique and demanded resilience and adaptability from the teams. The insights gained from that times led not only to the maintenance of the system but also to the development of brand new features and capabilities.

The high demand of the e-commerce system has put an extremely pressure on the network. The department of SDT was responsible for making sure that the infrastructure is suitable enough to handle the new surge of the users. Apart from the multiplied internet traffic, there had been some security threats, which in their turn acted like a facilitator for new developments and improvements of the system. Another challenge was connected to the interconnection of the front end of the e-commerce system to the back end. Although the e-commerce system is being developed by the SDT, the factual customer needs and problems are being handled by the customer support team. The global issues associated with the logistics resulted in delivery delays and brought the customers to the mistrust towards the system. The multilayer organizational structure and the huge amounts of messages from the users made the situation worse.

Initially, SDTs experienced difficulties in the new work environment with no proper work setup at their homes. The way of working alone for a long time brought up the challenges which they were not familiar with before. The barriers varied from resolving the technical issues to adapting to the remote collaboration. Yet another obstacle was the isolation and the shortage of social interaction with the colleagues. The inability of going to the office and not meeting others made them rely on the software tools for communication, collaboration and knowledge sharing. The sudden shift to online communication on its turn contributed to new experiences, both, connected to learning how to use those new software, and undeniably gaining new soft skills for asynchronous communication.

Gained skills of remote work and adaption to online collaboration and communication together with the expertise and dedication, the SDTs are now able to improve the system into more reliable and robust platform. The experienced challenges made them to continuously redesign and improve the system to meet the need of today’s customers, thereby new functionalities were developed as a result of new hype.

6.1 Further research

Taking into the account the findings of current study we would like to suggest additional research in some directions. The first and foremost aspect which needs additional research is the supply chain management of e-commerce. Some technical aspects have been considered in this thesis, still non-technical challenges can be investigated to understand the whole picture of supply chain. Nevertheless, business challenges of the new e-commerce hype in the post-pandemic times can be a subject of interest among researchers. Additionally, a more detailed research can be conducted to investigate the acquired soft skills and their importance in the hybrid work setup. As it has been mentioned in the Chapter 1.5. Delimitations, current thesis was focused to study a large enterprise in Sweden, however it would be valuable to do research on medium and small enterprises, also consider the perspective of non-European software products.

Appendices

Appendix 1. Interview guide

Part N1 - Demographic factors

1. What is your designation within the e-commerce development team in your organization, and what are your primary responsibilities and main work tasks?
2. How long have you worked with e-commerce systems?
3. Can you describe how your working routine changed during the Covid-19 pandemic, particularly in terms of your communication and collaboration with other team members and stakeholders?
4. What kind of technological tools or software did you use during the pandemic for your work, and how effective were these tools in helping you to solve your tasks?

Part N2 - Main questions

Mobile Version of the system

5. The mobile application is quite new and was launched just before the pandemic started. How did you manage to troubleshoot and fix the bugs or add new features to the app while working remotely?
6. What do you think were the biggest challenges that can be connected with the high number of usage of the application, caused by the quarantine period of Covid-19?
 - a. Were there any specific problems with compatibility of the app with different platforms, language related issues or security threats?

Payment system

7. The users of your e-commerce system can choose between different payment options to complete their purchases. These options require technical integrations with the payment systems. What kinds of technical issues can you recall as a developer to handle in the particular time of the pandemic?
8. The issues were connected to your system, or the third party system which was integrated, how you dealt with it? (more explanation)

Database/Inventory synchronization

9. Can you describe how does your e-commerce platform is connected to your inventory?
10. We have read that during pandemic users had issues of seeing the item available but after ordering they were informed that it is not correct. Can you elaborate in detail on having these kinds of issues and how you resolved them?

Shipping/Delivery (Supply chain integration)

11. Dealing with huge amounts of orders puts extra pressure on the shipping and delivery parts of the system. What were the primary issues you were faced with?

12. What other risks you estimated and prevented to make the shipment process more smooth? Can you bring some examples and how you dealt with them?

Customer support services

13. When the Covid-19 pandemic started, almost everyone went to work from home. How did you collaborate with the customer support services team to collect feedback from users to fix or improve the system? (Are there any integrated systems like CRM?)
14. How would you describe your experience with any need/possible new technical developments to help the customer support team to communicate with users?

Part N3 - Concluding parts

15. What were the insights you gained in terms of new technologies that you started to use for your in-house development (internal communication) or altered, as a result of Covid-19 pandemic?
16. How much these new systems and integrations supported to maintain the sales of your products?
17. What are the overall technical lessons learnt? How can you estimate on being prepared now if this kind of unforeseen situation happens again in the future?

Appendix 2. Informed consent



SCHOOL OF
ECONOMICS AND
MANAGEMENT

March 2023

Informed Consent Information

A Qualitative Research to study the Challenges experienced by E-Commerce Software Development Teams during Covid-19

Department: Information Systems

Researchers:

Hasmik Hakobyan
Narthana Murugesan

You are invited to take part in a research study. Detailed information about the thesis and your participation can be found below. Please read through this informed consent and feel free to let us know if you need some clarifications.

PURPOSE OF THE STUDY

The main purpose of the study is to understand the challenges faced by e-commerce systems during the pandemic of Covid-19. We are interested in how software development teams

overcame obstacles and supported the e-commerce systems in large enterprises. The results of this study may end up in developing digital strategy guidelines for the company and assist them in overcoming some issues before the actual problems come in future. In further, medium and small enterprises who want to extend their business towards e-commerce will also benefit from using our guidelines in the development of their products. The data collection method chosen for this study is by conducting interviews and the interviews will be recorded. Later, during the data analysis phase of the research, the interviews will be transcribed, and the text will be analyzed.

STUDY PROCEDURES

The whole questionnaire of the interview will be about 15-20 questions, divided into three parts. The first part is related to demographic factors; we will ask for your personal information and your professional background. Then, the second part will be the main part of the interview, where you will be asked to answer questions related to the topic. And finally, the concluding part will summarize the interview. The access to the recordings will be granted only to the investigators, and it will be kept in the LU cloud server and will be kept till the end of the study.

DURATION

This study will take approximately 30-45 minutes to complete; at the beginning, we will introduce ourselves and the purpose of the research.

PARTICIPATION

Please notice that your participation is purely voluntary. You will decide whether you wish to participate or not. In case you choose to participate, you will be required to fill out the fields below for your consent as an affirmation of your participation. Should you decide to withdraw during the study or even after the interview, please inform us, and your information, as well as the interview, will not be used in the data analysis, the deletion of the recording will be followed.

We as researchers guarantee the security and privacy of the collected data. The confidentiality of interviewees as well as the collected data will be presented in non-identifiable ways in the paper.

Informed Consent

Interview participant

For processing and storing the data gathered during the interview for the purpose of analysing the information in the scope of the Master thesis and eventually a scientific publication

I voluntarily give my consent to participate in this study. I have read the information above and agree that the interview process shall be recorded and later replayed by the researchers in order to transcribe the interview and start working on the data analysis.

I have the right to be informed if the processing of my personal data is affected in a way that may have a negative impact on me. For this purpose, I provide my email address to enable the future to contact.

Signature:

Print name (optional):

Email (optional):

Date:

Appendix 3. Interview analysis

In this section the analysis of all interviews are presented.

Respondent 1

Role	Senior Software engineer
Tasks	<ul style="list-style-type: none"> - Translate the new business requirements to functional software - Support product already in production - mentor the new joiners
Years of experience	nearly 10 years
Change of routine	- Relying more on tools for online communication
Tools to support tasks	<ul style="list-style-type: none"> - Communication: Microsoft Teams, Slack - In work: Miro boards - Maintaining tickets: Jira boards and GitHub
Mobile application	<ul style="list-style-type: none"> - instead works on the responsive design for the mobile appearance of the web - the online <u>traffic increased</u> - the API Gateway has a limit for hits per month - this quota used to expire, and they had to go <u>and increase the quota</u> - DDOS attacks prevented
Database/inventory synchronization	- the database the R1 is working on is connected to customer activities (tracking orders, enabling family membership, appointment booking and design meetings)
Customer support	- interaction with customers is being done through my markets and separate teams, with no direct contracting

	<ul style="list-style-type: none"> - the team is linking customer issues/bugs to the actual development team - new business requirements to bridge a customer into the store - need to develop a “Design your kitchen” option - book a consultation, measurements
New technologies insights	<ul style="list-style-type: none"> - Teams, Slack, and Miro were available but due to pandemic, made them more dependant - concise and brief communications - a new technique to live through asynchronous communication - to engage the team activities: Geoafinder, Scribble
New systems support sales	<ul style="list-style-type: none"> - <i>“all tools used help to keep the business running smoothly during the pandemic”</i>
Overall lessons learnt	<ul style="list-style-type: none"> - at the start didn't know how the business will continue - <i>“Now we have a plan for business continuation, so even if we are not able to move away from our house, as long as the Internet is there, communication lines are open”</i>

Respondent 2

Role	<ul style="list-style-type: none"> - product name: Sales Price execution - Senior DevOps Engineer
Tasks	<ul style="list-style-type: none"> - tech lead - making sure that the infrastructure is up to date, maintaining it
Years of experience	<ul style="list-style-type: none"> - 3.5 years
Change of routine	<ul style="list-style-type: none"> - change in communication with the team - The first week was difficult not seeing everyone in person - getting adjusted to working from home - not having a proper office setup - working all day from home - difficult to concentrate and focus on what needs to be done - not talking to the colleagues - took 3-4 months to settle down work from home - become more efficient over time - <i>“Now we see that we don't really need to be in office, so in that way we end up with hybrid”</i>
Tools to support tasks	<ul style="list-style-type: none"> - Microsoft Teams and Slack were used more and more - Miro boards (used whiteboards before for discussion) - with these digital whiteboards, multiple people can collaborate - IntelliJ, Idle for programming

	- GSP Google cloud, heavily used
Mobile application	<ul style="list-style-type: none"> - the customers started to shop more - e-commerce was not that much used before - usually 150 -200 requests per second, but during covid it went up to 400-500 per sec - the main challenges were making sure the infrastructure handles - scaling the system in a better way - kept getting new requirements (either legal or from customers)
Payment system	<ul style="list-style-type: none"> - the e-commerce holds only 1-2 payment options, others are external, integrated with 3rd party (Klarna, Swish) - Surge of customers buying products - put a lot of flow on both e-commerce and 3rd party
Database/inventory synchronization	- item availability issue
Customer support	<ul style="list-style-type: none"> - already had CRM solutions before covid - the intermediate help service desk tickets the issues to the correct team - might have increased the workforce - <i>"multiple levels of support"</i> - sometimes it was quick to get the team to solve if the support specialist knows who to handle the ticket - sometimes it took <i>"few days before ending up with the team that actually can fix the issue"</i>
New technologies insights	<ul style="list-style-type: none"> - used emails a lot, but now moved towards Teams and Slack - educating people to effectively use that tools - moved away from emails and <i>"put in the simpler words"</i> the communication - digitally dependent on the cloud, moved to the cloud just before the pandemic - didn't expect the load to get that high - made development changes - the cloud makes it easy to scale with the right configuration
New systems support sales	<ul style="list-style-type: none"> -increasing infrastructure - refactoring the code - the increased infrastructure makes more customers to easily and quickly buy new products and overall use the system - there were teams not in the cloud and had to use - customers are impatient and the response time needs to be short

	- <i>“Make sure we can perform better and quickly even if the load is higher”</i>
Overall lessons learnt	- collaboration from remote - majority work from home and deliver a good outcome - changed mindset, soft skill

Respondent 3

Role	- Product owner
Tasks	- whatever is sold either online or in-store everything is calculated by his products
Change of routine	- the primary problem was moving to remote - all the brainstorming was not available - when the talk is needed it is either a pre-scheduled or ad-hoc meetings - challenges with VPN
Tools to support tasks	- Microsoft Teams, Miro - documentation through Confluence - full use of Slack
Payment system	- if there are any issues on the payment page, the e-commerce backend doesn't receive any error - the 3rd party organization is responsible for handling the issues
Database/inventory synchronization	- Inventory is part of the Fulfilment are - the inventory is Centralized - <u>Item availability issues</u> - not subtracted immediately
Shipping and delivery	- stores were closed, transport providers not fully running, and the shipping was stopped
Customer support	- Self-return service added - there was a load on the customer support centre
New technologies insights	- more sessions with peer programming and reviews online - dividing work into multiple parts and collaborating
New systems support sales	- new features - developed availability solutions to clearly state which products are available at the start of the customer journey - new feature for selling unavailable products, the customer will receive a notification when the product is available
Overall lessons learnt	- for the next 5 years we are a bit more prepared now

Respondent 4

Role	- Senior software engineer
Tasks	- handling the cart and check-out process - gift card solutions - integration towards other providers (PSP)
Years of experience	14 years
Change of routine	- already worked in hybrid, since the teams are geographically scattered - communication tools not changed (Teams, Slack) - the teams in Sweden used to meet often before, but from starting covid went completely remote - stand up meetings changed - now communicate pretty much easier - started documenting everything
Tools to support tasks	- Miro - Slack - Jira - exploring new features and making full use of them - retrospective made easier with Jira tool - velocity calculation made automatically - Confluence for documentation - publishing team culture and findings (knowledge sharing), Grafana
Mobile application	- UI till the business logic of the backend - everything is connected - Omni channel API, the application id running in the Kubernetes - both mobile and web use that API - this backend app is being used by others as well - is there a bug from either of them it is the same - synthetic monitoring by different tools like the Grafana dashboard - creating an alert to capture the error statistics - these alerts are connected to the Slack channel - before covid, they moved to the cloud from the physical server - the Kubernetes console emits the error which is exported to the Grafana dashboard - checked and unchecked exceptions are being captured, after being alerted someone is looking at these alerts and understanding how big is the issue, after coming to conclusion a Jira ticket is created

	<ul style="list-style-type: none"> - most of the problems are from the Checked scenarios - <u>no drastic decrease in the number of errors, but rather than internet traffic</u> - cloud, to scale automatically, the application can scale up itself, that's the beauty of Kubernetes app
Payment system	<ul style="list-style-type: none"> - the problem can be the "Decline" message - the errors are connected to the <u>PSP (Payment service provider)</u> - the e-commerce app creates a payment session towards PSP with all the information needed - PSP is the intermediate piece - the issues can be diverse, connected to the bank or the PSP or to the customer - more traffic, bank and PSP need more time - 5 problems a day before, 10-15 problems during the pandemic - Reconciliation process - a new solution is developed to do the reconciliation process faster - if there is something wrong (timeout from the system) then an error message is popped up, this message is put in the list of reconciliation - there is a service-level agreement with 3rd party organizations to rise a ticket to then if something happens - Critical issues are being solved in 4 hours - The critical could be <i>"I am not able to do a particular payment"</i>
Database/inventory synchronization	<ul style="list-style-type: none"> - Delivery promise upfront - depending on the customer's zip code - certain items cannot be in stock because of the pandemic, they are not being produced - raw material shortage - kind of the connection problem
Shipping and delivery	<ul style="list-style-type: none"> - delivery plan with 3rd party partners (like PostNord) before the payment is done
Customer support	<ul style="list-style-type: none"> - collect the feedback and create new requirements - working with market support people, who bring high-level support - <i>"Pick-up at the store"</i> features available since the pandemic

	<ul style="list-style-type: none"> - technical needs from many customers - "Pick-up lockers" installed in many stores
New technologies insights	<ul style="list-style-type: none"> - becoming lazy - now more often work in a hybrid mode - it is so integrated all the time, cannot imagine life without
New systems support sales	<ul style="list-style-type: none"> - play an enormous role - The alert configured in Slack didn't exist - this means working all the time - a critical part of the work now - unavoidable part - the time that issue comes has reduced
Overall lessons learnt	<ul style="list-style-type: none"> - still doing things while physically at home - pair programming - more working from home - certain meetings are a problem still - the announcements are easier through Slack, no gathering is needed - moving to Cloud, catching up with the market - the company has a certain culture for all the employees to come together and work as a family, which was completely changed during the covid

Respondent 5

Role	- Data and Analytic leader
Tasks	<ul style="list-style-type: none"> - working with pricing - how to make the pricing process - analysing the previous data - working with the architecture
Years of experience	15 years
Change of routine	<ul style="list-style-type: none"> - workforce had the luxury to switch to working from home - at the beginning wasn't that hard - can't turn around to ask questions to colleagues, but instead need to schedule online - still the IT field is fortunate to work remotely even before
Tools to support tasks	<ul style="list-style-type: none"> - need to have lots of discussions with colleagues and business partners, stakeholders, decision-makers and others - Communication and collaboration tools - documenting tools - Confluence, is more efficient than

	<p>writing in the file system</p> <ul style="list-style-type: none"> - diagramming tools - Miro whiteboard - sharing the screens to discuss and show through Teams - not newly injected, but something they have been used for working - the tools weren't a big change - just the setting of the tools <p>- the challenge started when starting to come back to the office</p> <ul style="list-style-type: none"> - now more of a hybrid setup <p>- Post covid - joining the meeting either physically or online is fine</p>
Mobile application	<ul style="list-style-type: none"> - the app development has had the same challenges as any other app - closed stores, companies were forced to find a different way to reach their customers, and online came in <p>- the sales compared between the online and in-store went like a hokey stick</p> <ul style="list-style-type: none"> - before the pandemic, the share of e-commerce was very low compared to in-store sales, it was $\leq 10\%$, but during the pandemic (or at least during the first phase) the picture changed to 70-80 % - <i>“Due to the pandemic, there has been much more attention to online sales, the behaviour of the customer has probably changed”</i> - created a framework, where you can do experiments with a fraction of the traffic, customers, markets - <i>“Create a framework, where you can try out small features, small changes, or small audience, or a small part of the faction of the traffic”</i>, learn from it, then decide
Payment system	<ul style="list-style-type: none"> - more transactions online - because of the high demand a new feature <i>“Pay later”</i> was added - Ghost order, where the customer could place the order and pay for it, but then the connection between the order was lost
Database/inventory synchronization	<ul style="list-style-type: none"> - depending on where in the <i>“Customer journey”</i> - Fulfilment team

Shipping and delivery	- container issue, dispatching, workforce
Overall lessons learnt	- solve the challenges together - finding a challenge is not a problem, rather than solving this challenges together

Respondent 6

Role	- DevOps Engineer
Tasks	- Selling domain - dealing with sales and discounts - for coworkers - creating coupons - both for web apps and stores - the product is called “Sales discount management” - gather and investigate the data - breaking the requirements - maintaining them and putting on the developers
Years of experience	- 6+ years of experience
Change of routine	- the communication was being managed through virtual meeting - virtual fika - not like a coworker who physically works from the store, but they are software engineers, and managed pretty good
Tools to support tasks	- Teams integrated into the Outlook - Generally go with the Teams - for the notification used Slack - recording meetings for some members who are missing, for the later usage
Mobile application	- Teams integrated into the Outlook - Generally go with the Teams - for the notification used Slack - recording meetings for some members who are missing, for the later usage
Payment system	- API is being used by e-commerce, mobile and co-worker - The content delivery network is the frontend - a proper response is needed to be done since the frontend

	is calling their backend
Shipping and delivery	<ul style="list-style-type: none"> - Pick-up from any store and other features, have been enhanced during the pandemic - These kinds of enhancements were a kind of risk preventions
New technologies insights	<ul style="list-style-type: none"> - security threats from one country - attacks on the system - discounts were
Overall lessons learnt	<ul style="list-style-type: none"> - one good thing we learnt - the system is the endpoint for other consumers to all markets - in the future, we want to serve it per-market

Respondent 7

Role	- engineering manager
Tasks	<ul style="list-style-type: none"> - responsible for business-critical flows - end-to-end customer journey - responsible for e-commerce flow - engineering manager of fulfilment flow
Years of experience	4 in this role
Change of routine	<ul style="list-style-type: none"> - the team mostly prepared - digital investment - no physical meetings - no time to follow up the people - initially difficult to find the structure
Tools to support tasks	<ul style="list-style-type: none"> - Microsoft teams - upgraded to Microsoft Office 365 - had limitations when using Skype before - asynchronous communication - Jira - Confluence - GitHub - Agile way of working - investments in the tools - reporting, logs and doing analytics around - powerBI

	<ul style="list-style-type: none"> - Splank - Microsoft App Dynamics to monitor the end-to-end customer journey - "Kill The Darlings, so to say most of the in-house things we kill them and we started to work with these modernized and standardized tools."
Mobile application	<ul style="list-style-type: none"> - mobile application is used by a few markets - partly outsourcing from India and Sweden - no big challenges - scalability - speed of developing new feature - microservices - decoupling the system to prevent attacks - the prior digitalization helped a lot during the pandemic
Payment system	<ul style="list-style-type: none"> - fraud prevention - blacklisting service providers - a lot of requests coming from one particular user - lots of transactions - online was the only option so it caused problems - if e-commerce, then got fixed quickly, if the 3-rd party, nothing to do
Database/inventory synchronization	<ul style="list-style-type: none"> - everything is in the cloud - real-time updates - daily batches, lack of synchronization - struggle with the data synchronization - shortage of things - late response from the backend - shortage of workforce
Shipping and delivery	<ul style="list-style-type: none"> - over-promise - synchronization errors - Major business-critical incident - lockers - to handle a large number of orders -
Customer support	<ul style="list-style-type: none"> - customer support centre had a call to fix - tons of calls - customers angry - not completely aware of all new solutions - increase transparency - chat for discussion, collaboration - ping pong

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