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디지털 공급-수요 사슬 관리의 성과를 측정하기 위한 새로운 관점

New Perspective for Performance Measurement of Digital Supply Chain Management

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요 약

디지털 기술의 등장과 발전으로 기업은 디지털 기술을 공급-수요 사슬에 도입하여 관리하는 것이 필수적이 되었다. 그러나 이와 관련하여 여러 어려움, 그 중에서도 특히 디지털 공급-수요 사슬을 체계적으로 평가하는 어려움이 또한 늘고 있다. 그 이유는 산업계와 학계에 걸쳐 전반적으로 사용되는 표준화된 평가기준이 아직 부족하기 때문이다. 이에 따라, 본 논문에서는 사용자의 경험을 하나의 평가기준으로 제시하고자 한다. 따라서 세 개의 다른 포커스 그룹을 통해 데이터를 얻어 질적 분석 기법으로 연구하였다. 포커스 그룹 참여자들은 넷플릭스를 공급-수요 사슬의 예로 삼아 넷플릭스에 대한 사용 경험을 자유롭게 이야기 하였다. 넷플릭스는 디지털 콘텐츠, 즉 제품을 직접 소비자에게 전달하기 때문에 소비자의 일반적인 경험, 이 회사의 추천시스템에 대한 경험, 그리고 이와 관련된 정보 보안에 대한 인식이 매우 중요하다. 이러한 것들이 기존 고객의 만족도를 높이는 것은 물론, 새로운 고객의 유치에도 결정적인 역할을 할 수 있기 때문이다. 디지털 공급-수요 사슬에 대한 사용자의 일반적인 경험은 기업의 평가 척도에 중요하다. 또한 이러한 추천시스템과 이와 관련된 정보 보안은 디지털 공급-수요 사슬의 일부이다. 따라서 이에 대한 사용자의 경험과 인식을 측정하는 것은 디지털 공급-수요 사슬을 평가하는 데에 중요한 척도가 될 것이다.

키워드 : 디지털 공급-수요 사슬 관리, 성과 측정, 추천시스템, 정보보안, 넷플릭스

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Ⅰ. Introduction

Managing a supply chain has become an important factor for companies to survive in the globalized economy. In a traditional supply chain (SC), materials or goods (products or services), money, and information (e.g., a status of payment, location of a material or good) are separately moved among suppliers and customers. The SC (supply chain) management includes an effective and efficient coordination of these movements. Various measurements have been introduced and studied by researchers to successfully monitor and manage a supply chain (e.g., managing an inventory level and product assortment). These measurements have been embedded into norms and standards for practitioners to apply them in their businesses (Elrod *et al.*, 2013).

Research has introduced different measurements, with a strong focus on company's internal and financial perspectives, for example, managing inventory to decrease cost (Rasool *et al.*, 2022). However, it has been overlooked to develop measurements from a consumer's perspective for supply chain management (Rasool *et al.*, 2022). This paper argues that consumers play an important role, which needs to be taken into consideration especially when managing a digital supply chain, because digital goods can be directly delivered to consumers.

A digital supply chain incorporates digital technologies by connecting, integrating, and improving business activities to manage a supply chain (Büyüközkan and Göçer, 2018). However, it is not clear what measurements can be used to monitor a digital supply chain. For this reason, a purpose of this paper is exploring and suggesting potential performance measurements to manage a digital supply chain. In order to do that we first introduce how digital supply chain (SC) management has been developed from traditional SC management as below.

Companies have transformed their traditional supply chain management into digital SC management by implementing digital technologies (Büyüközkan and Göçer, 2018). However, not all of them can fully transform their SC management into a digital form. Due to the natures of their businesses, many companies need to deliver physical goods such as food products, clothing, and home appliances. These companies have been able to partially implemented digital technologies and transformed their traditional SC management into hybrid SC management. For example, these companies can take orders from websites by digitizing ordering and payment processes. While a delivering process is in a traditional way, a customer can track her/his order through Internet, which is again in a digital format. We call this kind of SC management as hybrid SC management.

In the meantime, some other companies have further transformed their traditional SC management into digital SC management. If companies carry digital goods that can be directly delivered to consumers through Internet (at least at the front-end of supply chain), they can fully digitize this part of SC. Front-end supply chain management means the management of understanding and delivering goods according to customers' needs (Min *et al.*, 2019). For example, a DVD rental company like Netflix have transformed its SC management in a digital form. In addition, many platform companies (e.g., Airbnb and Spotify) and content providers (Tving, and Disney+) that started their businesses on digital technologies launched, at least, the front-ends of their SC in a digital form (Min *et al.*, 2019). While a traditional supply chain has been moving toward a hybrid- or digital supply chain, universally agreed performance measurements of digital SC management have not been developed yet.

Among many dimensions of performance measurements for digital SC management, we firstly identify user experience (UX) from the research area of human-computer interaction. Since digital goods have been directly delivered to consumers in a digital supply chain, UX can be a performance measurement for digital SC management (Millecamp *et al.*, 2018; Rassol *et al.*, 2022). It is defined as an emotionally engaging experience before, during, and after the usage of digital goods (Reiterer and Geyer, 2013). Therefore, we will examine whether user experience (UX) can be a possible performance measurement for digital SC management. Second, the development of digital technologies has enabled companies to deliver individualized (or personalized) digital goods to customers in digital SC management (Mckelvey and Hunt, 2019; Min *et al.*, 2019). In order for companies to provide individualized digital goods, a recommender system plays a significant role (Lamkhede and Kofler, 2021; Shin, 2020). We therefore choose UX with a recommender system as a possible performance measurement for digital SC management. Third, companies need a lot of customers' data to develop and operate a recommender system to deliver individualized digital goods to customers. Hence, companies have collected customers' data as much as they could from personal data to log data even they have purchased external data if necessary. Since customers have witnessed the mishandles of customers' data in many cases through news, privacy has been issued on using digital goods based on a recommender system (Distler *et al.*, 2020; Sundar and Zhang, 2019; Zhang *et al.*, 2019). For these reasons, customers' general UX, UX with a recommender system, and privacy issues can be potential performance measurements as outcomes of digital SC management.

As an exploratory study, we collected data by interviewing people from three focus groups about their experiences with Netflix, especially about its recommender system and related privacy issues. The reason to use the example of Netflix is that Netflix was able to transform its supply chain into a digital format, at least, at the front-end, by implementing more and more technologies in its supply chain. In the digital supply chain at the front-end, a recommender system has become a key component to retain its users as well as to increase users' usage rates (Gomez-Uribe and Hunt, 2016; Trenker, 2022). Thus, this study focuses on general user experience (UX) on the Netflix, its recommender system of Netflix, and related privacy issues.

This study has academic contributions. First, we introduce UX of customers from the research area of human-computer interaction into the field of digital SC management. The field of SC management has been overlooked customer's perspective as a performance measurement for digital SC management (Rasool *et al.*, 2022). Second, companies can differentiate their goods from those of their competitors with an individualized (or personalized) recommendations service (Mckelvey and Hunt, 2019; Min *et al.*, 2019). To effectively manage a digital SC and provide personalized recommendations, a recommender system is necessity for a company (Lamkhede and Kofler, 2021; Shin, 2020). We contribute to the existing literature by introducing the significance of UX with a recommender system. Third, the findings about low private concerns in all three groups indicate that privacy issues can be dropped out as a performance measurement for digital SC management as long as digital goods are related to customers' hobbies.

This study has also practical contributions. First, the findings suggest that the variety of contents can influence on customers' general UX in the Netflix case. Thus, it is important for companies to identify elements influencing on customers' general UX that is a part of digital SC management. Second, the findings

related to UX with the recommender system of Netflix suggest that customers can differently perceive the recommender system by region and culture. Third, the findings related to privacy issues suggest that companies can actively collect usage data and also ask users their preferences related to their hobbies. The academic and practical contributions will be explained in the section of CONTRIBUTIONS.

In the next section, process changes from traditional to digital supply chain management will be describe before OTT services and Netflix. After that, performance measurements of supply chain (SC) management from a traditional SC to a digital SC will be explained. Then, the method section will be explained. Discussion and implications will be presented after the results section. Finally, this paper concludes that user experience (UX) should be taken into an account for a performance measurement of digital SC management with contributions and limitations.

Ⅱ. Process Changes from Traditional to Digital Supply Chain Management

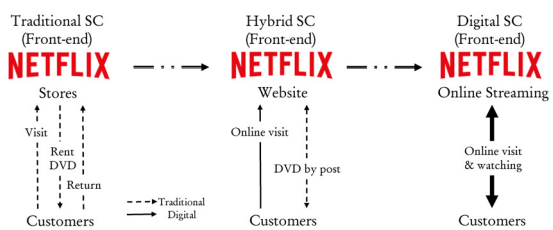
To gain a deep insight about process changes from traditional to digital supply chain management, we track the processes of Netflix's supply chain management at the front-end.

Due to the successful deployment of a digital supply chain into the business model, Netflix became one of the most influential players in the media and entertainment market (e.g., movies, dramas, and shows). Netflix has successfully transformed its traditional supply chain into digital supply chain. We take Netflix as an example for the process changes at the front-end of supply chain management, because the subscription-based video on demand (SVOD) market has rapidly grown in the number of subscribers as well as revenue (Trenker, 2022). Furthermore, people voluntarily use Netflix on their leisure time, which makes user experience (UX) an important part in digital SC management. We focus on a front-end supply chain side, since we explore user experience (UX) as a potential part of digital supply chain management.

Netflix started as a video-rental company by managing a traditional supply chain in 1997 (see <Figure 1>). Netflix quickly adopted digital technologies and opened its website. Customers could order DVDs online and then receive and return them by post (Netflix, 2022). Post means a system that physically transporting letters and parcels.

Netflix introduced a subscription-based price and added an individualised recommender system for its subscription users in 2000 (Netflix, 2022). Three years later Netflix's recommender system was patented in the United States. In 2005, Netflix added a profiling function for its users to provide customized contents. Netflix has provided a streaming service since 2007 (Netflix, 2022).

The implementation of digital technologies has con-



〈Figure 1〉 Evolution of the Front-end Supply Chain of Netflix

〈Table 1〉 Comparison of Processes from Traditional to Digital Supply Chain

Process step	Traditional SC	Hybrid SC	Digital SC
Selecting a content	By visiting a store	Through online catalogue	Directly searching or selecting from personalized recommendations
Obtaining and returning the content	Borrowing and returning DVDs	Post-mailing	Online streaming
Medium	DVDs	DVDs	Online streaming
What kind of personal data is stored	Basic personal data (Name, phone number, address, etc.)	Basic personal data + billing data	Basic personal data + billing data + online usage patterns (e.g., mouse movements, searching, selections, clicking, etc.)

tributed the evolution of supply chain management, especially, at the front-end supply chain. This also leads to the changes in the processes of the front-end supply chain management (see <Table 1>).

For traditional supply chain management, the company keeps a basic personal data (customer's name, phone number, and address) to rent out DVDs. When a customer does not return a borrowed DVD, the company can call her/him. It is usually not necessary to keep customer's billing data, because the customer pays a rental fee and a deposit when (s)he borrows a DVD.

For hybrid supply chain management, a customer goes over a catalogue on the website and puts an order to receive a DVD by post. In this case, the company keeps a basic personal and billing data. With the advance of digital technologies, the company can collect some data about customer's selection of contents.

For digital supply chain management, a customer visits the website and receives a streaming service based on a subscription plan. The company holds customer's basic personal and billing data as well as the data about her/his online usage pattern. It is essential for the company to collect as much data about customers' online usage patterns as it can in order to provide customized contents that customers may like. Although this phenomenon has raised privacy issues, collecting a great amount of customers' data is critical for a recommender system as a part of digital supply chain (Steck *et al.*, 2021).

Ⅲ. OTT Services and Netflix

In the section, we review OTT services and Netflix in detail. Then, we will explain how performance measurements have changed from traditional to digital SC management.

The video-on-demand market steadily has grown over the last few years. Within the market report, Trenker (2022) illustrated a global revenue growth of 15.6 percent from 2017. One of the main reasons for their popularity is independence among time, place, and device while enjoying a content. Additionally, exclusive contents and a large database of films and shows are perceived as benefits (Trenker, 2022).

In comparison to traditional TV services, Netflix offers a better value proposition (Lotz, 2021). To find out how Netflix influences the current entertainment market, Lotz (2021) consolidated and analyzed company reports, with a strong focus on the location of subscribers, commission/co-commission by country/region as well as the ten most-viewed titles of the year in 17 different countries. Since Netflix has offered international-based content as well as drived a localization strategy, its contents became popular

and could compete against TV services and cinemas (Lotz, 2021).

One study compares Subscription video-on-demand (SVOD) services to the movie industry by analyzing distributors' value chains and business models (Clement *et al.*, 2018). Providers of SVOD services can more easily access users' data and analyze users' needs with their recommender systems than those in the movie industry (Clement *et al.*, 2018). Furthermore, this kind of SVODs' personalization strategy has raised privacy concerns (Hadida *et al.*, 2021). McKelvey and Hunt (2019) highlighted that individualized SVOD services based on the concept to mimic discoverability has influenced users' behavior regardless privacy concerns.

In Europa and the United States, Netflix and Amazon Prime Video have become the main players in the market and their market shares in Asia are growing as well (Trenker, 2022). Song (2021) compared five factors of Netflix and Amazon Prime Video: personalization, closed loop, usage-based pricing, collaboration ecosystem, and organizational agility and analyzed various documents such as industry documents, press releases, company blogs, executive interviews, and case studies. He found that Netflix has a better personalization than Amazon Prime Video because of Netflix's recommender system. Netflix uses A/B testing to gather user feedback, while Amazon does not have a content feedback loop (Song, 2021).

Gomez-Uribe and Hunt (2016) investigated how Netflix recommended movies to customers in detail. According to their research, there are different components consisting of the recommender system. The *personalized video ranker* orders the entire catalogue of videos for each member's profile in a personalized way. The *top-N video ranker* finds the best few personalized recommendations in the entire catalogue for each member. Within *trending now* is about a personalization of shorter-term temporal trends to a user. The component of *continue watching* orders the videos in the same named row on the interface. *Because you watched* anchors its recommendation to a single video watched by a user. Furthermore, the *page generation* uses the output of all the above-mentioned algorithms to construct every single page of recommendations (Gomez-Uribe and Hunt, 2017). By using heterogeneous input data, like user behavior, those algorithms are enriched with deep learning methods, resulting in substantial improvement for recommendations (Steck *et al.*, 2021).

Summing up the literature regarding SVOD services, especially Netflix, the important role of individualization (or personalization) with a recommender system becomes visible. On the one hand, the individualization strategy distinguishes Netflix from services in the traditional movie industry (Clement *et al.*, 2018; Hadida *et al.*, 2021; Lotz, 2021; McKelvey and Hunt, 2019). On the other hand, the individualization strategy plays a crucial part in Netflixs' business model and differentiates Netflix's services from other SVOD services. A recommender system is considered to have an important task, as it needs to take user behavior, user feedback, and personal interests into account. To fulfil this role, the system needs to be fed, trained, and tested with personal data (Gomez-Uribe and Hunt, 2017; Streck *et al.*, 2021; Song, 2021). This raises the question of privacy concerns and sustainable handling of private data (Clement *et al.*, 2018; Hadida *et al.*, 2021).

Ⅳ. Performance Measurements from Traditional to Digital Supply Chain Management

The management of a traditional supply chain is

based on various measurements such as inventory cost, response time, and efficiency of replenishment cycle (Elrod *et al.*, 2013). For example, a company can maintain high inventory level to avoid out-of-stock and to manage fast response time for products, that increase inventory cost. Companies need to be sophisticated to manage this traditional supply chain by trade-offing among those different performance measurements. Traditional supply chain management has to also deal with many uncertainties, particularly fast changes of customers' requirements and conflicting requirements among departments within a company (Elrod *et al.*, 2013).

These performance measurements for traditional supply chain management have been developed focusing on efficiently and effectively moving materials and goods over a supply chain. When transforming toward hybrid supply chain management, these performance measurements still offer insights into areas of improvements or opportunities for the implementations of new processes, because physical materials and goods yet need to be moved over a supply chain. Most of the time, a trade-off among the performance measurements is still needed to achieve an efficient supply chain for hybrid SC management. Meanwhile adopting digital technologies, digitized data in a supply chain is overloaded. Although it has become obvious for a company to efficiently and effectively manage those data, efficiently and effectively moving physical materials and goods is prior to managing digital data in hybrid SC management.

Not all supply chains can be transformed into digital supply chains, only those supply chains that carry digitized goods (e.g., contents on Netflix and Airbnb) over Internet can be transformed into digital supply chains.

As a digital supply chain carries digital goods, the traditional SCM performance measurements are not applicable. In order to monitor and control a digital supply chain effectively, appropriate performance measurements are needed. In fact, the literature of digital SC management has actively appeared since year 2018 by introducing benefits of digital SC such as visibility of SC, standardization of a process, etc. (Agrawal and Narain, 2018). Büyüközkan and Göçer (2018) tried to define a digital SC as 'an intelligent, best-fit technological system based on big data' and identified some characteristics of a digital SC such as global connectivity, transparency, real-time inventory, etc. Zhang *et al.* (2019) raised security and trust issues on a digital SC. Min *et al.* (2019) emphasized individualized offerings based on data analysis as a key component of competitive advantage in SC management. Garay-Rondero *et al.* (2020) suggested a model for digital SC with five essential elements: project management, human-technology relationship, formation of technical infrastructure, enablers and features deployment, and digital and physical SC flows. Recent literature has continuously focused on the relationship between data science and supply chain management (Seyedghorban *et al.*, 2020) as well as the relationship between digital technologies and SC management (Zekhnini *et al.*, 2020). Farajpour *et al.* (2022) proposed a consolidated framework to understand digital SC management with layers such as digital SC strategies, enablers, processes, data management and analytics, etc. Finally, Rasool *et al.* (2022) provided the overview of performance metrics based on the meta-analysis of the existing studies and identified that 'metrics related to internal and financial perspectives received the most attention' and recognized gaps such as absence to measure digital transformation impact on customers. It means that there is a paucity of universally agreed performance measurements for digital SC management from the customer perspective even though some studies suggest measurements from internal and financial perspectives (Rasool *et al.*, 2022). As <Table 2> shows the summary

〈Table 2〉 Literature Review of Digital Supply Chain Management

Author	Aim	Approach	Method	Data
Elrod *et al.* (2013)	Review and synthesize current metrics for SCM	Descriptive study + Meta-analysis + Qualitative data gathering	Literature review + Categorization of metrics + Interview about metrics	Interview with 3 experts
Agrawal and Narain (2018)	Currently only few companies are equipped to enter digitalization era with their supply chain	Seven dimensions of digital supply chain management	Literature review	Connecting current literature
Büyüközkan and Göçer (2018)	Develop a general framework for DSCM	Descriptive study + Meta-analysis of current studies	Literature review	Review and analysis of current publications
Zhang *et al.* (2019)	Discuss current status and challenges focusing on security and trust problems of DSC systems	Exploratory study	Scientific literature and publication of organizations	Assessing risks of technologies that are used to optimize Digital SC management
Min *et al.* (2019)	Discuss on how key components of SCM have changed	Based on papers related to SC management from the year 2001 in the Journal of Business Logistic	Literature review	
Garay-Rondero *et al.* (2020)	Conceptual model that defines the key components shaping a new Digital SC	Descriptive study	Literature review articles from 1989 to 2019 dealing evolution of conceptual SCM models	Study of the constructs and components of SC management
Seyedghorban *et al.* (2020)	Research topics in past, present and future	Descriptive study + Meta-analysis	Literature review + Mixed-method → bibliometric analysis → qualitative content analysis	Bibliometric analysis of 331 articles with 12,709 references was first collected followed by a qualitative content analysis
Zekhnini *et al.* (2020)	Focus on the relationship between digital technologies and SC Management	Descriptive study + Meta-analysis	Literature review + Bibliometric analysis	
Rasool *et al.* (2022)	Give an overview of current metrics within digital SC management	Descriptive study + Meta-analysis of current studies	Systematic literature review to find current studies Balanced scorecard to group results	248 papers with studies on SC management Grouping of 299 performance metrics into 4 categories
Farajpour *et al.* (2022)	Consolidate a Framework for DSCM considering the value stream	Descriptive study + Meta-analysis	Literature review + Classification and thematic analysis of literature	Literature review of 107 papers

〈Table 3〉 Performance Measurements from Traditional to Digital Supply Chain Management

Supply Chain (SC)	Goal	Management	Optimization	Risk
Traditional	Moving materials (goods), money, and information	Efficiently moving physical materials and products with relevant performance measurements	Trying to optimize a whole SC by trade-offs among performance measurements	Uncertainties on a SC and risks on trade-offs among performance measurements
Hybrid	Moving money and information can be digitized	Same with the traditional SC and appropriately adopting digital technologies	Depending on how to integrate digital technologies	Same with the traditional SC and with the digital SC
Digital	Providing seamless digital goods with digital payments	No universally agreed measurement	Providing customized recommendations based on the analysis of users' data	Inappropriate recommendations, privacy issues, and local regulations

of literature review in digital SC management, most studies are based on meta-analysis and literature review. We therefore explore performance measurements for digital SC management from the customer perspective.

Although companies, that have developed and managed digital SC, face new risks, like privacy laws and regulations concerning collecting and using data of customers, they need to use those data in order to develop and provide digital goods based on their recommender systems. Thus, it is important that users have positively experienced with digital goods in general and with recommender systems. In this way, users can voluntarily agree and provide their data to a company with low privacy concerns. For these reasons, user experience (UX) should be included as a performance measurement of digital SC management. We summarized goals, managements, optimizations, and risks of the traditional, hybrid, and digital SC managements in <Table 3>.

In a broad perspective, Netflix can be seen as a part of the movie industry (Trenker, 2022). Within this industry, customers' data will be increasingly more important and then the analysis of these data becomes a key driver for success (Hadida *et al.*, 2021). In addition, identifying, accessing, and analyzing new data in order to understand and predict users' needs will be critical for Netflix to succeed (Clement *et al.*, 2018).

Recommendations, as in the case of Netflix, can enhance the UX, first, by organizing the content library and categorizing users into groups with distinctive labels (Lamkhede and Kofler, 2021). Second, recommendations can be personalized by analyzing users' activities and quickly provided based on the organized library and the categorized groups (Gomez-Uribe and Hunt, 2016; Steck *et al.*, 2021). As user experience (UX) is positively related to a proper personalization and negatively related to privacy concerns (Sundar and Zhang, 2019), Netflix's recommender system can enhance UX meanwhile decreasing users' privacy concerns in Netflix's digital SC management.

In the previous sections, we noted that measurements for the customer side of a digital SC are not the main focus of current research (Rasool *et al.*, 2022). To address this gap, we propose a three-folded option to measure customer satisfaction within the front end of the digital SC by using the example of Netflix. First, general UX will be measured to maintain insights about users' emotions while using Netflix (Reiterer and Geyer, 2013; Sundar and Zhang, 2019). UX with the recommender system is the second measurement

because the recommender system is an important part of Netflixs' business model including individualization strategy (Gomez-Uribe and Hunt, 2017; Song, 2021; Streck *et al.*, 2021). Lastly, privacy concerns and possible issues will be targeted. As explained earlier, the recommender system relies on users to create individual recommendations. Furthermore, UX can easily be influenced by privacy concerns (Clement *et al.*, 2018; Hadida *et al.*, 2021; Sundar and Zhang, 2019). Therefore, we propose to measure the front end of Netflixs' digital SC with general UX, UX with the recommender system, and privacy issues.

Ⅴ. Method

Exploratory study refers to a study used to investigate a problem which has not been clearly defined (Schulz, 2012). Thus, with an explorative study, researchers can understand an existing research problem better (Döring and Bortz, 2016; Schulz, 2012).

5.1 Study Set-up

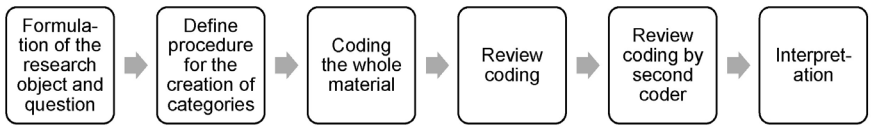
As an explorative study, we formed different focus groups and studied their experiences with digital goods, which can be useful to identify performance measurements for digital SC management. The purpose of this explorative study is exploring possibilities of using UX, UX with a recommender system, and relevant privacy issues as performance measurements for digital SC management. For this reason, the focus groups do not represent their countries or general publics. The data from the focus groups is only for the purpose of this exploratory research. Based on the study, we encourage researchers to develop concrete measurement items for digital SC management in future.

5.2 Participant Recruitment

We organized group discussions to gather different opinions about general user experience (UX) of Netflix, its recommender system, and related privacy issues. We complied with the general rules of thumb to cover a topic by three to five groups (Schulz, 2012), by setting up three different student group discussions. At the time when we held group discussions, all participants were students at one of national universities in Korea and used or have used Netflix for at least over a year. The participants were between nineteen till twenty-five years old (see <Table 4>). The first group consisted of four participants from France and Germany, the second group had three participants from Vietnam, and the last group had four participants from Korea. By taking different backgrounds into account, we could gain a broader perspective on how UX can be a performance measurement for digital SC management.

〈Table 4〉 Overview of Participants

Characteristic	Group 1	Group 2	Group 3
Country of Origin	France, Germany	Vietnam	Korea
Age	19 to 25	20 to 21	21 to 25
Gender	1 male 3 females	2 males 1 female	1 male 3 females
Field of study	Translation & Culture, Engineering	Translation & Culture, Hospitality & Tourism	Business, Translation & Culture, Art & History, Natural Science



〈Figure 2〉 Coding Process

5.3 Data Gathering and Analysis

To make participants freely express their opinions, the interviews were semi-structured. To frame the interview, open questions were developed based on the literature (Döring and Bortz, 2016). In total seventeen questions were asked, which was slightly more than the literature suggests. However, five questions were introductory questions, which made the length of the questionnaire more manageable for the participants. The interview questions are presented in <Appendix 1>. Furthermore, the interview questions were validated through a pre-test (Döring and Bortz, 2016). Within this pre-test, no major errors were detected. Only minor changes (e.g., the order of questions) were made. All interviews were transcribed before the evaluation. To achieve consistency, a template was developed for the transcripts (Döring and Bortz, 2016; Schulz, 2012). The whole interview was transcribed with the help of a word integrated speech-to-text tool without missing any opinion stated by the participants.

The analysis of the interviews was done with a qualitative content analysis following the literature of Mayring (2000). In order to build categories, an inductive approach was used by summarizing main statements (Mayring, 2022). The coding process is fully illustrated by <Figure 2>.

Organizing a great amount of material in order to extract meanings is a key point in a qualitative content analysis. Mayring (2022) identifies several types to interpret and organize the material. Within this paper, the summary and explication types were used. Due to this reason, the categories were built inductively (Mayring, 2022). The main idea of the procedure is to formulate a definition criterion derived from the theoretical background and the research question that summarises the aspects of the text material (Mayring, 2000). In the case of this paper, the statements of the first group interviews were summarized and grouped together. From this grouping, subcategories emerged. They were then again grouped together and summarized to obtain the main categories. These codes were then applied to the second group interviews. When new themes, which were not displayed by the current codes, appeared, the same procedure for gaining the sub-codes from the first group interviews was applied. The same steps were taken for the third group interviews. In the next step, the whole codes for statements were reviewed and lastly discussed with the second coder. Two researchers independently reviewed and classified the interview statements as coders. With this check-coding (Miles and Huberman, 1994), we were enabled to assess the interrater reliability (Fleenor *et al.*, 1996). The two coders' initial classifications matched above the 80% level. The coders discussed their codings until a consensus was achieved where they failed to agree. The codebook is included in <Appendix 2>.

Ⅵ. Results

In this section, the results of the analyses are presented. As an exploratory study, different perspectives from different regions (European, Vietnamese, and Korean regions) are considered. The results are struc-

〈Table 5〉 Summary of Interview Results

Discussion theme	Group 1	Group 2	Group 3
General UX	• Regular usage of Netflix • Satisfied with content on Netflix	• Regular usage of Netflix • Highly satisfied with content on Netflix	• Regular usage of Netflix • More or less satisfied with content on Netflix
UX with the recommender system	• Recommendations on front page	• Focus on external recommendations	• Recommendations on front page but also external recommendations
	• Recommender system generally captures users tastes	• Usage of recommender system strongly depends on context. But it captures users' tastes	• Recommendations are not always accurate • Good to narrow down genre
	• Little to no knowledge about recommender system	• Little knowledge about recommender system • Wish to learn more	• Heard of the term, recommender system, but not in the context of Netflix
Privacy issues	• Generally, more careful in allowing access to user data	• More open to allow access to all data	• Generally, more careful in allowing access to user data
	• Recommender system uses data from user behaviour as well as external data	• Recommender system uses data from user behaviour	• Recommender system uses data from user behaviour and from users' feedbacks
	• Concerns about recommender system and data usage are low, because users subscribe to many other platforms	• Convenience overweighs privacy concern as long as the collected data is not too personal	• Convenience overweighs privacy concern as long as the collected data is not too personal

tured by three discussion categories of UX for a performance measurement of digital SC management in <Table 5>.

The main categories we identified were general UX of Netflix, UX with its recommender system, and finally, related privacy issues.

6.1 General (UX) of Netflix

All interviewees were regular users of Netflix. One minor restriction arose in group 3 (Koreans), where interviewee one (G3-I1) specified that he/she quitted the subscription and moved to another service. Nevertheless, interviewee one (G3-I1) used Netflix regularly when subscribed. In general, all groups were satisfied with the contents on Netflix. Group 1 (French and German interviewees) pointed out that they perceived limitations in the content range. Interviewee four (G1-I4) stated that "…now I think it's [Netflix] just maybe a little boring because they don't add a lot of things…" Later, the same Interviewee explained, that "…so that's not categories [genres; note from author] that are really represented on Netflix…" Although interviewee two (G1-I2) first disagreed with the statement of interviewee four (G1-I4). After the explanation and discussion, they could somewhat agree on the limited list of contents on Netflix.

The list of Netflix contents was positively perceived within the second group (G2), due to wide content range and excellent quality. However, the localization strategy of Netflix seemed confusing the interviewees in group 2 (G2), as interviewee three (G2-I3) explained

the following: "…when I came to Korea, all the Viet (1s: 1s means that the interviewee paused about one second between phrases) Vietnamese subtitles disappeared (laugh) on (1s) on Netflix so I (1s) It is all Korean subtitles and (2s) However, it has (1s) still has like (1s) English subtitle, so I still can watch it so it is not really (1s) a minus point of it…"

Group 3 (G3) was satisfied with the list of contents on Netflix, but also identified limitations. The interviewees of group 3 pointed out the large number of contents on Netflix, but at the same time, they felt difficult to explore new genres. Interviewee two (G3-I2) clarified that "…sometimes it is good, but mostly, the contents are a bit too similar or boring…"

6.2 UX with the Recommender System of Netflix

Within all groups, the interviewees had little to no knowledge about the recommender system of Netflix. However, the interviewees in group two (G2) expressed the wish to learn more about such systems. Interestingly, group three (G3) brought up other web services like Google or Instagram, when they were asked about their knowledge of a recommender system.

Concerning the recommender system used by Netflix, group one (G1) identified it mainly on the front page without specifying where exactly it was. In addition, interviewee three (G1-I3) mentioned "… Yeah (--) for Netflix, go to like (--) I don't know how it's called in English but it's like what's coming up soon…" Those recommendations were perceived positively, as the interviewees in group one (G1) expressed that the recommendations captured their tastes.

Interestingly, group 2 (G2) brought up external recommendations such as those on social media sites (e.g., Instagram, Facebook, and others) when talking about Netflix's recommendations. However, the recommendations of Netflix's system seemed to play a minor role for this group. This was further stressed when asked directly about the usage of recommendations. The answers were divided. According to group two (G2), the usage of recommendations depended on the context. The interviewees revealed that the recommendations might or might not capture their tastes. However, it was important for them not to be fully dependent on the recommendations.

Group three (G3) identified the recommendations of Netflix mainly on the starting page of Netflix without any further indications. Another key point in the discussion of group three (G3) was about external recommendations from social media sites, especially from YouTube. Broadly speaking, the experiences of recommendations were various. On the one hand, the recommendations did not clearly capture users' tastes. On the other hand, the recommendations were perceived helpful, because some of them captured users' preferences and reduced their searching time. Furthermore, interviewee one (G3-I1) expressed her/his experience with those recommendations, "…Well (--) I feel like comfortable [about recommendations; note from author]. I am a little scared about giving my information, but I feel comfortable so…" Interviewee two (G3-I2) also agreed on that.

6.3 User Perception on Privacy Issues

Concerning privacy issues, the interviewees in group one (G1) had no concern in their personal data usage for a recommender system by the company. They assumed that users already gave a permit to the company about using their data when they started to use a service provided by the company. Interviewee one (G1-I1) explained further "…And (-) you signed up to so many platforms and (--) so it is (-) here and there is your data and I don't know…" Group one (G1) supposed

that the company gather users' data from its website and bought users' data from external sources and then analyzed those data for the recommender system and other purposes.

For group two (G2), the privacy concern about Netflix's recommender system was fairly low, since the convenience of the system overweighed the concern. In addition, the interviewees emphasized that the data access by the company might influence on the usefulness of a service or website. However, the interviewees also pointed out the relevance of the information type matters. This can be illustrated by the following quote of interviewee 2 (G2-I2), when asked about the up- and downsides of personal data access of a recommender system: "…Yeah. I think it is good, (1s) positive thing, because it can analyze (1s) my hobby except (1s) the password of bank account (ehm) and something like that (ehm) (which is) very important to me. (1s) I can provide (1s) lot of (1s) data…"

Group three (G3) considered watching a content (movie, drama, etc.) on Netflix as a hobby. Therefore, their concerns related to the recommender system are low. Interviewee one (G3-I1) describes "…so that is why most people feeling like they are safe. Because it is kinda like (--) their preferred things (-) it doesn't feel like we are not safe…" Concerning Netflix's data gathering for the recommender system, interviewees one and two (G3-I1 and G3-I2) brought up user's feedback, by stating that Netflix asked them for their preferred genre. For this reason, interviewee one (G3-I1) revealed no great concern about giving data to Netflix. This is also illustrated by further comments of interviewee one (G3-I1) , such as "…Like a phone number or these things are really important (--) but like (-) they just look into our taste like that (--) so we don't care…", or by interviewee two (G3-I2) "…We don't really care about it [giving personal information to Netflix]…"

Ⅶ. Discussion and Implication

The interviewees in all the groups heard the term, recommender system, but they had no to little knowledge about what a recommender system was at first. Then, group three (G3) discussed recommender systems outside of Netflix, indicating that they knew recommender systems in general and understood technologies relevant to recommender systems. Users who had some knowledge about a recommender system wanted the systems to be transparent and accurate (Shin, 2020).

In the case of Netflix, the discussion of group three (G3) implied that the recommender system of Netflix was neither transparent nor accurate, because the interviewees did not accept recommendations or perceived them useful. Although the other groups perceived the recommendations were more useful, they usually noticed them on the front page, which leaded to the question whether the participants were aware of the various recommendations that were on the various website pages of Netflix.

Concerning various notices of recommendations by Netflix's recommender system, group one (G1) identified them on the front page and they considered them helpful, because the recommendations captured their tastes. As described by Steck *et al.* (2021), this is one of the main goals for Netflix's recommender system. Meanwhile, group two (G2) followed some recommendations that captured their tastes, but they mainly talked about external recommendations (not Netflix, but other websites or social networking sites). Interestingly, group three (G3) also identified recommendations on the front page. However, they thought that Netflix's recommender system was not able to fully grasp their tastes and the recommender system was not accurate enough for the Korean group. This indicates that a recommender system should be modi-

fied by different regional and cultural user groups (McKelvey and Hunt, 2019). Although there were various types of recommendations on Netflix's webpages (Gomez-Uribe and Hunt, 2016), they seemed to be not perceived well by users. Only few of users noticed them well.

Acquisti and Grossklags (2005) describe that most users are aware of the usage of their personal data by companies. Accordingly, all groups were aware that their personal data was collected and used by Netflix, especially their usage patterns. Group one (G1) thought that Netflix might purchase external data to link with the data it collected. Group three (G3) considered that users' feedbacks might be one of data gathering points to Netflix's recommender system. Nevertheless, privacy concerns were relatively low in all three groups. For group two (G2) and group three (G3), convenience was overweight privacy concerns as long as the collected data was not too personal. This confirms the privacy trade-off described by Sundar and Zhang (2019). In addition, Shin (2020) notes that trust in a system is positively related for users to provide their personal data, which can especially be observed by group two (G2) and group three (G3). The interviewees considered that watching contents on Netflix was their hobby. They were therefore comfortable with giving their personal data including usage patterns to the system, because they considered that these data were not too personal. A similar behaviour can be found in the study of Seo *et al.* (2022), where perceived social benefit positively influences user's behaviour to give out personal information on social media.

Ⅷ. Conclusions, Contributions, and Limitations

We investigated the processes and performance measurements from traditional SC to digital SC by using Netflix as an example. The recommender system is important as a part of Netflix's digital supply chain, because Netflix's digital goods are directly delivered to consumers. For this reason, general user experience (UX) on Netflix, UX on the recommender system, and user's concern on related privacy issues can be performance measurements of Netflix's digital SC management. Hence, three group discussions were conducted and analyzed with the qualitative content analysis.

Users' general experiences with Netflix's contents are positive even though some people consider that the range of contents has been narrowed.

Netflix's recommendations by the recommender system have been perceived somewhat helpful. However, this perception of the recommender system is dependent on the discussion groups. Furthermore, if the recommendations by the system do not capture the users' tastes, they can be perceived as bothersome, which increases a risk for customers to leave Netflix. The recommender system as a part of digital SC has positively and negatively influence on user experience (UX) of the recommender system.

Additionally, privacy concerns can have an impact on the UX, however in this case, all interviews indicate that the convenience of using Netflix overweighs their privacy concerns. The convenience comes in form of the personal recommendations that are perceived as time saving.

This study has some academic contributions. First, we introduce UX of customers from the research area of human-computer interaction into the field of digital SC management. The field of SC management has been overlooked customer's perspective as a performance measurement for digital SC management (Rasool *et al.*, 2022). With the qualitative method, we illustrate UX of customers as a universally appli-

cable performance measurement for digital SC management, because digital goods can be directly delivered to customers.

Second, in digital SC management, it becomes important for companies to deliver and assort digital goods to customers, so customers can easily select and use digital goods. Furthermore, with the effective and efficient delivery and assortment of digital goods to customers, so called an individualized (or personalized) recommendations service, companies can differentiate their goods from those of their competitors (Mckelvey and Hunt, 2019; Min *et al.*, 2019). To effectively manage a digital SC and provide personalized recommendations, a recommender system is necessity for a company (Lamkhede and Kofler, 2021; Shin, 2020). We contribute to the existing literature by introducing not only the significance of UX with a recommender system but also different perceptions on a recommender system by focus groups by culture. European subjects generally satisfied with the recommender system of Netflix, but Vietnam and Korean subjects seemed relying on the recommendations outside of Netflix. This result opens that UX with a recommender system can be a performance measurement for digital SC management but cultural and regional perspectives should be considered.

Third, the findings about low private concerns in all three groups indicate that privacy issues can be dropped out as a performance measurement for digital SC management as long as digital goods are related to customers' hobbies. This result is different from the existing literature (Distler *et al.*, 2020; Sundar and Zhang, 2019; Zhang *et al.*, 2019). On this other hand, if digital goods are related to financial products or require personal data, privacy issues can be a performance measurement for digital SC management. Thus, privacy issues should be further researched by different types of digital goods.

This study has practical contributions as well. First, the findings suggest that the variety of contents can influence on customers' general UX in the Netflix case. Thus, it is important for companies to identify elements influencing on customers' general UX that is a part of digital SC management. If companies can properly identify and improve important elements influencing on customers' general UX, they enhance their digital SC management by providing digital goods that customers are looking forward.

Second, the findings related to UX with the recommender system of Netflix suggest that customers can differently perceive the recommender system by region and culture. Interestingly, Vietnamese and Korean subjects relied on the recommendations outside of Netflix. Perhaps, this can be related to collectivism culture, because they mentioned the recommendations from their SNSs. Their SNSs are one of main virtual hubs for networking their friends. However, this should be further studied. At this point, companies need to differentiate their strategies of recommender systems by region and culture.

Third, the findings related to privacy issues suggest that companies can actively collect usage data and also ask users their preferences related to their hobbies. As shown in the findings, users do not worry about privacy issues on hobby-related platforms. If companies can collect customers' detail preferences, it will helpful for companies to further develop a recommender system in order to provide individualized digital goods, which can contribute to improve the overall performance of their digital SC management.

This study comes with several limitations. First, the interviewees were diversified in term of nationalities but they (either international students or Korean students) were belonged to one university, which might lead to a bias. Second, possible group effects within the discussion settings were not taken into con-

sideration.

The exploration of UX as one dimension of performance measurements for digital SC management can provide practitioners and researchers a new perspective on how to measure and manage a digital supply chain. UX of digital SC management can be developed further as a universal measurement in the digital supply chain field. This point of view helps to develop and apply new ways on measuring performance of digital SC management. By doing so, further research is needed to explore a systematic way of measuring UX in the digital SC management field.

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〈Appendix 1〉

Interview Questions

ID	Question	Literature reference
1	Welcoming participants, introduction to each other	Introduction to discussion, Döring and Bortz (2016)
3	Explaining about group discussion and reassuring that there is no wrong answer (we want participants' opinions)	Introduction to discussion, Döring and Bortz (2016)
2	Consent for recording	Introduction to discussion, Döring and Bortz (2016)
4	After downloading an App, in general do you grant access to your personal data? Have you ever experienced that you are not able to download it? What were the reasons?	added after review with Prof.
6	Do you use Netflix? If so, do you use it regularly and since when?	Introduction to topic, Döring and Bortz (2016)
5	Do you log out after using Netflix?	added after review with Prof.
7	Are you satisfied with contents on Netflix? What do you like about it and what not?	Introduction to topic, Döring and Bortz (2016)
8	When subscribing to the service, do you read the terms and condition/privacy notice?	Sundar *et al.* (2019)
9	Do you agree on all terms and conditions or only the necessary ones? Why?	Sundar *et al.* (2019)
10	Have you ever noticed recommendations of contents (e.g., movies, dramas, and shows)? Where exactly have you noticed them?	Gomez-Uribe and Hunt (2016), Lobato (2018), Lamkhede and Kofler (2021)
11	Have you followed those recommendations?	McKelvey and Hunt (2019)
12	How do you feel about these recommendations?	McKelvey and Hunt (2019), Sundar *et al.* (2019)
14	Have you ever heard about recommender systems?	Gomez-Uribe and Hunt (2016), Schendel *et al.* (2020)
13	Do you have any concerns about those recommendations by a recommender system? Is there anything positive/negative about those recommendations?	Sundar *et al.* (2019)
15	How do you think that recommender systems are collecting your data and that how those collected data are used?	Gomez-Uribe and Hunt (2016)
16	Do you prefer to select ones from the provided recommendations or do you prefer to search contents by yourself?	Pichl *et al.* (2017)
17	Do you have any concerns about privacy while using those recommendation systems?	follow-up question, only if necessary

〈Appendix 2〉

Code book

blue writing = adaption after 2nd interview	orange writing = adaption after 3rd interview	purple writing = adaption after revision
Category ID; Subcategory ID	Main category	Subcategory
A; A.1, A.2, A.3	General attitude towards privacy settings while using apps	1. Allow all access 2. Specific restrictions in access 3. no experience in not being able to use a app
B; B.1, B.2	Reasons for general privacy attitude	1. perceived usefulness 2. type of information matters
Ca; C.1, C.2, C.3, C.4	Duration of subscription to Netflix	1. around 2 years 2. more than 2 years 3. more than 5 years 4. quit services
Cb Cb.1, Cb.2, C.3	Usage of Netflix	1. daily 2. several times during the week 3. using it as background
D; D.1, D.2; D.3; D.4, D.5	Logout behaviour	1. Log out after usage 2. Stay logged in 3. Stay logged in because of convenience 4. Depends on used device 5. Stay logged in, but erase history
E; E.1, E.2, E.3, E.4, E.5, E.6, E.7, E.8, E.9	Satisfaction with netflix content	1. not much genres 2. wide range of content (positive) 2.1 too much content 3. generally satisfied 4. difficult to find something new 5. good streaming quality 6. high fees 7. localization strategy can be confusing/ regulations 8. privacy concerns 9. chances to less know genres/directors
F; F.1, F.2, F.3, F.4, F.5	Reading and agreement to terms and conditions	1. not reading it 2. not reading it and full agreement 3. not reading it and partial agreement 4. reading it partially depending on context 5. no concerns
G		Note: this category was deleted after the final revision of the categories

Category ID; Subcategory ID	Main category	Subcategory
H; H.1, H.2, H.3; H.4	Reasons for not reading terms and conditions	1. too long 2. need to use application 3. difficulties to understand 4. understanding doesn't matter 5. same as on other website/services
I I.1, I.2, I.3, I.4, I.5, I.6, I.7, I.8	recognizing recommendations on Netflix	1. front page 2. category "coming soon" 3. not recognizing them in search 4. recognizing them in search 5. external recommendations (e.g. SNS) 6. after watching 7. not recognize them in app specifically 8. category "picks for you"
J; J.1, J.2; J.3, J.4, J.5, J.6, J.7, J.8, J.9, J.10	Helpfullness of recommendations	1. capturing users taste 2. reminder to ongoing shows 3. not relying on them 4. finding movie in preferred genre 5. searching with specific movie in mind 6. depending on context 7. only watching same content 8. recommendations not that accurate 9. decision to watched also based on other factors 10. reduce searching time
K; K.1, K.2, K.3, K.4, K.5	Knowledge about recommender systems	1. Heard of it 2. Basic 3. Want to know more 4. None 5. Not in connection to Netflix
L L.1, L.2, L.3, L.4, L.5, L.6, L.7, L.8	Concerns related to recommendations and recommender systems	1. no concerns 2. spying on user 3. convenience overweighs concerns 4. usage comes with giving some personal data 5. subscribed to many platforms (→ doesn't matter anymore) 6. as long as not too personal information is used, there are no concerns 7. leaking of data 8. Misusing
M; M.1, M.2, M.3	Data used for recommender systems	1. user behaviour 2. buying external data 3. User feedback
N; N.1, N.2, N.3	Development of concerns	1. older generations care more 2. younger generations care less 3. need for more literacy

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New Perspective for Performance Measurement of Digital Supply Chain Management

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Abstract

With the emergence of new digital technologies into a supply chain, it is essential for companies to incorporate these technologies in managing their supply chains. However, various challenges have been identified in digital supply chain management, especially when it comes to its assessment. There are no universally agreed measurements for the performance of digital supply chain management within the research community so far. This paper explores an option of using user experience as one of possible measurements. Therefore, three different focus-group discussions were held and later analyzed with a qualitative content analysis. The subscription-based video on demand service, Netflix was used as an example in those discussions. Due to the fact that Netflix provides a digital product as a streamline service, user experience is critical for the company. Especially, user experience with a recommender system and related privacy issues have become significant for a company to retain existing customers and attract new customers in many fields. Since the recommender system and related privacy issues are parts of a digital supply chain, user experience can be one of appropriate measurements for digital supply chain management. This study opens a new perspective for research on performance measurements of digital supply chain management.

Keywords: ***Digital Supply Chain Management, Performance Measurement, Recommender System, Privacy, Netflix***

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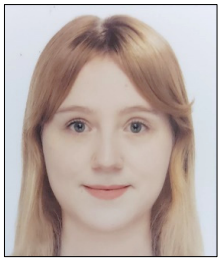

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