Empirical Studies on the Role of Input Control on Digital Platforms

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Evgheni Croitor

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Erstgutachter: Prof. Dr. Alexander Benlian
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Abstract

Digital platforms such as Android, Uber or Airbnb have become hotspots of economic interactions between complementors (i.e., producers) and end-users (i.e., consumers). As the number of complementors and offered complements on digital platforms grow, platform providers need to exercise control to align their interests and strategies with those of the complementors. To manage complementors and their complements, platform providers draw on control modes. In this thesis, control mode refers to set of mechanisms employed by platform provider to control (e.g., approve, guide and monitor) complementors and their complements on digital platforms. To advance the emergent research in the field of control modes on digital platforms, this thesis focuses on a control mode that is widespread in practice but has been largely overlooked in IS research so far, namely input control. Input control can be described as the set of mechanisms used by the platform provider to screen and sort out complementors and their complements before entering the digital platform.

Within five articles, this thesis addresses the role and importance of input control on digital platforms by investigating the effects of input control in four different platform contexts (i.e., mobile applications, web-browsers, crowdfunding and e-marketplaces). The first article describes the development of an enhanced conceptual definition for input control and a corresponding measurement scale for questionnaire-based survey research that helps us measure input control more accurately and gauge its impact on platform complementors. The developed measurement scale was rigorously validated in the context of mobile application platforms (i.e., Android and iOS) based on the guidelines and recommendations in extant scale development literature.

The second article deals with the distinction between complementor-related and complement-related input control mechanisms that address complementors and complements, respectively. Using a combination of quantitative (i.e., survey) and qualitative (i.e., interviews) methods applied in the context of web-browser platforms (i.e., Chrome and Firefox), the results revealed that both mechanisms affect complementors' overall perception of input control on digital platforms. Moreover, the results showed that complementors' perceived usefulness of and satisfaction with a digital platform served as an important driving force through which perceived input control affects complementors' continuance intentions.

Drawing on IS control literature and goal attainment theory, the third article addresses the effects of input control and self control on complementors' intentions to stay on their respective

digital platform. Results of an online survey with complementors from two major reward-based crowdfunding platforms (i.e., Kickstarter and Indiegogo) revealed that input control reduces and self control increases complementors' willingness to stay. Interestingly, these effects can be explained through the comparison of associated usefulness and effort of using the digital platform.

The fourth article investigates the impact of input control and clan control in the context of e-marketplace platforms (i.e., Amazon and Etsy). The results revealed opposing effects of input control and clan control on complementors' beliefs, attitudes and behavioral outcomes. In particular, whereas input control had a negative effect on complementors' perceived usefulness, satisfaction and continuance intention, clan control exerted a positive effect on the observed variables.

The fifth and last article examines the influence of input control on complementors' performance. Results of a field survey with sellers on Amazon indicated that input control reduces complementors' intrinsic motivation, resulting in a lower performance on a digital platform. Surprisingly, the findings revealed that input control has no direct effect on complementors' performance when accounting for intrinsic motivation.

Taken together, this thesis showcases the role and importance of input control and provides a deeper and more comprehensive understanding of how complementors perceive and react to input control mechanisms on digital platforms. Furthermore, the findings shed light on the underlying explanatory mechanisms of why the effects of input control on digital platforms unfold. As such, this thesis answers several calls for research in platform governance and control literature, and lays the foundation for future studies on digital platforms. The overarching contributions of this thesis for research consists of (1) investigating the effects of input control on complementors' behavior and performance outcomes on digital platforms, and (2) exploring input control in various platform contexts with unique circumstances and influences as well as in combination with other control modes. Additionally, this thesis provides crucial insights for platform providers on how and why input control mechanisms affect complementors behavior and performance outcomes. The findings therefore provide valuable impetus for platform providers to maintain platforms' long-term success und sustainability.

Zusammenfassung

Digitale Plattformen wie Android, Uber oder Airbnb sind Hotspots wirtschaftlicher Interaktionen zwischen Komplementären (d. h. Produzenten) und Endnutzern (d. h. Konsumenten). Um die Interessen und Strategien der Plattformanbieter mit dem Verhalten der Komplementäre in Einklang zu bringen, üben Plattformanbieter über verschiedene Kontrollmodi (d.h. Mechanismen) Kontrollen aus (z. B. Rahmenbedingungen vorgebene, Komplemente genehmigen). Die vorliegende Dissertation konzentriert sich auf einen Kontrollmodus, der in der Praxis weit verbreitet ist, aber in der IS-Forschung bisher weitgehend übersehen wurde, nämlich die Input-Kontrolle. Input-Kontrolle kann als die Menge an Mechanismen beschrieben werden, die vom Plattform-Anbieter eingesetzt werden, um Komplementäre und ihre Komplemente vor dem Betreten der digitalen Plattform zu überprüfen und auszusortieren. Diese Dissertation dient dazu, die Forschung im Bereich der Kontrollmodi auf digitalen Plattformen voranzutreiben

In fünf Artikeln befasst sich die Dissertation mit der Rolle und Bedeutung der Input-Kontrolle auf digitalen Plattformen, indem sie Input-Kontrolle in vier verschiedenen Plattformkontexten (d.h. mobile Anwendungen, Web-Browser, Crowdfunding und E-Marktplätze) untersucht. Der erste Artikel beschreibt die Entwicklung einer erweiterten konzeptionellen Definition für Input-Kontrolle und einer entsprechenden Messskala für Umfrageforschung. Diese Entwicklungen helfen, Input-Kontrolle genauer zu messen und ihre Auswirkungen auf Komplementäre zu erfassen. Die entwickelte Messskala wurde im Kontext mobiler Anwendungsplattformen (d. h. Android und iOS) auf der Grundlage der Richtlinien und Empfehlungen in der vorhandenen Literatur zur Skalenentwicklung streng validiert.

Der zweite Artikel befasst sich mit der Unterscheidung zwischen Input-Kontrolle der Komplementäre und Input-Kontrolle der Komplemente. Unter Verwendung einer Kombination aus quantitativen (d.h. Umfrage) und qualitativen (d.h. Interviews) Methoden, die im Kontext von Webbrowser-Plattformen (d.h. Chrome und Firefox) angewandt wurden, zeigten die Ergebnisse, dass beide Mechanismen die Wahrnehmung der Input-Kontrolle auf digitalen Plattformen beeinflussen. Darüber hinaus zeigen die Ergebnisse, dass die von den Komplementären wahrgenommene Nützlichkeit und Zufriedenheit mit einer digitalen Plattform als eine wichtige treibende Kraft fungiert, durch die die wahrgenommene Input-Kontrolle die weitere Nutzung der Plattform beeinflusst.

Der dritte Artikel befasst sich mit den Auswirkungen von Input-Kontrolle und Self-Kontrolle auf die Absichten von Komplementären auf ihrer jeweiligen digitalen Plattform zu bleiben. Die Ergebnisse einer Online-Befragung mit Komplementären von zwei der größten belohnungsbasierten Crowdfunding-Plattformen (d.h. Kickstarter und Indiegogo) zeigen, dass Input-Kontrolle die Absichten der Komplementäre auf der Plattform zu bleiben reduziert und Self-Kontrolle diese Absichten erhöht. Diese Effekte können durch den Vergleich von verbundenen Nutzen und Aufwand erklärt werden.

Der vierte Artikel untersucht die Auswirkungen von Input-Kontrolle und Clan-Kontrolle im Kontext von E-Marketplace-Plattformen (d. h. Amazon und Etsy). Die Ergebnisse zeigen gegensätzliche Effekte von Input-Kontrolle und Clan-Kontrolle auf die Überzeugungen, Einstellungen und Verhaltensresultate der Komplementäre. Während Input-Kontrolle einen negativen Effekt auf die wahrgenommene Nützlichkeit, die Zufriedenheit und die Fortsetzungsabsicht der Komplementäre hat, übt Clan-Kontrolle einen positiven Effekt auf die beobachteten Variablen aus.

Der fünfte und letzte Artikel untersucht den Einfluss der Input-Kontrolle auf die Leistung der Komplementäre. Die Ergebnisse einer Online-Umfrage mit Verkäufern auf der E-Marketplace-Plattform Amazon zeigen, dass Input-Kontrolle die intrinsische Motivation der Komplementäre reduziert, was zu einer geringeren Leistung auf einer digitalen Plattform führt. Überraschenderweise zeigen die Ergebnisse, dass Input-Kontrolle keinen direkten Einfluss auf die Leistung der Komplementäre hat, wenn man die intrinsische Motivation der Komplementäre berücksichtigt.

Insgesamt hebt die Dissertation die Rolle und Bedeutung der Input-Kontrolle hervor und liefert ein tieferes und umfassenderes Verständnis dafür, wie Komplementäre Input-Kontrolle auf digitalen Plattformen wahrnehmen und auf sie reagieren. Darüber hinaus beleuchten die Ergebnisse die zugrundeliegenden Erklärungsmechanismen, warum sich die Effekte von Input-Kontrolle auf digitalen Plattformen entfalten. Damit beantwortet diese Dissertation mehrere Forderungen nach Forschung in der Plattform-Governance- und Kontroll-Literatur und legt den Grundstein für zukünftige Studien zu digitalen Plattformen. Die übergreifenden Beiträge der Dissertation für die Forschung bestehen darin, (1) die Auswirkungen von Input-Kontrolle auf das Verhalten und die Leistungsergebnisse von Komplementären auf digitalen Plattformen zu untersuchen; und (2) Input-Kontrolle in verschiedenen Plattformkontexten mit einzigartigen Eigenschaften und Einflüssen sowie in Kombination mit anderen Kontrollmodi zu erforschen. Darüber hinaus bietet die Dissertation wichtige Erkenntnisse für Plattformanbieter darüber, wie

und warum Input-Kontrolle das Verhalten und die Leistung von Komplementären beeinflusst und wie Erfolg und Nachhaltigkeit von Plattformen durch Input-Kontrolle langfristig erhalten bleiben.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

AVE	Average Variance Extracted
CA	Cronbach's Alpha
CFA	Confirmatory Factor Analysis
CFI	Comparative-Fit-Index
CI	Continuance Intention
CR	Composite Reliability
GAT	Goal Attainment Theory
H	Hypothesis
HTMT	Heterotrait-Monotrait Ratio of Correlations
ICF	Input Control Fairness
IFI	Incremental-Fit-Index
IM	Intrinsic Motivation
IS	Information Systems
IT	Information Technology
LLCI	Lower Limit of Confidence Interval
LM	Linear Model
PCC	Perceived Clan Control
PE	Perceived Effort
PIC	Perceived Input Control
PLS	Partial Least Squares
PNGA	Perceived Net Goal Attainment
PP	Perceived Performance

PSC	Perceived Self Control
PU	Perceived Usefulness
RQ	Research Question
RMSE	Root Mean Square Error
RMSEA	Root Mean Square Error of Approximation
SD	Standard Deviation
SE	Standard Error
SEM	Structural Equation Model
SI	Switching Intention
SOR	Stimuli-Organism-Response
SRMR	Standardized Root Mean Residual
TLI	Tucker-Lewis-Index
ULCI	Upper Limit of Confidence Interval
VIF	Variance Inflation Factor

Chapter 1: Introduction

1.1 Motivation and Research Questions

Over the past decade, digital platforms (e.g., Amazon, GoFundMe and Android) have fundamentally changed the way products and services are created, distributed and maintained (de Reuver et al., 2018). A digital platform is defined as an infrastructure that mediates interactions between complementors (e.g., sellers, campaign organizers and developers) and end-users (e.g., buyers, donors and mobile app users) (Foerderer et al., 2018; McIntyre & Srinivasan, 2017). Economic viability and success of a digital platform hinges on complementors' performance and their continuous supply of complements (e.g., products, crowdfunding campaigns and mobile apps) (Kathuria et al., 2020; Tavalaei & Cennamo, 2020). These complements attract end-users to the platform and thereby foment positive cross-side network effects (Benlian et al., 2015; Thies et al., 2018).

As the number of complementors and offered complements grow, platform providers need to exercise control to align their interests and strategies with those of the complementors. To achieve this goal, platform providers draw on control modes rooted in control theory (Kirsch, 1997; Ouchi, 1980). Control mode refers to set of mechanisms employed by platform provider to control (e.g., approve, guide and monitor) complementors and their complements on digital platforms (Tiwana et al., 2010). Given the limited practicability of traditional control modes (i.e., behavior, output, self and clan control) in platform settings (Tiwana, 2015a), platform providers often resort to a control mode that is widespread in practice but thus far has been largely overlooked in IS research: *input control*. Input control is commonly defined as adjudicating which complementors and complements are granted access to a platform ecosystem (e.g., in the form of screening and approval processes) (Tiwana et al., 2010). It is a form of formal control or "gatekeeping" that regulates which complementors and complements are allowed into a platform ecosystem and which ones are rejected. It usually involves formal application and selection processes (Cardinal et al., 2004). Input control is a pervasive phenomenon on a multitude of platform ecosystems ranging from mobile apps and online games through browsers and e-marketplaces to crowdfunding. Despite the pervasiveness of its application in practice and its fundamental implications for platform ecosystems and their key actors, it is surprising to find that research on input control is still in its early phase. Three research gaps are particularly noteworthy in IS control literature on digital platforms.

First, the few studies investigating input control have thus far proposed an undifferentiated and high-level conceptualization without shedding light on the core practices that constitute input

control and how these practices are (differentially) perceived by complementors (Boudreau, 2012; Cardinal, 2001). This lack of a clear and substantial conceptualization calls for the development of a deeper theoretical foundation of input control. Indeed, several researchers have called for the development of a measurement scale for input control, particularly for platform contexts, due to a lack of consistency on what this concept means and how it should be measured (Tiwana, 2015a; Tiwana et al., 2010). Besides rather global and relatively coarse approaches to conceptualize and measure input control (Tiwana, 2015a), previous research has largely focused on the macro (i.e., platform) level of analysis to study the implications of input control (Thies et al., 2018; Wessel et al., 2017), but neglected more nuanced analyses that capture the micro (i.e., individual) perspective of complementors who are directly affected by input control.

Second, convincing complementors to continually supply complements to a digital platform is one of the most crucial tasks for platform providers (Boudreau, 2012; Eaton et al., 2015; Kathuria et al., 2020; O'Mahony & Karp, 2020). Although previous studies have investigated the effects of (other) control modes (i.e., behavior, output, self and clan control) on complementors' continuance intentions (Goldbach et al., 2018; Goldbach et al., 2014), important insights on how perceptions of input control affect complementors' behavioral intentions (i.e., continuance intentions) are still largely absent. Furthermore, it is unclear whether perceived usefulness and satisfaction – the two antecedents of continuance intention in the IS Continuance Model (Bhattacherjee, 2001) – can explain why perceptions of input control affect complementors' continuance intentions.

Third, IS researchers studying effects of control modes and success of digital platforms predominantly focused on complementors' behavioral intentions (e.g., continuance intentions) (Cram et al., 2020; Goldbach et al., 2018). However, control-related research increasingly underscores the need to address complementors' performance outcomes (i.e., perceived performance) (Mora-Monge et al., 2019; Rietveld et al., 2020; Wang & Cavusoglu, 2015). In this regard, a factor repeatedly mentioned to relate to complementors' perceived performance is complementors' intrinsic motivation (e.g., Bande et al., 2016; Cerasoli & Ford, 2014; Dysvik & Kuvaas, 2011). Previous research indicated that intrinsic motivation of complementors mediates the effect of control modes on complementors' perceived performance (Goldbach & Benlian, 2015b). Thus far, this relationship was only investigated in the context of self control and clan control. As such, our knowledge on how and why perception of input control affects complementors' performance on digital platforms is still limited in IS research.

In summary, to address the research gaps related to IS control in the digital platforms literature, the main goal of this thesis is to shed light on the nature and effects of input control on complementors' crucial behavior and performance outcomes. As such, the thesis focuses on the following three overarching research questions:

RQ1: What is the conceptual definition of perceived input control and how can it be measured?
RQ2: How and why does perceived input control affect complementors' continuance intentions?
RQ3: How and why does perceived input control affect complementors' performance?

To obtain reliable answers to these research questions, five empirical studies were conducted across four different platform contexts (i.e., mobile applications, web-browsers, crowdfunding, and e-marketplaces). This not only allowed to uncover multiple facets of the effect of input control, but also to confirm and expand previous findings. The resulting studies were published in five peer-reviewed IS outlets. In the following, the thesis presents theoretical foundations on digital platforms and control theory and is positioned in the context of previous research. Subsequently, the underlying research framework is outlined and the overall structure of the thesis is presented.

1.2 Theoretical Foundations

This section begins by outlining the foundations of digital platforms to explain the connection between different key concepts of a platform ecosystem. Subsequently, control theory and distinct types of control modes are presented to elaborate on the positioning and the importance of this thesis.

1.2.1 Digital Platforms

Prior IS and strategic management research has defined and conceptualized digital platforms as infrastructures that mediate interactions between complementors and end-users (Eisenmann et al., 2011; Foerderer et al., 2018; McIntyre & Srinivasan, 2017). This thesis focuses particularly on the roles of platform providers and complementors as well as their complements, as these collectively form a platform ecosystem (Ceccagnoli et al., 2012; Tiwana, 2015a). Platform providers design, develop, and govern the platform and thereby manage interactions between complementors and end-users (Eisenmann et al., 2011). Complementors are external parties who contribute complements to the platform ecosystems, but are not directly related to the platform providers (Wiener et al., 2020). For example, application developers provide apps in the case of Android, drivers provide driving services in the case of Uber, and hosts provide accommodations in the case of Airbnb. Lastly, end-users are individuals or organizations that

use complements available in the platform ecosystems (Parker et al., 2017). For example, end-users are users of apps in the case of Android, passengers in the case of Uber, and organizations in the case of Salesforce AppExchange. Table 1-1 synthesizes the outlined concepts that inform the understanding of digital platforms in this thesis.

Concept	**Definition**	**Examples**	
Digital Platform	Infrastructure that mediates interactions between complementors and end-users (McIntyre & Srinivasan, 2017)	Android	Airbnb
Platform Provider	Individual or organization that designs, develops, and governs a platform (Eisenmann et al., 2011)	Alphabet Inc.	Airbnb Inc.
Complementors	The independent providers of complements that contribute to the platform ecosystem (McIntyre & Srinivasan, 2017)	App developers	Hosts
Complements	Products or services provided by a complementor (McIntyre & Srinivasan, 2017)	Apps	Apartment
End-users	Individuals or organizations that use complements available on the platform ecosystem (Parker et al., 2017)	Users of apps	Tenants

Table 1-1: Key Concepts in the Context of Digital Platforms

Interactions between complementors and end-users typically induce cross-side network effects (Galbreth et al., 2005; Katz & Shapiro, 1985; Thies et al., 2018). This means, the higher the number of complementors offering complements on a platform, the higher the number of end-users who access the platform, thereby attracting more complementors. Positive cross-side network effects thus foster continuous growth of the platform. The increasing number of complementors and complements on digital platforms forces platform providers to pay attention to the design and implementation of platform governance. Platform governance has been found to substantially influence complementors' actions and decisions (Claussen et al., 2013; Rietveld et al., 2020) by delineating how platform providers specify decision rights, ownership, and control (Gawer & Cusumano, 2014; Song et al., 2018). Decision rights refer to an agreement between platform providers and complementors on who has the authority and responsibility to decide on specific aspects of the digital platform. Ownership, on the other hand, refers to

whether the platform is owned by a single organization or is shared by multiple actors of a platform ecosystem. Finally, control is exercised by platform providers to align their interests and strategies with those of the complementors. To understand the mechanism and consequences of control, the next section introduces control theory as the theoretical underpinning of this thesis.

1.2.2 Control Theory

Control theory is based on the assumption that individuals exhibit goals incongruent to those of the controller, which is why organizations seek mechanisms for controlling these individuals (Kirsch, 1997; Ouchi, 1979). As such, control is generally defined as a controller's attempts to influence controlees' behavior such that it aligns with organizational goals (Choudhury & Sabherwal, 2003). The nature of control has been extensively studied within the context of systems development projects and IS outsourcing (Cram et al., 2016; Mähring et al., 2018; Remus et al., 2020; Wiener et al., 2016). However, with the emergence of the digital era and the rising importance of digital platforms, the purpose of control has progressively shifted to the context of platform ecosystems (Gregory et al., 2018; Saunders et al., 2020; Wiener et al., 2019).

The relationship between platform providers and complementors differs greatly from the traditional controller-controlee relationship suggested by control theory (Kirsch, 1997; Ouchi, 1979). Specifically, in the platform setting, complementors are largely independent to decide for themselves which complements to provide to the digital platform (Tiwana et al., 2010). Moreover, they make autonomous decisions on how these complements should be created (Hurni et al., 2020). Considering control in platform settings, a key challenge thus pertains to the design of control structures (Barrett et al., 2015). Applied to digital platforms, control constitutes means (e.g., approval, guidance and monitoring) through which platform providers assert that complementors and complements are aligned with the platform's interests (Tiwana, 2015a). Control mechanisms are specific forms of control that manifest in control modes (Kirsch, 1997). IS Literature on control (Kirsch, 1997; Remus et al., 2020; Wiener et al., 2016) makes a fundamental distinction between formal and informal control modes (see Figure 1-1). Formal control modes (i.e., input control, behavior control, and output control) are enforced by platform providers through specifications and evaluations (Cardinal, 2001; Cardinal et al., 2004). In comparison, informal control modes (i.e., self control and clan control) are built on meanings of self-regulation and shared norms among complementors (Wiener et al., 2016).

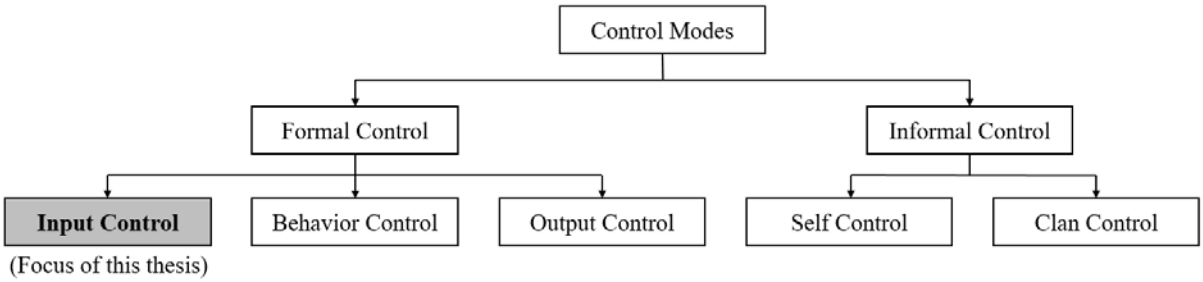

Figure 1-1: Types of Control Modes

As part of the informal control modes, clan control refers to the set of mechanisms used by the platform provider to establish shared norms, values and strong affiliation feelings among complementors. By promulgating shared values, beliefs and common goals, complementors commit themselves to these mutual beliefs and goals and therefore commonly tend to engage in similar behaviors and produce similar outcomes (Kirsch et al., 2010). With self control, platform providers encourage complementors to set their own goals and self-regulate their activities and outcomes in achieving these goals (Henderson & Lee, 1992). Platform providers may also design an appropriate environment as well as offer tools and trainings for such self-regulations. In terms of output control, output requirements and performance targets are pre-specified by platform providers as objectives which are then monitored, evaluated and rewarded accordingly. In contrast, within behavior control, no specific outcomes are pre-determined; instead, platform providers monitor and guide complementors' behaviors on a platform. This thesis focuses on the role of input control, as this control mode has been largely overlooked in previous IS research. As outlined above, platform providers exerting input control use gatekeeping and screening procedures to decide which complementors and complements can enter the respective platform.

1.3 Thesis Positioning

Control modes have been widely studied in IS research and have been proven to be effective governance mechanisms in traditional IS contexts. The emergence of digital platform ecosystems has brought fundamental changes to the relationship between controller and controlee and has made the applicability of conventional and well-studied control modes (i.e., behavior, output, self and clan control) rather difficult and less useful in such environments with high uncertainty (Snell, 1992; Tiwana, 2015a). For this reason, IS research has recently started to explicitly call for studies that address the role of a hitherto underexplored control mode, namely *input control* (e.g., Dellermann et al., 2016; Goldbach et al., 2018; Tiwana, 2015a). To answer these calls, this thesis strives to showcase the role and importance of input control on digital platforms. Furthermore, the results elucidate multiple underlying explanatory

mechanisms of how and why complementors' perceptions of input control affect their behavior and performance outcomes on digital platforms.

Drawing on the stimuli-organism-response (SOR) model from environmental psychology (Mehrabian & Russell, 1974), a research framework is derived to illustrate the focus and positioning of this thesis. The SOR model posits that stimuli within an actors' environment influence their cognitive and affective processes (organism), which in turn determine specific intentions and outcomes (Mehrabian & Russell, 1974). In the context of this thesis, input control represents the core "stimulus" in the research framework. Input control can be (objectively) manipulated by the platform provider (e.g., by changing rules or procedures for screening complementors and complements) and is (subjectively) perceived by complementors who have to consider these rules when submitting their complements for review. As such, the SOR model serves as an appropriate foundation to visualize and explain the connection between input control (i.e., stimulus), the affected mediation processes (i.e., organism), and respective intentions and outcomes (i.e., responses). Figure 1-2 provides an overview of the articles' main content embedded in the SOR model.

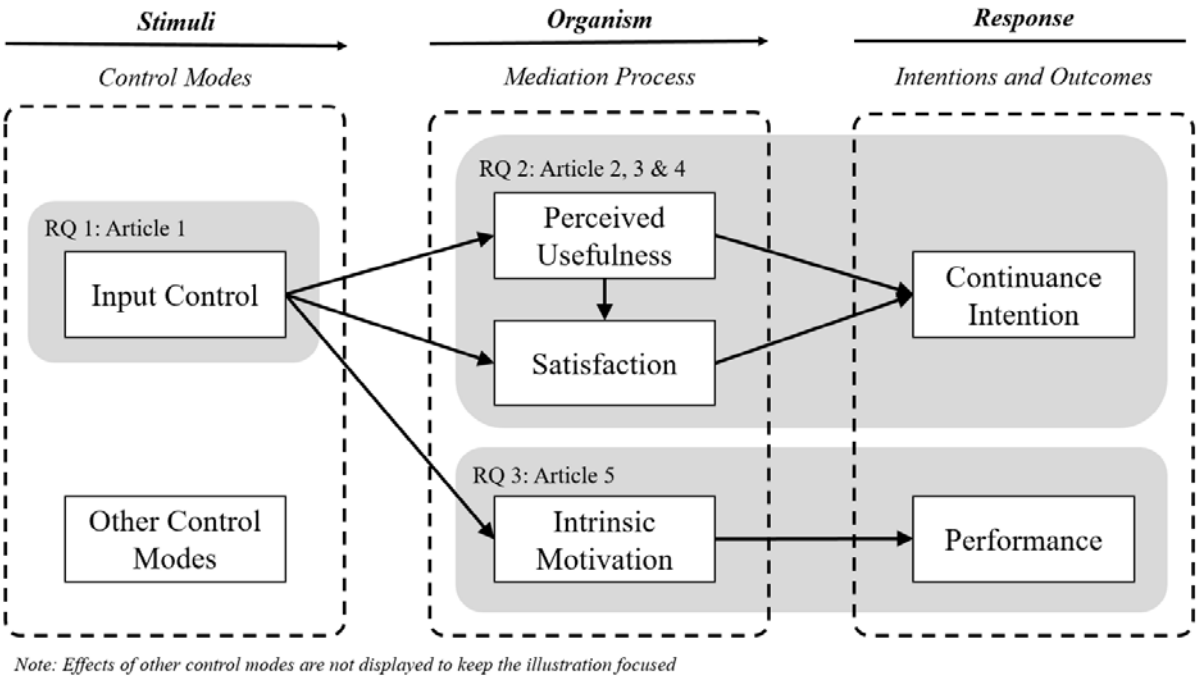

Figure 1-2: Research Framework

In summary, the first article describes how input control is conceptualized and can be measured in the context of digital platforms. The articles 2, 3 and 4 investigate the effect of input control on complementors' perceived usefulness, satisfaction and their subsequent continuance intention in different platform contexts. The final article is concerned with the effect of input

control on complementors' performance with a focus on the mediating role of complementors' intrinsic motivation.

In addressing the research questions, I want to contribute to the literature centered around IS control on digital platforms by theoretically conceptualizing input control as a viable formal mechanism to govern the relationship between platform providers and complementors. Furthermore, I aim to advance nascent research on digital platforms by highlighting that changing input control practices can have far-reaching and profound effects on complementors and thereby on entire digital platform ecosystem. As such, this thesis is part of the broader umbrella of emerging research examining the success and sustainability of digital platforms.

1.4 Thesis Structure and Synopses

This thesis is organized into eight chapters. The introductory chapter motivates the research questions and outlines the theoretical foundations. To address the overarching research questions, six studies were conducted and published in peer-reviewed IS outlets across five research articles. These articles constitute chapters 2 to 6 with slight deviations from the originally published version in order to ensure a consistent layout throughout the thesis. The final chapter summarizes the main theoretical and practical contributions and provides directions for future research. All articles of this thesis are conducted as part of a project funded by the *Deutsche Forschungsgemeinschaft (DFG)* called "Input-Kontrollpraktiken und ihre Implikationen für Software Plattform Ökosysteme (OpenEco)" (project number: 321298175, https://gepris.dfg.de/gepris/projekt/321298175). Table 1-2 provides an overview of the chapters and articles.

Chapter 2 Article 1	**Perceived Input Control – Scale Development** Croitor, E., Benlian, A. (2019): "Perceived Input Control on Online Platforms from the Application Developer Perspective: Conceptualization and Scale Development", *Journal of Decision Systems*, 28 (1), 19-40. **VHB: B**
Chapter 3 Article 2	**Perceived Input Control on Web-Browser Platforms** Croitor, E., Adam, M., Benlian, A. (2020): "Perceived Input Control on Digital Platforms: A Mixed-Methods Investigation of Web-Browser Platforms", *Journal of Decision Systems*, 30 (1), 47-68. **VHB: B**
Chapter 4 Article 3	**Control Modes on Crowdfunding Platforms** Croitor, E., Werner, D., Benlian, A. (2021): "The Effects of Control Mechanisms on Complementors' Behavioral Intentions: An Empirical Study of Reward-Based Crowdfunding Platforms", *Hawaii International Conference on System Sciences*, January 5-8, A Digital Conference. **VHB: C**

Chapter 5 Article 4	**Control Modes on E-Marketplace Platforms** Croitor, E., Werner, D., Adam, M., Benlian, A. (2021): "Opposing Effects of Input Control and Clan Control for Sellers on E-Marketplace Platforms", *Electronic Markets*, forthcoming. **VHB: B**
Chapter 6 Article 5	**Perceived Input Control on Amazon** Croitor, E., Werner, D. (2021): "Exploring the Relationship between Perceived Input Control and Complementors' Perceived Performance: An Empirical Study on Amazon", *European Conference on Information Systems*, June 14-16, A Virtual AIS Conference. **VHB: B**

Table 1-2: Overview of the Chapters and Articles

In the following, each of the five articles is summarized and the main findings and contributions to the research questions are presented. These articles use the first-person plural point of view (i.e., 'we'), as multiple authors were involved in their creation.

Article 1 – Chapter 2: Perceived Input Control – Scale Development

Even though IS scholars have repeatedly pointed to the importance of studying complement screening, vetting and gatekeeping practices in the context of digital platforms (Tiwana, 2015a; Tiwana et al., 2010), research on input control and how it is conceptualized and measured is conspicuously absent. Article 1 (Chapter 2) describes the development of an enhanced conceptual definition for input control and a corresponding measurement scale for questionnaire-based survey research that helps us measure input control more accurately and gauge its impact on platform complementors, end-users and platform ecosystems overall. The construct definition and the corresponding measurement items of input control were rigorously developed based on qualitative (i.e., exploratory, open-ended interviews with subject matter experts) and quantitative (i.e., card sorting procedures, pretest survey, main survey) research methods. All of these methods and procedures were conducted based on the rigorous guidelines and recommendations in extant scale development literature (MacKenzie et al., 2011). The convergent, discriminant and nomological validity of the scale was validated in the context of mobile application platforms (i.e., Android and iOS). This study therefore contributes to answering the first research question (*RQ1*) of this thesis on how perceived input control is conceptualized and measured on digital platforms.

Article 2 – Chapter 3: Perceived Input Control on Web-Browser Platforms

With the second article (Chapter 3) we aim to contribute to answering the second research question (*RQ2*) on how and why complementors' perception of input control affects their continuance intentions. Using a sequential mixed-methods approach (i.e., combination of a quantitative and a qualitative method) we conducted two studies in the context of web-browser platforms (i.e., Chrome and Firefox). We first conducted an online survey with 114

complementors to investigate hypothesized relationships, then we conducted semi-structured interviews with 22 additional complementors to confirm and complement the formerly found relationships. Both studies provide consistent support for the assertion that input control negatively affects complementors' continuance intentions and that perceived usefulness and satisfaction mediate these effects. Furthermore, the results indicated that perception of both complementor-related (i.e., control of complementor) and complement-related (i.e., control of complement) input control affect complementors' overall perceived input control.

Article 3 – Chapter 4: Control Modes on Crowdfunding Platforms

Given the importance of examining input control not just in isolation but also in combination with other control modes, article 3 (Chapter 4) provides insights on the effects of input control and self control on complementors' crucial behavioral outcomes (i.e., continuance and switching intention). Drawing on IS control literature and goal attainment theory, we conducted an online survey with 116 complementors from two major reward-based crowdfunding platforms (i.e., Kickstarter and Indiegogo). Our findings reveal that input control decreases and self control increases complementors' intention to stay on their respective digital platform. Furthermore, we shed light on the role of complementors' perceived effort, perceived usefulness and satisfaction in shaping these relationships. Therefore, our third study contributes to the second research question (*RQ2*) by revealing the underlying explanatory mechanisms of why the effects of input control on complementors' continuance intentions occur.

Article 4 – Chapter 5: Control Modes on E-Marketplace Platforms

With article 4 (Chapter 5) we continue the investigation of the effects of input control in combination with other control modes by including clan control into our research framework (see Table 1-1). Results of a field survey with 471 complementors in the context of e-marketplace platforms (i.e., Amazon and Etsy) revealed that input control had a negative effect on complementors' perceived usefulness, satisfaction, and continuance intentions, whereas positive effects were observed with clan control. Furthermore, we found that intrinsic motivation mediates the observed direct effects. As such, this article contributes to answering the second overarching research question (*R2*) by showing how and why input control affects complementors' continuance intentions with high external validity.

Article 5 – Chapter 6: Perceived Input Control on Amazon

The study presented in the last article (Chapter 6) of the thesis is concerned with the effects of complementors' perception of input control on their performance while focusing on the mediating role of intrinsic motivation. As previous research indicated that input control can lead to both positive and negative reactions of complementors (Tiwana, 2015a; Wessel et al.,

2017), it was unclear whether input control actually enhances or impairs complementors' performance. Drawing on IS control literature and self-determination theory, we conducted an online survey with 286 sellers on Amazon to analyze the relationship between input control and complementors' performance. Results of our study demonstrate that intrinsic motivation mediates the effect of input control on complementors' performance. Furthermore, our results surprisingly revealed that input control has no direct effect on complementors' performance when accounting for intrinsic motivation. This study therefore contributes to answering the third research question (*RQ3*) on how and why complementors' perception of input control affects their performance on digital platforms.

Additional Articles (not included in the thesis):

In addition to the publications listed above, the following articles were also published or submitted for publication during my time as a Ph.D. candidate. These articles, however, are not part of the thesis:

- Croitor, E., Werner, D., Adam, M., Benlian, A. (2021): "Unravelling the Relationship between Perceived Input Control and Intention to Join", *Information Systems Journal*, second round of review. **VHB: A**
- Werner, D., Croitor, E., Röthke, K., Adam, M. (2021): "Affording Users Active Control on the Quantity of Ads on Websites – A Randomized Field Experiment", *International Conference on Information Systems*, December 12-15, Austin, US, under review. **VHB: A**
- Franz, A., Croitor, E. (2021): "Who Bites the Hook? The Moderating Effect of Users' Social Networking Site Use: A Randomized Field Experiment", *European Conference on Information Systems*, June 14-16, A Virtual AIS Conference. **VHB: B**
- Croitor, E., Adam, M. (2020): "Perceived Input Control on Digital Platforms: an Empirical Investigation", *European Conference on Information Systems*, June 15-17, A Virtual AIS Conference.* **VHB: B**
- Grupp, T., Wallbach, S., Croitor, E. (2020): "The Role of Resistance to Change in Software Updates' Impact on Information Systems Continuance", *European Conference on Information Systems*, June 15-17, A Virtual AIS Conference.* **VHB: B**
- Croitor, E. (2018): "Developing an Instrument to Measure Perceived Input Control on Online Platforms from the App Developer Perspective", *European Conference on Information Systems*, June 23-28, Portsmouth, UK. **VHB: B**

* These research articles were nominated for a best paper award.

Chapter 2: Perceived Input Control - Scale Development

Title: Perceived Input Control on Online Platforms from the Application Developer Perspective: Conceptualization and Scale Development (2019)

Authors: Evgheni Croitor, Technical University of Darmstadt, Germany

Alexander Benlian, Technical University of Darmstadt, Germany

Published in: Journal of Decision Systems, 28 (1), 19-40.

Abstract

Over the last decade, complements of third-party complementors have increasingly become the cornerstone of platform ecosystems' success and sustainability. Given their importance, the procedures and practices used on platforms to screen and sort out complementors and their complements are crucial in regulating platform governance. Although Information Systems (IS) research has paid considerable attention to traditional control modes and how they are applied on digital platforms, there is still a lack of research on input control and how it is conceptualized and measured from the complementors' perspective. Drawing on established scale development methodologies, we conceptualize perceived input control (PIC) as a second-order construct and empirically refine it over several rounds of validation concluding with a web-based survey of mobile application developers (N=100). Our measurement instrument not only captures complementors' overall perceptions of input control across different platform contexts, but also breaks these perceptions down into distinct lower-level input control factors. Furthermore, we demonstrate PIC's nomological validity in the context of IS continuance research. Overall, our study contributes to a more comprehensive understanding of platform-specific input control mechanisms in particular and platform governance in general. Implications for further research and practice are discussed.

Keywords: Input Control, Scale Development, Digital Platforms, Continuance Intention, Platform Openness

2.1 Introduction

During the past decade, digital platforms (e.g., Steam, Amazon, Airbnb, Kickstarter, Android) and their corresponding ecosystems have fundamentally changed the way products and services are developed, distributed, and maintained (Gawer & Henderson, 2007; Jansen et al., 2009). Platform providers deliberately open up their ecosystems and enable complementors to provide complements (e.g., games, products, apartments, campaigns, mobile apps) to the platform (Boudreau, 2012; Thies et al., 2016). Enabling access to complementors increases platforms' ingenuity, innovative capacity and skills (Ceccagnoli et al., 2012) and allows them to respond more rapidly to changing markets and customer needs (Boudreau & Lakhani, 2009). A digital platform is thereby defined as a multisided market that enables interactions between complementors and end-users (e.g., suppliers and buyers) (Koh & Fichman, 2014). More broadly, the term platform ecosystem refers to the platform and all stakeholders interacting on the platform (Gawer & Cusumano, 2014).

A particularly critical interaction between complementors and a platform is the ongoing supply of numerous complements that are supposed to attract end-users to the platform to foment positive cross-side network effects (Boudreau, 2012). In order to maintain platform prosperity and health, a key challenge for platform providers is to align and balance the numerous and diverse goals and behaviors of complementors with the platform's strategies. Constantly attracting new complementors or avoiding that existing ones switch to rival platforms are important objectives for the platform's long-term viability and success (Benlian et al., 2015). Failing to lure new complementors may lead to the demise of a platform, as witnessed with platforms such as Nokia or Blackberry that missed among other problems to create and manage a persistent pipeline of high-quality complements (Tiwana, 2014). Against this backdrop, platform providers are well advised to nurture and shape a platform ecosystem that encourages complementors to keep contributing innovative, useful and high-quality complements to the platform.

Control modes that help coordinate interactions between the various stakeholders on platforms are a central building block of platform governance, and platform providers exercise various forms of formal and informal control to influence behaviors and performance outcomes of complementors (Tiwana et al., 2010). Traditional control modes (i.e., behavior, output, self, and clan control) have been extensively studied in different contexts such as IT projects, IT outsourcing, and on software platforms (Goldbach et al., 2018; Manikas, 2016), and have provided valuable findings. However, research on input control and how it is *conceptualize* and measured is conspicuously absent, even though IS scholars have repeatedly pointed to the

importance of studying complement screening, vetting and gatekeeping practices in the context of digital platforms and how they affect complementors (Tiwana, 2015a; Tiwana et al., 2010). Indeed, despite input control's apparent importance, the complementors' perspective has been widely neglected in previous approaches that investigated input control (Tiwana, 2015a; Wiener et al., 2016). In fact, to date, there has been no systematically developed measurement instrument for complementors' perceptions of input control mechanisms on digital platforms (Goldbach et al., 2018; Tiwana, 2015a).

Given these calls for research and the research gap identified above, this paper aims to contribute to a richer understanding of complementors' perceptions of input control and how they relate to important individual downstream factors, in particular complementors' intention to keep contributing to a platform. Hence, we ask the following research question:

RQ: What is the conceptual definition of perceived input control and how can it be measured?

The remainder of this paper is organized as follows: The following section presents the theoretical background and related IS literature on control modes. Next, we describe our scale development process and the specific procedures we employed to develop and validate the Perceived Input Control (PIC) measurement instrument. Finally, we discuss our study's contributions, implications, and limitations, and avenues for future research.

2.2 Theoretical Background

Since control is one of the core building blocks of platform governance, several control modes are currently applied by platform providers (Tiwana et al., 2010). We define control as a controller's attempts to influence a controlees behavior according to the controller's goals (Ouchi, 1979). Two main categories of control modes are distinguished in prior literature, which are formal and informal modes of control (Kirsch, 1997). Formal control is further differentiated into behavior and output control. In terms of output control, output requirements and performance targets are pre-specified as objectives, which are then monitored, evaluated and rewarded accordingly. By contrast, under behavior control, no specific outcomes are pre-determined and specific procedures and methodologies must be followed instead.

Informal control is classified into self control and clan control (Bergvall-Kåreborn & Howcroft, 2011). With self control, controllers encourage individuals to set their own goals and self-regulate their activities and outcomes in achieving these goals (Henderson & Lee, 1992). In regard to clan control, members of a group commit themselves to mutual beliefs and goals and therefore commonly tend to engage in similar behaviors and produce similar outcomes, based on shared values and norms (Kirsch et al., 2010). Informal control modes are especially relevant when desired outcomes and behaviors are unknown or difficult to monitor (Chua et al., 2012).

Both formal and informal control modes (and their combinations) have been widely studied in IS research and have been proven to be effective governance mechanisms to coordinate the controller-controlee relationship in classical IS contexts (Chua et al., 2012; Gregory et al., 2013; Roberts et al., 2006). The emergence of digital platform ecosystems has brought fundamental changes to the classical controller-controlee relationship and has made the applicability of classical and well-studied control modes (i.e., behavior, output, and clan control) rather difficult and less useful in environments with high environmental uncertainty (Snell, 1992; Tiwana, 2015a). First, output control, which is the predominant control mode in traditional IT outsourcing, is redundant and unnecessary on digital platforms because the end-user market typically judges winners and losers (e.g., end-users reject low-quality applications). Moreover, the myriad of complements offered on a platform makes output control and assessment (e.g., via key performance indicators) prohibitively costly. Second, behavior control is impractical because of the sheer complexity in monitoring and steering the behavior of thousands of complementors. Moreover, behavior control is well known for its stifling effect on creativity, which is particularly detrimental on digital platforms that heavily rely on the expertise and ingenuity of their complementor communities (Benlian et al., 2015). Finally, deploying clan control requires large orchestration efforts, time and a relatively stable complementor community ─ prerequisites that are challenging to satisfy in digital platform ecosystems usually having highly dynamic and continuously evolving boundaries (Tiwana, 2014).

Given the limited practicability of traditional control modes on digital platforms, platform providers often switch to an alternative formal control mode that is widespread in practice but has been largely overlooked in IS research so far: input control. Input control on digital platforms is a form of formal control or “gatekeeping” that regulates which complements are allowed into a platform ecosystem and which ones are rejected. Input control usually involves formal application and selection processes (Cardinal et al., 2017; Cardinal et al., 2004). Manipulation of input control can have far-reaching and profound effects on the entire ecosystem, given that opening or closing access an ecosystem has a direct impact on the amount and quality of complements entering the ecosystem and thus on the attractiveness of a platform’s profile and offering to platform end-users (Thies et al., 2018; Wessel et al., 2017). Strong changes in input control may even have the potential to unbalance an entire platform ecosystem as well as transform its character, as too liberal input control may lead to coordination failures and quality issues, while too stringent input control may thwart diversity and innovation in an ecosystem (de Reuver & Bouwman, 2012).

Despite the popularity of input control mechanisms in practice and their fundamental implications for platform ecosystems and key actors, it is surprising that research on input control is still in its infancy (Tiwana, 2015a; Tiwana et al., 2010). In the previous IS research, input control has sometimes been referred implicitly without being acknowledged theoretically as such. For example, Choudhury and Sabherwal (2003) point to the importance of assessing the quality delivered by information technology vendors as well as vendors' project staffing choices. The large neglect of input control in IS research is, however, likely because it was not as visibly observed in traditional IT (outsourcing/offshoring) projects as it is in platform settings. Only scant literature in management and organizational research has investigated input control explicitly but used inconsistent terminology and various definitions to refer to screening (Sah & Stiglitz, 1986), selection of employees from an applicant pool (Snell, 1992), and bouncer rights (Boudreau, 2010). Recent studies in platform ecosystems have started to examine input control amongst other control modes and provided largely anecdotal and qualitative insights. For example, the relationship between control and boundary resources on Apple's iPhone platform was extensively investigated (Eaton et al., 2015; Ghazawneh & Henfridsson, 2013). In addition, the tension between control and autonomy in a business software ecosystem was explored (Wareham et al., 2014). Based on results of our literature review, there is only minimal research that has brought input control and its effects to the forefront of its investigations (Boudreau, 2012; Tiwana, 2015a). Despite these valuable initial efforts, however, the nature (i.e., conceptualization) of input control in platform ecosystems remained rather vague and its measurement inconsistent.

In summary, recent IS research has largely neglected input control and those few studies that have looked at it have examined input control based on an undifferentiated and high-level conceptualization (Thies et al., 2018; Tiwana, 2015a) without shedding light on the core practices that constitute input control. This lack of a clear and substantial conceptualization calls for the development of a deeper theoretical foundation of input control. Besides rather global and relatively lean approaches to conceptualize and measure input control (e.g., Tiwana, 2015a), previous research has largely focused on the macro (i.e., platform) level of analysis to study the implications of input control (e.g., Thies et al., 2018; Wessel et al., 2017), but neglected a more nuanced analysis that captures the micro (i.e., individual) perspective of platform complementors who are directly affected by input control.

Despite recent calls for investigating the relationship between input control and complementors' attitudes and behaviors and for identifying effective input control mechanisms used by platform providers (Benlian et al., 2015; Eaton et al., 2015; Hilkert et al., 2011), almost

no studies have empirically and systematically explored the nature and implications of different input control mechanisms in platform ecosystems. In order to fill this research gap, we aim to develop a construct and measurement instrument that should not only provide a consistent conceptualization and definition of input control, but should also precisely capture complementors' general and more specific perceptions of input control. A common understanding and consistent measurement of perceived input control will ultimately help future research and practitioners better accumulate and consolidate knowledge about input control mechanisms and their implications for complementors and platforms overall.

2.3 Construct Development and Research Design

The primary objective of this study is to systematically and rigorously develop and validate a scale for perceived input control (PIC). Several approaches in developing scales have been proposed in IS research (Boudreau et al., 2001; MacKenzie et al., 2011; Moore & Benbasat, 1991; Segars, 1997). Following these guidelines, we conducted five steps to create an instrument to measure PIC. Figure 2-1 summarizes the main steps in the scale development and validation process.

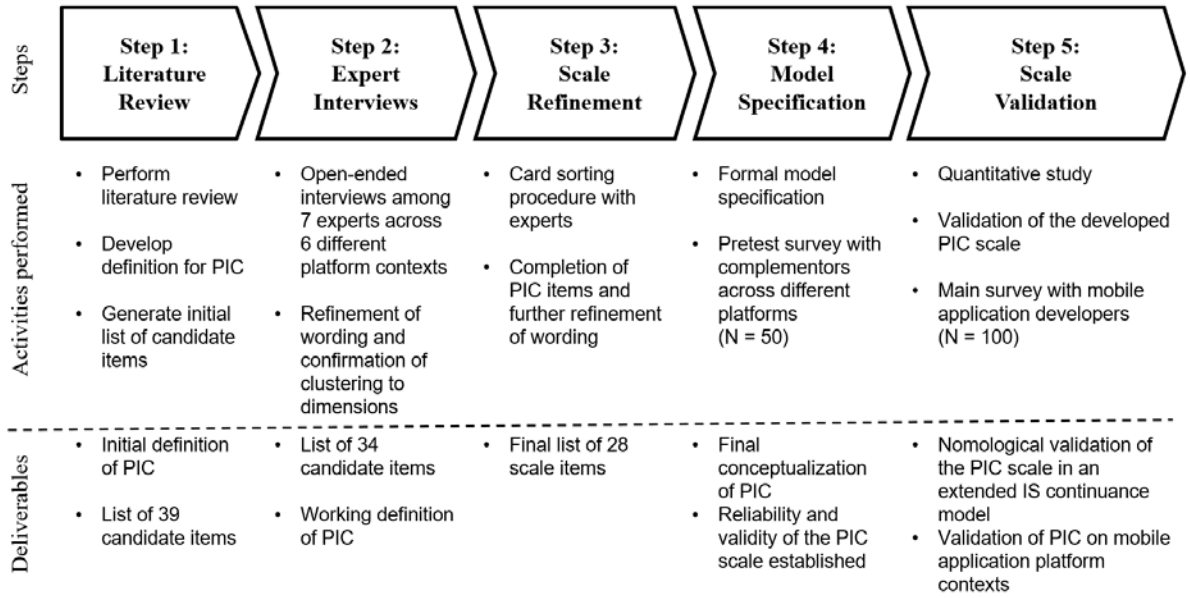

Figure 2-1: Overview of the Scale Development Process for Perceived Input Control

In the first step, we performed a structured literature review and developed an initial working definition of PIC. Based on these results, we generated an initial list of candidate items. Second, we conducted expert interviews to purify and revise our list of items. A card-sorting method was performed to evaluate content validity and to refine the scale items. Fourth, we formally specified the measurement model and conducted a pretest survey across different platform contexts (i.e., mobile applications, web-browsers, gaming platforms, and crowdfunding) to

evaluate the defined construct structure, as well as the construct's convergent and discriminant validity. In our final step, we administered a main survey to mobile application developers and validated the PIC scale in an extended nomological network of IS continuance (Bhattacherjee, 2001).

2.3.1 Literature Review

We started the scale development process by conducting a systematic literature review (Webster & Watson, 2002) on input control and subsequently developed an initial list of scale items based on previous literature. In doing so, we followed the extant guidelines that have been presented in previous IS research (Boell & Cecez-Kecmanovic, 2015; Brocke et al., 2015; Okoli & Schabram, 2010).

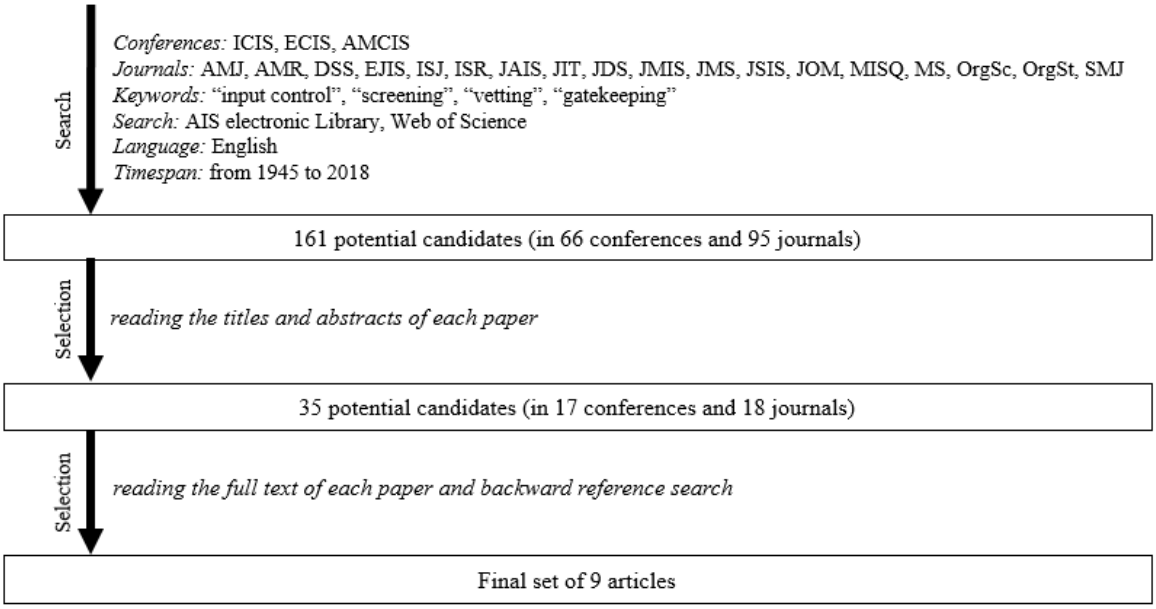

Figure 2-2: Search and Selection Process

At the outset of our literature search, we included 18 highly-ranked IS and management journals (including the Senior Scholars' Basket of IS Journals) and proceedings of leading IS conferences (i.e., ICIS, ECIS and AMCIS) (see Figure 2-2). We used Web of Science and the AIS eLibrary to conduct the literature review and applied keyword search using different combinations of related search terms such as "input control", "screening", "vetting" and "gatekeeping" (journal title abbreviations and exact search strings are provided in Table A3 and A4 of the Appendix). Our search was constrained to articles written in English between 1945 and 2018. As a result, an initial pool of 161 search results was found. The main selection process was split into two phases. After reading the titles and abstracts of each article in the first phase, we determined 126 irrelevant articles and excluded them from the initial pool. In the second phase, we assessed the remaining 35 articles by reading the main content of the papers. We

screened the resulting papers to keep only those that mentioned the term "Input Control" within the context of gatekeeping and screening process. Additionally, we performed a backward reference search for relevant articles to identify other important documents. In doing so, we identified ten definitions of input control in nine articles (see Table 2-1).

Discipline	**Definition**	**Author**
Platform Ecosystems	*"We define input control as the degree to which a platform owner adjudicates allowing revisions of an extension into the ecosystem."*	Tiwana (2015a)
	"Formal control intended by the platform owner to regulate inputs into the ecosystem."	Tiwana (2015a)
	"Gatekeeping represents the degree to which the platform owner uses predefined objective acceptance criteria for judging what apps and app developers are allowed into a platform's ecosystem."	Tiwana (2014)
Project Organization	*"Managing the resources that are used as inputs to project activities."*	Wiener et al. (2017)
	"Mode of formal control that refers to the allocation and manipulation of human, financial, and material project resources."	Jaworski (1988)
	"Input controls refer to the management of materials and human resources."	Vlasic and Yetton (2004)
	"Input control is the use of control mechanisms to manage resources acquired by the firm; it focuses on human, material, and financial resources flowing into the firm."	Cardinal et al. (2004)
	"Input control is seen as the control of a task through resources and other inputs, including selection and recruitment of personnel in relation to this task."	Mähring (2002)
Human Resources	*"Input control system seek to control the selection and training process of an employee."*	Krausert (2009)
	"Input Control regulates the antecedent conditions of performance - the knowledge, skills, abilities, values and motives of employees."	Snell (1992)

Table 2-1: Conceptual Definitions of Input Control Identified in the Literature Review

The next step of the literature review was to extract existing definitions of input control, as well as items measuring input control (if available). The definition of input control appeared mostly in the field of project organization and human resources. Only a few articles included platform-related definitions of input control (i.e., Tiwana, 2015a). However, these articles transferred and adapted items from other organizational contexts (Cardinal et al., 2004) but did not engage in a thorough and rigorous scale development process in the context of digital platforms.

Based on our literature review and following recommendations (Rossiter, 2002) on conceptualizing constructs by specifying the attribute of interest, the focal object and the rater entity. We consider the attribute of interest (i.e., input control), the focal object (i.e., digital platforms), and the rater entity (i.e., complementors) to define perceived input control as follows:

Perceived input control (PIC) is defined as complementors' perception of the degree to which a platform provider uses gatekeeping and screening procedures to allow complementors and their complements to enter a digital platform.

Based on this definition of PIC, along with the principles of creating new construct items in the scale development literature (DeVellis, 2012; MacKenzie et al., 2011), we collected, modified, and generated a total of 39 initial items measuring PIC as a candidate pool for future refinements. In particular, these items were used as a starting point for conducting expert interviews, which will be discussed in the next section.

2.3.2 Expert Interviews

Combining expert interviews with a systematic literature review is a recommended method to create an initial set of candidate items (Churchill, 1979). The use of these methods is assumed to generate a list of candidate items with a relatively high degree of content validity (Moore & Benbasat, 1991). For this reason, and to help identify underlying dimensions and to explore general perceptions of PIC, we performed open-ended expert interviews based on the literature review results of the first step.

The criteria to choose our interview partners were led by the goal to cover as many different types of digital platforms as possible. Therefore, we drew on a convenience sample and interviewed a mobile application developer (i.e., Android, iOS), a game developer (i.e., Steam), a video producer (i.e., YouTube, MyVideo), two online merchants (i.e., Amazon), a web-browser extension developer (i.e., Chrome, Firefox), and a campaign creator for a social project (i.e., Betterplace.org, GoFundMe). Five of the interviews were conducted face-to-face and the remaining two by phone. All interview partners had less than two years of experience with corresponding digital platforms, which was an important criterion for our interviews. The interviewees were asked to describe their personal experience of submitting their first and last complement to a digital platform. Applying open-ended interviews including think-aloud techniques enabled us to see perspectives we had not considered before and ensured us to dig deep into the target domain until we reached a satisfactory point of saturation, where the benefit of conducting further interviews was deemed marginal (Bogner et al., 2009; Hoffmann, 2007).

As a notable result, the interviews revealed that all interviewees had to undergo a more or less extensive online registration process on the platform before being able to submit their complement. Although most platforms had only low requirements for the registration, some of them had a time-consuming screening process (e.g., Amazon, Steam). Moreover, the creator of a social campaign failed to complete registration on several donation-based crowdfunding platforms due to burdensome complementor-related regulatory requirements. These findings motivated us to divide PIC on platforms into two distinct categories. The first category is related to the complementor-related screening process that usually has to be completed only once and includes complementors' registration and authentication on the platform, as well as all corresponding actions (i.e., paying registration fee, providing required licenses, certificates and additional accounts). The second category refers to vetting and gatekeeping processes related to complement itself and has to be repeated for each complement submitted to the platform. This phase involves fulfilling all complement-related requirements, which are imposed by the platform provider (i.e., paying submission fee, complying with copyright, performance, and security standards). Expert interviews also helped us to identify four major facets or dimensions of PIC, which are common across all platform contexts for both categories of the screening process. The resulting facets and examples for facets of PIC that emerged in the expert interviews are presented in Table 2-2.

Facets of PIC	**Complementor**	**Complement**
Financial Barrier (FB)	Complementor Registration Fee	Complement Submission Fee
Regulatory Requirements (RR)	License, Certificate	Copyright, Privacy, Safety
Technical Requirements (TR)	Bank Account, Email	Performance, Design, Security
Temporal Expenditure (TE)	Authentication Time	Complement Review Time

Table 2-2: Facets of Perceived Input Control

Considering the outcomes of the expert interviews, we revised our initial item pool and adapted them to the two phases of input control. In doing so, we developed preliminary items that comprehensively capture the most essential aspects of PIC from a complementors' perspective. For each facet of PIC, we generated 3-5 items. Additionally, following previous scale development studies (e.g., Barki et al., 2007; Benlian et al., 2015), we derived additional 5 items for complementors' overall perception of input control (OP), because overall perceptions of a multi-dimensional construct allows capturing a phenomenon on a higher level of conceptualization. A list of 34 items in total was taken over to the scale refinement procedure, which will be described in the next section.

2.3.3 Scale Refinement

To evaluate content validity (McKenzie et al., 1999) of the initial set of items and to refine our PIC scale, two rounds of card sorting were performed (Anderson & Gerbing, 1991; Hinkin, 1998). We chose a card sorting procedure because this approach seems to be most appropriate to show that (1) the individual item is representative of an aspect of the content domain of the construct and (2) the items as a set are collectively representative of the entire content domain of the construct (Hinkin, 1995; MacKenzie et al., 2011). Furthermore, we selected two inter-rater agreement measures, Cohen's Kappa (Cohen, 1960) and the item placement ratio to assess the reliability of the sorting process and the content validity of candidate items (Moore & Benbasat, 1991).

Target Categories			**Theoretical Categories**								
			Complementor				Complement				OP
			FB	RR	TR	TE	FB	RR	TR	TE	
Actual Categories	Complementor	FB	31/40	1/1	1/-	1/-	3/-	-/-	-/-	-/-	-/-
		RR	-/-	54/27	-/-	6/2	-/-	3/4	-/-	-/-	11/2
		TR	-/-	1/1	16/19	-/-	-/-	-/1	1/-	-/-	-/3
		TE	2/-	3/1	-/-	31/26	-/-	-/1	-/-	6/1	1/7
	Complement	FB	2/-	-/-	-/-	-/-	15/19	-/-	-/-	-/-	-/-
		RR	-/-	-/2	-/-	-/-	-/-	17/23	8/8	1/2	5/1
		TR	-/-	-/-	1/1	-/-	-/-	6/1	16/34	-/-	3/-
		TE	-/-	-/-	-/-	2/1	-/-	-/-	-/4	9/15	1/1
	OP		1/-	11/3	-/-	5/1	-/-	1/-	-/4	2/1	24/28
	N/A		-/-	2/5	-/-	-/-	-/-	-/-	2/-	-/-	-/-
Item Placement (total 306/290)			36/40	72/40	18/20	45/30	18/19	27/30	27/50	18/19	45/42
Hit-Ratio (avg. 0.69/0.82)			0.86/ 1.00	0.75/ 0.68	0.88/ 0.95	0.69/ 0.87	0.83/ 1.00	0.63/ 0.77	0.59/ 0.68	0.50/ 0.79	0.53/ 0.66

Table 2-3: Results of Both Rounds of the Card Sorting Exercise

In the first round of the card sorting exercise, six doctoral students and three student assistants with experience in the subject matter were recruited to participate. Prior to the procedure, necessary instructions and categories were explained to all judges. They were encouraged to ask questions, if any instruction or the meaning of the dimension was unclear. Then, these judges were asked to assign each of the 34 items to exactly one of the nine predefined categories. Additionally, we included an N/A category in the sorting procedure to identify confusing and ambiguous items. The results of item placements for each PIC dimension in the first round are depicted in Table 2-3. The average placement ratio of the items within the target dimension was 0.69, indicating a need for further item refinement and an additional round of

card sorting. Thus, we removed 5 items and rephrased 12 items with low hit-ratio values. Finally, a list of 29 items was retained for the second round of the card sorting procedure.

We conducted the second round of card sorting using an online card-sorting tool called "Optimal Workshop". For this round, we invited a completely new set of knowledgeable judges consisting of three post-doctoral students and seven doctoral students. Similar to the first round, all instructions and categories were explained within the card-sorting tool. Participants had the opportunity to assign 29 items to nine predefined categories by using drag-and-drop features. The average hit ratio of 0.82 was above the recommended threshold of 0.80 (Cenfetelli et al., 2008; Moore & Benbasat, 1991), suggesting that the candidate items were generally assigned to the intended category. Furthermore, the results of the inter-rater agreement measures revealed scores between 0.61 and 0.87. We considered an average Cohen's kappa of 0.71 to be acceptable, since a commonly used threshold value for kappa is 0.70 (Boudreau et al., 2001) and kappa statistics between 0.61 and 0.87 indicate substantially strong inter-rater agreement scores (Landis & Koch, 1977). Overall, these results suggested high content validity that led us to proceed in our scale development process. However, based on the results of the second round of card sorting and feedback of the raters, we eliminated one ambiguous item and slightly modified six additional items. The final list of 28 scale items is presented in Table A1 of the Appendix.

2.3.4 Model Specification and Pretest

In the next step of our scale development process, several tasks were performed. First, we determined the conceptual structure of PIC in terms of construct specification. After the formal specification of the measurement model, a pretest survey was conducted to collect data for subsequent model validation (MacKenzie et al., 2011). Finally, we assessed the measurement model of PIC by examining discriminant validity, multicollinearity, item loadings, internal consistency, and convergent validity.

We formally specified the measurement model of PIC following the guidelines by MacKenzie et al. (2011). Giving the hierarchical conceptual nature of PIC as described in section 2.3.2., we had to define the causal relationship (which can be either reflective or formative) between the 28 indicators, the eight sub-dimensions, and the focal construct (PIC). The overall structure and corresponding relationships among the constructs were determined by applying extant recommendations in the methodological literature (Jarvis et al., 2003; Petter et al., 2007). Since our eight sub-dimensions are conceptually distinct categories (a change within complementor-related financial barrier, for instance, is not associated with a change in complement-related technical requirements), we can assume that the eight sub-dimensions are formative indicators

of the PIC construct. Regarding the relationship between the eight sub-dimensions of PIC and their individual underlying facets, our decision to use the reflective indicator specification (over formative indicator) for the first-order construct is consistent with several criteria recommended for choosing that specification (e.g., dropping indicator does not change the meaning of construct). This approach for conceptualization of multidimensional constructs is consistent with previous studies in IS research (Benlian et al., 2011; Polites et al., 2012). Taken together, the resulting suggested structure of PIC is equivalent to a reflective first-order, formative second-order (Type II/Panel D) model (Jarvis et al., 2003; MacKenzie et al., 2011). After the formal specification of the measurement model, we conducted a pretest to evaluate the scale's convergent and discriminant validity (MacKenzie et al., 2011).

The data to assess the proposed conceptualization was gathered through an online survey among complementors across several platform contexts (i.e., Steam, Android, Amazon, and Kickstarter). The questionnaire included the 28 PIC items that survived the card sorting exercise (see Table A1 in the Appendix). All items were measured on a seven-point Likert-type scale from 1 ("strongly disagree") to 7 ("strongly agree"). We also integrated attention check items to ensure high sample quality. The invitation to participate in this study was sent to about 1,087 complementors by email. Consistent with previous research, the email addresses were gathered from different platform forums (e.g., Benlian et al., 2011). We explained the purpose of our study on the survey's start page and ensured anonymity and confidentiality of the response data. Participation was encouraged by raffling off Amazon vouchers with a total value of 150 Euro. As a result, a sample of 50 valid responses was obtained for our pretest, resulting in a response rate of 4.6%, which is within the range of studies with comparable settings (Benlian et al., 2015; Goldbach et al., 2018). While the sample size was clearly at the lower end of recommended threshold values in structural equation modelling (Christopher Westland, 2010; Hair et al., 2016), our main goal of this pretest was to validate the inner structure of PIC's measurement model (MacKenzie et al., 2011).

We performed the analysis by conducting a confirmatory factor analysis (CFA) in IBM AMOS (version 25) to evaluate hypothesized model and to ascertain the convergent and discriminant validity of our measurement model. Figure 3-3 depicts the results of the CFA with 28 observed and 9 latent variables. The psychometric properties of the measurement model were verified following the guidelines by Fornell and Larcker (1981). More specifically, we evaluated discriminant validity, multicollinearity, item loadings, internal consistency, and convergent validity. We compared the squared roots of average variance extracted (AVE) for each construct with all correlations between all other constructs. Table 2-4 lists the correlation matrix, with

square roots of the AVE on the diagonal. As a result, each construct fulfilled the Fornell-Larcker criterion, concluding that all constructs are sufficiently discriminant. Additionally, we measured variance inflation factors (VIF) to assess the level of multicollinearity. Resulting VIF values were lower than the common threshold of 5.00 (Gefen et al., 2011; Hair et al., 2009) implying no multicollinearity problems.

All item loadings were significant ($p < 0.001$) and above the threshold value of 0.70. The values of composite reliability (CR) exceeded the threshold of 0.80. For the second-order latent construct with first-order sub-dimensions as formative indicators, the construct reliability for all dimensions can be assessed using Cronbach's Alpha (CA). The internal consistency of all reflective constructs clearly exceeded the threshold of 0.70, suggesting acceptable reliability. Overall, these results provide strong empirical support for construct reliability, convergent validity, and discriminant validity of our measurement model.

		Complementor				Complement				PIC	CR	CA	VIF
		FB	RR	TR	TE	FB	RR	TR	TE				
Complementor	FB	**0.987**									0.987	0.987	2.521
	RR	0.478	**0.950**								0.946	0.946	2.773
	TR	0.391	0.483	**0.866**							0.852	0.831	1.692
	TE	0.512	0.678	0.483	**0.942**						0.940	0.936	4.389
Complement	FB	0.714	0.593	0.455	0.599	**0.989**					0.989	0.989	4.534
	RR	0.270	0.591	0.149	0.503	0.461	**0.894**				0.894	0.873	1.802
	TR	0.414	0.473	0.346	0.220	0.528	0.334	**0.866**			0.831	0.834	1.910
	TE	0.448	0.580	0.312	0.752	0.749	0.491	0.455	**0.886**		0.876	0.860	4.617
PIC		0.689	0.590	0.338	0.615	0.785	0.518	0.537	0.737	**0.903**	0.925	0.925	-

Table 2-4: Correlation Matrix, Cronbach's Alpha, Composite Reliability and VIF

As presented in Figure 2-3, the model constructs explained 75% of the variance of the PIC construct. However, the results indicated that only complementor-related financial barrier ($\beta = 0.34$, $p < 0.01$) and complement-related time expenditure ($\beta = 0.35$, $p < 0.05$) had a strong and significant effect on PIC. The insignificant impact of the remaining sub-dimensions might be explained by the low sample size or a confluence of different platform contexts in our pretest sample. Despite the low and insignificant path coefficients of some sub-dimensions, we decided to retain these sub-dimensions because they added important content to the focal construct, did not display excessive collinearity (see the results in Table 2-4), and might differ in their relative importance for perceived input control in other platform contexts.

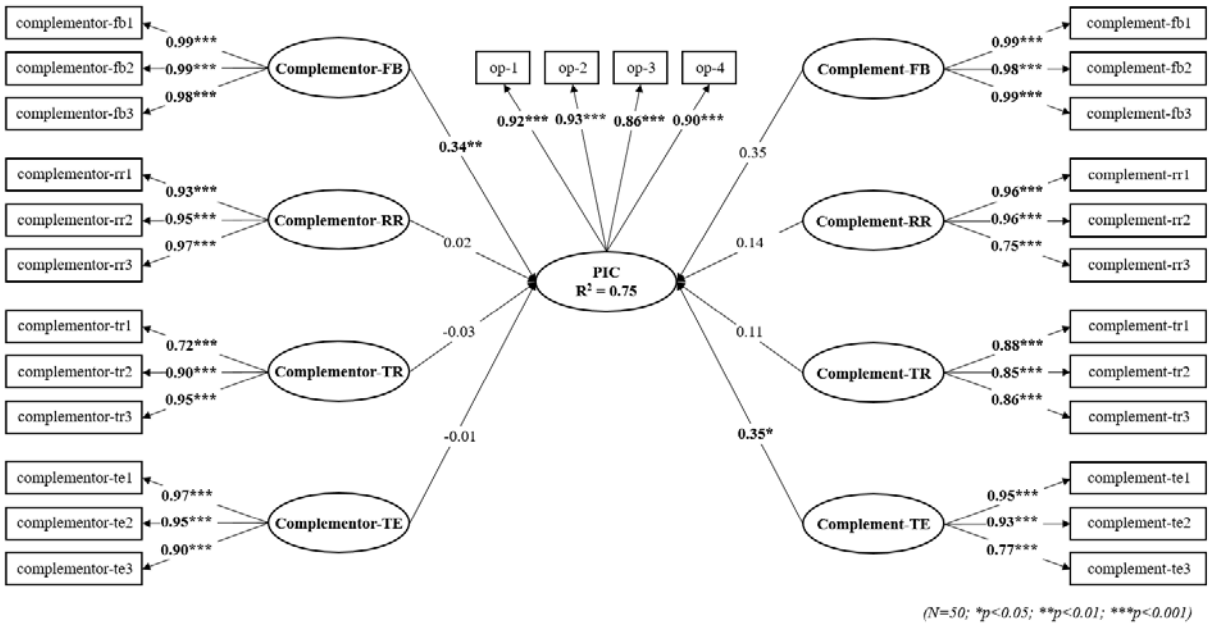

Figure 2-3: Structural Equation Modelling - Path Analysis

2.3.5 Main Survey and Scale Validation

The focus of our last step was to conduct a main survey for empirical validation of our measurement model and evaluation of the PIC construct within the nomological network of IS continuance (MacKenzie et al., 2011) which posits that users' continuous usage behavior is affected by users' perceptions of critical attributes (e.g., usefulness) of the IS and their satisfaction with the IS (Bhattacherjee, 2001). Applying this theoretical logic to our context, we hypothesize perceived input control (PIC) to negatively affect complementors' continuance intentions (controlling for satisfaction and perceived usefulness). Complementors that perceive high and stringent input control practices on a platform are more likely to be denied access to a platform and experience rejection of (some of) their submitted complements, which should decrease complementors' intentions to keep contributing to the platform in the future. In contrast, complementors perceiving low input control are granted access to a platform without major barriers and difficulties, which should increase their intentions to contribute complements in the future.

We investigated the scale and its nomological validity in a web-based survey that was conducted in early 2018 in collaboration with an international market research firm called "Innovate". Mobile application developers (i.e., Android and iOS) were chosen as target group in our main study because mobile application platforms are typical digital platforms with controlled access for third-party developers and their applications. We limited the target group to developers from the United States and United Kingdom. In addition to our 28 PIC items, the survey included three items to measure continuance intention (CI) as the dependent variable

based on the behavioral intention construct (Agarwal & Karahanna, 2000) and adopted to the platform context (e.g., Goldbach et al., 2018). Measures of this construct were included for subsequent assessment of nomological validity and are depicted in Table A2 of the Appendix[†]. All questionnaire items were measured using a seven-point Likert-type scale, anchored at (1) = strongly disagree and (7) = strongly agree. Moreover, the survey gathered demographic details of developers (i.e., gender, age, education, and country) including their experience with the platform (i.e., years of experience and number of applications developed), which are summarized in Table 2-5. After 28 responses were discarded based on strict data quality checks (e.g., completion time, attention questions, missing data), a total of 100 usable responses were available for data analysis. Although this sample size was again relatively close to recommended minimum sample sizes, it allowed for a conservative test of the model specification and nomological validity of PIC.

Category	%	Category	%	Category	%
Gender:		**Education:**		**Experience:**	
• Male	63	• High school graduate	6	• less than 1 year	4
• Female	37	• Associate degree	9	• 1 to 3 years	21
Age:		• Bachelor's degree	49	• 3 to 5 years	38
• below 25	2	• Master's degree	26	• 5 to 7 years	26
• 25 – 34	50	• Professional degree	8	• more than 7 years	11
• 35 – 44	32	• Doctorate degree	2	**Applications developed:**	
• 45 – 54	15	**Country:**		• two	29
• over 54	1	• United Kingdom	53	• three	26
		• USA	47	• more than three	45

Table 2-5: Sample Characteristics (N = 100)

IBM SPSS AMOS (Version 25.0) was used for structural equation modeling and analysis. This software was also used together with the bootstrap resampling method (5,000 bootstrap samples) to determine the significance of the paths within the structural model. Comparing the model fit indices against the recommended thresholds, our model indicated a good overall fit with the data (Table 2-6). The $\chi 2/df$ ratio of 1.491 ($\chi 2$ =447.397, df = 300) was below the cut-off value of 0.20. The root mean square error of approximation (RMSEA) of 0.07 and the standardized root mean residual (SRMR) of 0.043 were both below the recommended cut-off value of 0.08. The comparative-fit-index (CFI) of 0.953 and the incremental-fit-index (IFI) of 0.954 were also both above the cut-off value of 0.90. The Tucker-Lewis-index (TLI) of 0.941

[†] The survey also included items for Satisfaction and Perceived Usefulness. Since our substantial findings remained unaffected by entering these constructs in the nomological network, we excluded them from our main analysis.

was slightly below the cut-off value of 0.95 (Bentler, 1990; Bentler & Bonett, 1980; Hu & Bentler, 1999; Sharma et al., 2005).

χ^2	df	χ^2 /df	RMSEA	SRMR	CFI	IFI	TLI
447.397	300	1.491	0.07	0.043	0.953	0.954	0.941

Table 2-6: Model Fit Statistics for PIC as an Aggregate Construct

To assess the behavior of our newly developed construct in the nomological network of IS continuance, we related PIC to complementors' continuance intentions (Agarwal & Lucas, 2005; Diamantopoulos & Winklhofer, 2001; MacKenzie et al., 2011). The structural model analysis presented in Figure 2-4 shows the relationship between PIC as the independent variable and continuance intention as the dependent variable.

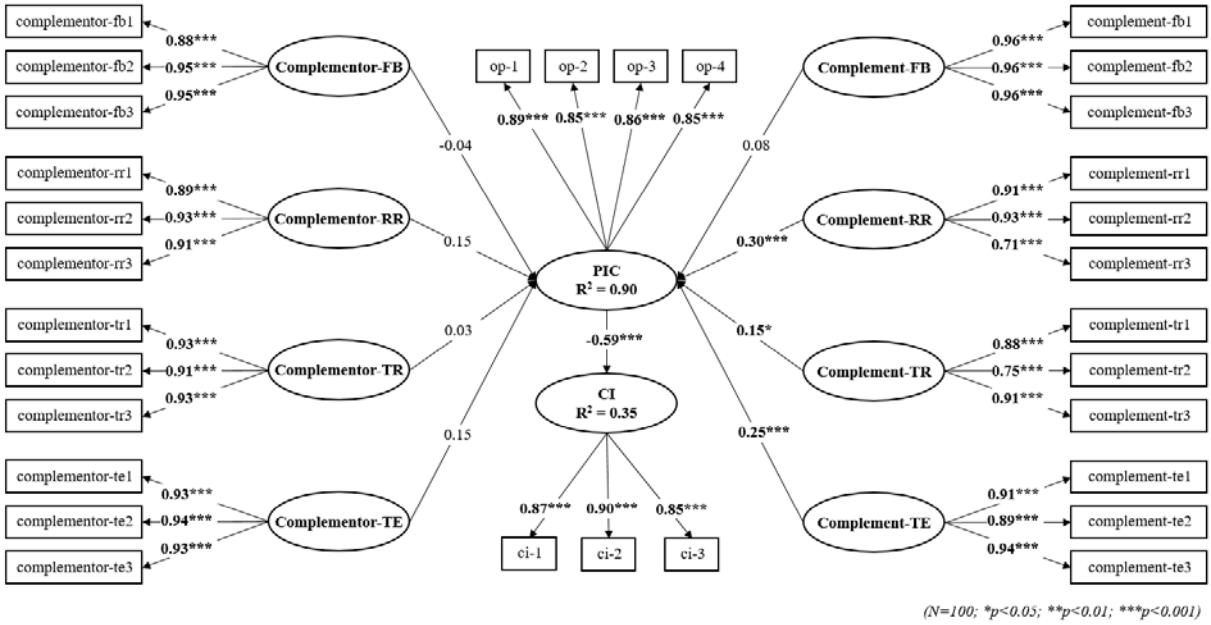

Figure 2-4: Structural Equation Modelling - Path Analysis with CI

We again tested a number of fit indices to evaluate the overall model fit including continuance intention as dependent variable. The analysis resulted again in acceptable model fit with $\chi2$/df of 1.586 ($\chi2$ = 612.060, df = 386), RMSEA of 0.077, SRMR of 0.056, CFI of 0.933, IFI of 0.935, and TLI of 0.935. Overall, PIC's sub-dimensions explained 90% of the total variance of the PIC construct pointing to a high explanatory power. The results indicated that predominantly complement-related sub-dimensions of PIC had a strong and significant effect on the overall PIC. In particular, complement-related regulatory requirements (β = 0.30, $p < 0.001$), complement-related technical requirements (β = 0.15, $p < 0.05$), and complement-related time expenditure (β = 0.25, $p < 0.001$) had positive and significant effects on the aggregate PIC construct. These results correspond well with actual input control mechanisms exercised on mobile application platforms (i.e., Android and iOS). The insignificant effects of the remaining sub-dimensions may thus manifest that the underlying aspects are of lower

relevance to complementors' perceived input control in the context of mobile application platforms.

Most importantly, the results of the nomological analysis indicate a significant negative effect (β = -0.59, $p < 0.001$) of PIC on complementors' continuance intention, explaining a considerable portion of its variance ($R^2 = 0.35$). Thus, the hypothesized relationship between the complementors' perception of input control and their intention to keep contributing to a platform could be supported, demonstrating PIC's nomological validity and predictive power. Based on the observed variance explained, we also conducted a post-hoc statistical power analysis using G*Power 3.1 (Faul et al., 2009). The analysis revealed a statistical power of 0.999 indicating that our sample size is sufficient for the purpose of the analysis (Cohen, 1992).

2.4 Contributions to Research and Practice

With our conceptualization and measurement instrument for PIC, we provide several contributions to research and practice. Previous research has repeatedly called for the development of a measurement scale for input control in digital platform context due to a lack of consistency on what this concept means and how it should be measured (Tiwana, 2015a; Tiwana et al., 2010). Our systematic literature review revealed that to date no study has systematically investigated the conceptual foundations of input control as it relates to digital platform contexts. In this study, we addressed this research gap by developing a sound conceptualization and robust measurement instrument for PIC. We found supportive evidence across the samples used in the scape development process for the psycho- metric properties of the PIC scale indicating that they are valid and reliable measures. The PIC scale thus provides a thoroughly validated instrument to capture the particularities and nuances of PIC in various platform contexts and thereby contribute to a comprehensive understanding of the properties that denote complementors' perceptions of platforms' gatekeeping practices. In particular, in contrast to previous research that has exclusively focused on complement screening and approval, our conceptualization of PIC provides a more holistic account of how complementors form their perceptions about a platform's input control practices. In fact, it acknowledges that their perceptions are not only shaped by complement vetting but also by gatekeeping and screening processes related to complementors themselves. This distinction is crucial in digital platform contexts, given that platform providers are increasingly advised to control not only 'what' complements are allowed into their platform ecosystem but also 'whom' they allow to continuously participate in this ecosystem.

The pattern of results reported in our study also support the nomological and criterion validity of the PIC scale demonstrating a direct effect of perceived input control on complementors'

intention to keep contributing to a platform. While previous studies have largely focused on the platform level of analysis to study the implications of input control (Thies et al., 2018; Wessel et al., 2017), our study thus adds to previous IS control research and platform governance literature by shedding light on important individual-level implications of input control for complementors who are a major source of innovation and ingenuity for platforms. We also hope that a rigorously developed input control scale will increase comparability of future research results across different platform contexts over time. In this regard, the group of items capturing complementors' overall perception of input control may lend itself as a short scale for PIC in survey studies where input control is not the main focus of inquiry.

From a practical perspective, the findings of this study support platform providers in selecting input control mechanisms and in getting a more complete picture of its underlying facets. A clear understanding of complementors' perceptions of platform input control and the possibility to measure it is an invaluable tool for platform providers to not only pinpoint missing or inadequately addressed input control facets on platforms. It is also useful to decide whether consideration or neglect of these facets can outweigh shortcomings against the background of a more or less open platform strategy (Schlagwein et al., 2017). Furthermore, we provide empirical evidence that PIC has a significant negative effect on complementors' intentions to keep contributing to a platform, and therefore our study highlights the importance of input control as a strategic tool for the long-term platform provider-complementor relationship. Finally, our investigations revealed that two input control dimensions, namely complementor-related input control (i.e., during registration) and complement-related input control (i.e., during complement submission), have to be taken into account when analyzing platform input control as perceived by complementors. This distinction may help platform providers allocate their attention and budgets more efficiently in their gatekeeping and screening processes.

2.5 Limitations and Future Research

We recognize several limitations in our study, which provide opportunities for future research. First, our main study model was validated with a sample of 100 complementors, which is at the lower end of recommended sample sizes for a conclusive validation with structural equation modelling. Notwithstanding this limitation, the effects found in our study can be considered conservative compared to studies with larger sample sizes. That said, it is possible that the impact of some PIC sub-dimensions become significant and substantial with larger sample sizes, and we thus invite future research to replicate our study using a higher number of observations (MacKenzie et al., 2011). Furthermore, the results of our main survey were validated in the context of mobile application platforms. Further research should validate the

PIC measurement instrument across diverse platform contexts (e.g., web-browsers, crowdfunding, and e-marketplaces) and reveal the relative importance of the different PIC sub-dimensions. Beyond helping to further evaluate the measurement instrument, a comparison of the results could provide relevant insights into advantages and disadvantages of different input control mechanisms across various platforms types. Third, our main survey was conducted only with participants who actually managed to get access to the platform. Future research should also try to capture the perception of input control of complementors whose access to a platform was denied. Finally, in this study we focused our research attention on theoretically developing and empirically validating PIC in platform contexts. However, we explicitly neglected to consider how input control interacts with other control modes typically applied in platform settings. Considering that input control is not exercised in a vacuum but usually co-occurs with other formal or informal control modes, future research should examine how PIC is complemented or substituted by other control modes and how they interrelate in their effects on important platform outcomes.

In a nutshell, this study conceptualized and measured perceived input control from a complementors' perspective and related the perception of input control to their intention to keep contributing to the platform. In doing so, our study's findings contribute to a better understanding of platform-specific input control mechanisms in particular and platform governance in general. Hence, it is our hope that the PIC instrument serves as a catalyst for future theoretical development and research to aid platform providers in making more informed gatekeeping decisions.

Chapter 3: Perceived Input Control on Web-Browser Platforms

Title: Perceived Input Control on Digital Platforms: A Mixed-Methods Investigation of Web-Browser Platforms (2020)

Authors: Evgheni Croitor, Technical University of Darmstadt, Germany
Martin Adam, Technical University of Darmstadt, Germany
Alexander Benlian, Technical University of Darmstadt, Germany

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Abstract

Complementary products and services of third-party complementors have become one of the cornerstones for the success and sustainability of digital platforms. To understand how and why these complementors and their complements decide to contribute to digital platforms, Information Systems (IS) research has paid considerable attention to the effects of control modes on shaping platform governance. However, there is still a lack of understanding of the causal effects of a widely applied, yet under-examined control mode, namely input control (i.e., the set of mechanisms that screen and sort out complementors and their complements before entering the digital platform's ecosystem). In particular, extant literature has largely ignored the distinction between complementor-related and complement-related input control. Using a sequential mixed-methods approach, this paper first provides results of a quantitative study from a survey with 114 web-browser extension developers to investigate hypothesized relationships, then provides a qualitative study based on semi-structured interviews with 22 developers to confirm and complement the formerly found relationships. Both studies provide consistent support for the assertion that both complementor-related and complement-related input control negatively affects complementors' continuance intentions and that perceived usefulness and satisfaction mediate these effects. As such, our paper contributes to IS governance research primarily by (1) conceptually distinguishing between complementor-related and complement-related input control and (2) uncovering their distinct effects on critical complementor beliefs, attitudes and behavioral intentions.

Keywords: Input Control, Digital Platforms, Platform Governance, Control Modes, Continuance Intention, Mixed-Methods

3.1 Introduction

Digital platforms have become a prevalent phenomenon in various contexts, such as software development (e.g., Android), innovation (e.g., Kickstarter), and hospitality (e.g., Airbnb), and have fundamentally changed the way products and services are created, distributed, and consumed (Constantinides et al., 2018; de Reuver et al., 2018). Moreover, digital platforms have been increasingly opening up and thus experiencing a steady increase in the number of complementors and complements (e.g., mobile apps, crowdfunding campaigns, and accommodations) (Boudreau, 2012; Thies et al., 2016). For example, between November 2013 and November 2019, the number of available applications on Android has increased from 1.2 million to 2.8 million (AppBrain, 2019), the number of live projects on Kickstarter from 1.1 thousand to over 3.9 thousand (Kickstarter, 2019), and the number of listed accommodations on Airbnb from 500 thousand to over 6.9 million (Airbnb, 2019).

As the number of complementors and complements on digital platforms have drastically increased, information systems (IS) researchers have started to pay more attention to the role of platform governance (e.g., Ghazawneh & Henfridsson, 2013; Goldbach & Benlian, 2015b; Goldbach et al., 2014; Halckenhaeusser et al., 2020). Platform governance refers to the fundamental decisions of platform providers concerning decision rights, ownership, and control (Gawer & Cusumano, 2014; Song et al., 2018; Tiwana et al., 2010). Previous research on platform governance focused mainly on an identified key trade-off between “granting access vs. devolving control” (Boudreau, 2010, p. 124). On the one hand, opening up platforms to complementors can increase both the number and variety of complements and thus the platforms’ ingenuity, innovative capacity, and diversity (Benlian et al., 2015; Ceccagnoli et al., 2012). On the other hand, opening up platforms to complementary innovation can result in a lack of control over the complementors and their complements. Consequently, platform providers might no longer be able to align their interests and strategies with those of the complementors, potentially resulting in detrimental consequences for digital platforms (Almirall & Casadesus-Masanell, 2010; Boudreau, 2012). For instance, during the Atari shock in the 1980s, Atari’s platform was flooded with low-quality video games due to the platform’s inability to control quality, which was a main factor in contributing to its decline (Coughlan, 2004). More recently, the lack of control has led to drawbacks of contemporary platforms, such as an increase in fake campaigns on established crowdfunding platforms (Cumming et al., 2019; Wessel et al., 2016) and the emergence of unwanted adware in extensions on web-browser platforms (Thomas et al., 2015).

To influence platform governance and thus manage access, behaviors, and outcomes of complementors and their complements, platform providers can draw on various control modes (i.e., the set of mechanisms to control complementors and their complements in the platform's ecosystem) (Tiwana et al., 2010). Traditional control modes (i.e., behavior, output, self and clan control) have been extensively studied in various contexts (Choudhury & Sabherwal, 2003; Goldbach et al., 2018; Keil et al., 2013). We differentiate from prior literature on digital platforms by focusing on a recently-looming and hitherto underexplored control mode, namely *input control*. Input control can be described as the set of mechanisms used by platform providers to screen and sort out complementors and their complements before they can enter a platform's ecosystem (Croitor & Benlian, 2019). Although IS scholars have pointed at the importance of studying input control in the context of digital platforms (Thies et al., 2018; Tiwana, 2015a), IS governance research on input control on platforms is yet in its early stages and has so far only focused on scale development (Croitor & Benlian, 2019) and preliminary analysis based on publicly available data (Thies et al., 2018; Tiwana, 2015a). Furthermore, despite the existence of complementor-related input control and complement-related input control, prior literature on platforms has primarily focused on the effects of complement-related input control (Thies et al., 2018; Tiwana, 2015a).

To advance our understanding of input control, our paper intends to shed light on how complementors perceive and react to a platform's input control. More specifically, we focus on the complementors' perceived input control (PIC), because even though a platform provider decides on the specific forms of input control, it is the complementors who eventually perceive the input control and make the decision to use the platform. Moreover, we differentiate between perceived complementor-related input control (Complementor-PIC) and perceived complement-related input control (Complement-PIC) to refer to input control-related control mechanisms that address complementors or complements, respectively. Lastly, to investigate how and why a platform's PIC impacts complementors' decisions to continue contributing to the respective digital platform, we draw on the IS continuance model (Bhattacherjee, 2001) and investigate the PIC's causal effects on complementors' beliefs (i.e., perceived usefulness), attitudes (i.e., satisfaction), and behavioral intentions (i.e., continuance intentions). We thus analyze the relationship between a platform's PIC and the complementors' willingness to keep contributing to the respective digital platform. In sum, we intend to investigate the following research question:

RQ: How does PIC, differentiated by Complementor-PIC and Complement-PIC, affect complementors' perceived usefulness, satisfaction, and continuance intentions on digital platforms?

To answer this research question, we used a sequential mixed-methods approach that includes a quantitative and a qualitative study (Venkatesh et al., 2016; Venkatesh et al., 2013). We first tested our hypotheses using quantitative (survey) data obtained from 114 third-party extension developers on two leading web-browser platforms (i.e., Chrome and Firefox). Then, we analyzed the qualitative (interview) data obtained from 22 additional developers to confirm and complement the formerly found results.

Our paper offers noteworthy contributions to both research and practice. First, our paper adds to previous IS governance research (e.g., Cram et al., 2016; Wiener et al., 2016), in particular to IS control research, by theoretically and empirically distinguishing between two dimensions of PIC, namely Complementor-PIC and Complement-PIC. Second, our paper contributes to the body of knowledge in IS governance literature, which is widely advanced in organizational and project-related contexts but relatively limited in the context of digital platforms (Tiwana et al., 2010). Specifically, we increase our understanding of the effects of PIC on complementors' perceived usefulness, satisfaction and continuance intentions. Third and lastly, whereas previous studies investigated PIC in the context of mobile application platforms (Croitor & Benlian, 2019), our research provides insights on effects of PIC in a new platform context (i.e., web-browser platforms) (Hong et al., 2014; Johns, 2006). In terms of practical implications, our paper offers platform providers valuable insights on how their input control affects complementors' perceptions and thus their willingness to stay on and keep contributing to digital platforms, nurturing platform health and sustainability.

3.2 Theoretical Background

3.2.1 Digital Platforms

Prior IS and strategic management research has defined and conceptualized digital platforms as infrastructures that mediate interactions between complementors and end-users (Eisenmann et al., 2011; Foerderer et al., 2018; McIntyre & Srinivasan, 2017). Most important to our paper are the roles of platform providers and complementors as well as their complements, as they collectively form a platform ecosystem (Ceccagnoli et al., 2012; Tiwana, 2015a). Platform providers design, develop, and govern the platform and thereby manage interactions between complementors and end-users (Eisenmann et al., 2011). Complementors are external parties who contribute complements to the platform ecosystems, but are not directly related to the platform providers (Wiener et al., 2020). For example, application developers provide apps in

the case of Android, drivers provide driving services in the case of Uber, and hosts provide accommodations in the case of Airbnb. Lastly, end-users are individuals or organizations that use complements available in the platform ecosystems (Parker et al., 2017). For example, end-users are users of apps in the case of Android, passengers in the case of Uber, and tenants in the case of Airbnb. Table 3-1 synthesizes the outlined concepts that inform our understanding of digital platforms in this paper.

Concept	**Definition**	**References**
Digital Platform	Infrastructure that mediates interactions between complementors and end-users.	McIntyre and Srinivasan (2017)
Platform Ecosystem	The platform with its network of complementors and complements.	Ceccagnoli et al. (2012)
Platform Provider	Individual or organization that designs, develops, and governs a platform.	Eisenmann et al. (2011)
Complementor	The independent provider of complements that contributes to the platform ecosystem.	McIntyre and Srinivasan (2017)
Complements	Products or services provided by a complementor.	McIntyre and Srinivasan (2017)
End-users	Individuals or organizations that use complements available on the platform ecosystem.	Parker et al. (2017)

Table 3-1: Key Concepts in the Context of Digital Platforms

3.2.2 Platform Governance and Control Modes

Consistent with previous research (Foerderer et al., 2018; Tiwana, 2015a; Wareham et al., 2014), we use the term platform governance to refer to the fundamental decisions of platform providers concerning decision rights, ownership, and control (Gawer & Cusumano, 2014; Song et al., 2018; Tiwana et al., 2010). In the context of digital platforms, control refers to means through which the platform provider ensures that complementors and complements are aligned with what is in the interests of the platform (Tiwana, 2015a). Control mechanisms are specific forms of control that manifest in control modes (Kirsch, 1997). IS governance literature makes a fundamental distinction between control modes, which can be divided into formal and informal types of control (Kirsch, 1997; Ouchi, 1979; Wiener et al., 2016). Formal control modes (i.e., input control, behavior control, and output control) are enforced by platform provider through specification and evaluation (Cardinal, 2001; Cardinal et al., 2004). Informal control modes (i.e., self control and clan control) are socially enforced through shared norms and values of groups or individuals (Wiener et al., 2016). Brief definitions of control modes and exemplary mechanisms on digital platforms are presented in Table 3-2.

Control modes	**Brief definition**	**Control mechanisms (examples)**
Input Control	The degree to which platform provider uses gatekeeping and screening procedures to allow complementors and their complements to enter a platform (Croitor & Benlian, 2019).	- Complementor registration - Complement review process
Behavior Control	The degree to which platform provider monitors and guides complementors behaviors on a platform (Goldbach et al., 2018).	- Guidelines and best-practices - Regular suggestions and feedback
Output Control	The degree to which platform provider evaluates, punishes and rewards complementors outcomes on a platform (Goldbach et al., 2018).	- Performance metrics - Complement rating by end-users
Self Control	The degree to which complementors set their own goals and monitor themselves based on intrinsic motivation (Goldbach & Benlian, 2015b).	- Tools and training for self-regulation - Work autonomy
Clan Control	The degree to which complementors share norms and values that motivate their behaviors within a peer group (Goldbach & Benlian, 2015b).	- Evaluating and correcting each other - Social sanctioning

Table 3-2: Control Modes on Digital Platforms

In case of input control, which is in the focus of this paper, platform providers use gatekeeping procedures to decide which complementors and complements can enter the respective digital platform (Croitor & Benlian, 2019). Although different forms of input control were considered in various contexts (Cardinal et al., 2004; Kim & Tiwana, 2016), prior IS control research has mainly examined the causal effects of behavior, output, self and clan control, overlooking the increasing relevance of input control for platform ecosystems (e.g., Choudhury & Sabherwal, 2003; Kirsch et al., 2002). The few studies that looked at input control on digital platforms produced only limited findings: Within crowdfunding, relaxing campaign requirements has been linked to decreasing quality and increasing quantity of submitted campaigns (Thies et al., 2018; Wessel et al., 2017), whereas in the context of web-browsers (Tiwana, 2015a), input control over extensions was linked to increased extensions' market performance. The growing number of complementors and complements on digital platforms reinforces the theoretical significance of input control in contrast to the well-studied behavior, output, self and clan control modes in platform ecosystems (Tiwana, 2015a).

Depending on platform goals and context, platform providers can predefine (1) complementor-related and (2) complement-related input control mechanisms. Complementor-related input control mechanisms comprise requirements that revolve around complementors themselves (e.g., specific residency, background check, and proof of identity), mostly during the registration and authentication of the complementors. Complement-related input control mechanisms comprise complement-specific requirements, in which the provided complement is the object of investigation (e.g., security standards, quality checks, technical requirements), mostly during the submission process of complements. Consider, for example, the input control process that Chrome uses to screen out developers (i.e., complementors on web-browser platforms) and their extensions (i.e., complements on web-browser platforms), which seek access to the Chrome ecosystem: First, developers are required to create a developer account and to pay a one-time registration fee to verify their accounts, preventing fraudulent extensions in the Chrome ecosystem. Afterwards, any extension must go through an automated review process, which confirms compliance with formal quality guidelines. As a result, the extension can be accepted, rejected, or forwarded for manual review. Developers who fail the extension review are required to fix the identified problems before resubmitting the extensions. Additional examples of complementor-related and complement-related input control across various platform contexts are shown in Table 3-3.

Platform	**Complementor**	**Complement**	**Complementor-related input control**	**Complement-related input control**
Uber	Driver	Driving service	Checks for driving violations and violent crime.	Verification of vehicle insurance.
Amazon	Seller	Product	Verification of identity and trading license.	Consistent with current laws and policies.
GlobalGiving	Organizer	Campaign	Check for certificate of government registration.	Program materials and funding documents.
Airbnb	Host	Accommodation	Verification of identity and background checks.	Check for amenities standards.

Table 3-3: Complementor-related and Complement-related Input Control

Despite the importance of understanding complementors' perceptions of input control for the success and sustainability of entire platform ecosystems, there is still a need for a richer conceptualization and inclusion of different dimensions of PIC to assess their relative importance for digital platforms. Consequently, in this paper, we differentiate between two PIC dimensions that contribute to the formation of complementors' perceptions of input control: (1) complementor-related PIC (Complementor-PIC) and (2) complement-related PIC (Complement-PIC). Conceptualizing both dimensions of PIC will provide insights for a differentiated understanding of factors that constitute complementors' PIC and how these perceptions translate into continuance intentions to the respective platforms.

3.3 Research Model and Hypothesis Development

3.3.1 Research Model

Following guidelines by Hong et al. (2014) on developing context-specific models, we adopted the established model of IS Continuance by Bhattacherjee (2001). This model is particularly suitable for two reasons: First, in line with our objective of investigating complementors' long-term intentions, the IS Continuance Model captures complementors' post-adoption behaviors (i.e., continued use rather than first-time use of the digital platform). Second, the model improves our ability to explain complementors' continuance intentions based on both beliefs (i.e., perceived usefulness) and attitudes (i.e., satisfaction) of complementors. In line with the most common approach (Hong et al., 2014), we included the context-specific variable (i.e., perceived input control) as antecedents of the core constructs (i.e., perceived usefulness and satisfaction) as illustrated in Figure 3-1.

We propose that PIC, conceptualized as a second-order construct, has a negative effect on complementors' perceived usefulness, satisfaction, and subsequent continuance intention. We do not hypothesize for any causal effect between perceived usefulness, satisfaction and continuance intention, as prior IS research has consistently shown that individuals' intentions to contribute to a platform is affected by their satisfaction with and perceived usefulness of the platform (e.g., Kim et al., 2016; Li & Liu, 2014).

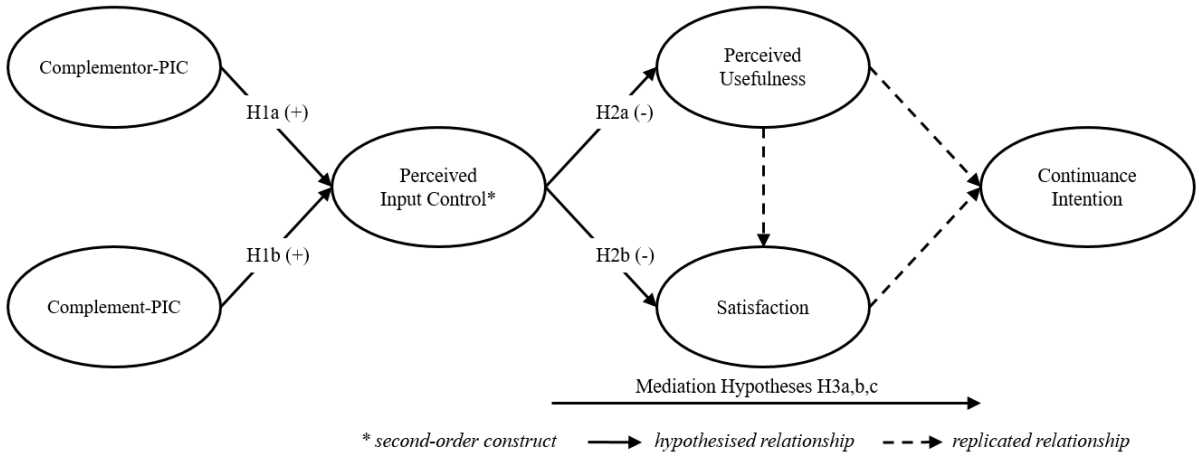

Figure 3-1: Research Model

3.3.2 Hypothesis Development

Following recommendations on conceptualization of multidimensional constructs (Jarvis et al., 2003; Law et al., 1998; Polites et al., 2012; Wright et al., 2012) and consistent with prior IS research (Rai et al., 2006; Teo et al., 2003), we conceptualized perceived input control as a formative second-order aggregate construct with two sub-constructs: Complementor-PIC and Complement-PIC. We suggest that the perception of input control arises when complementors perceive barriers complicating the registration on a digital platform. For example, high registration costs and corresponding expenses (e.g., fees, certificates, and licenses) can prevent complementors from entering a digital platform (Tauscher & Laudien, 2018). Additionally, perception of input control arises when complementors perceive barriers complicating the submission to a digital platform. For example, aside from common technical requirements, complements must comply with existing regulations (e.g., national and professional laws), and thus confirm with regulatory requirements (Furstenau & Auschra, 2016). Consequently, in the context of digital platforms, we expect an overall increase of PIC resulting from increase in the Complementor-PIC and Complement-PIC. Hence, we hypothesize:

H1a: Complementor-PIC has a positive effect on PIC.

H1b: Complement-PIC has a positive effect on PIC.

In the context of digital platforms, perceived usefulness refers to the extent to which complementors perceive a platform as useful for their performance (adapted from Davis, 1989) and satisfaction refers to their evaluation and affective response to the overall experience with the platform (adapted from Oliver, 1980). Complementors that perceive high PIC on a platform are more likely to be denied access to a platform and experience rejection of their submitted complements, which we hypothesize to decrease perceived usefulness of and satisfaction with a digital platform. In contrast, complementors perceiving low PIC expect their complements to

be submitted without considerable barriers. This argument is supported by literature showing that lower entry barriers and easy access for individuals leads to higher perceived usefulness und satisfaction (Benlian et al., 2015; Eaton et al., 2015; Song et al., 2018; Wu & Chen, 2017). Thus, we hypothesize:

H2a: PIC has a negative effect on complementors' perceived usefulness.

H2b: PIC has a negative effect on complementors' satisfaction.

In the context of digital platforms, continuance intentions refers to complementors' behavioral intentions to remain in the platform ecosystem and to keep contributing complements to that digital platform (adapted from Agarwal & Karahanna, 2000). In line with the arguments presented above and considering that the IS continuance model proposes that both perceived usefulness and satisfaction influence continuance intentions (Bhattacherjee, 2001), we thus conclude:

H3a: Perceived usefulness mediates the relationship between PIC and complementors' continuance intention.

H3b: Satisfaction mediates the relationship between PIC and complementors' continuance intention.

H3c: Perceived usefulness and satisfaction sequentially mediate the relationship between PIC and complementors' continuance intention.

3.4 Methodology

3.4.1 Research Context

Our empirical setting takes place on Chrome and Firefox, two major web-browser platforms. Both platforms extend their product boundaries by encouraging a large number of developers (i.e., complementors on web-browser platforms) to supply extensions (i.e., complements on web-browser platforms). Extensions provide add-on functionalities for users, such as ad blocking, privacy protection and search tools. The majority of developers use cross-platform extension development tools (i.e., APIs) and submit their extensions to both platforms at the same time, because the effort of developing an extension is largely independent of the number of platforms that are targeted. Chrome and Firefox offer ideal settings for our empirical analyses for several reasons: First, Chrome and Firefox are typical two-sided platforms with complementors and end-users. Second, to distribute their extensions, developers on both platforms are required to pass through a complementor-related and a complement-related input control process. Third, apart from a registration fee, the input control practices on both platforms are similar, allowing to investigate both platforms from complementors' perspective at the same time. Finally, extensions from over 150,000 developers are currently available

online (ca. 15,900 on Firefox and ca. 189,000 on Chrome). Together, Chrome and Firefox hold over 70% of the browser market worldwide (StatCounter, 2019).

3.4.2 Research Design

For a rich understanding of the relationship between PIC and complementors' continuance intentions, it is beneficial to confirm and complement the results from the quantitative study with data from a qualitative study, thus revealing insights into a relationship that cannot be fully understood using only one type of method (Venkatesh et al., 2016; Venkatesh et al., 2013). Thus, we adopted a mixed-methods approach (Venkatesh et al., 2013) to test and substantiate the proposed research model by combining quantitative data collected through a survey with qualitative data collected through interviews. In the following, we will sequentially present these two studies and our findings.

3.5 Quantitative Study (Survey)

3.5.1 Survey Data Collection and Sample Description

We collected quantitative data in collaboration with an international market research firm through an online survey. Expert sampling was used since individuals of our target group were required to have particular experience with extension submission on web-browser platforms. We limited the target group to web-browser extension developers from the United States and the United Kingdom. After 19 responses were discarded based on strict quality checks (e.g., completion time, attention checks, and missing data), the final sample consisted of 114 valid responses for the data analysis. Descriptive statistics of participants are presented in the Table A5 of the Appendix.

We performed a number of steps to reduce any common method bias that might arise because of the use of a single data source (Podsakoff et al., 2003). First, during the design of the study's procedures, we minimized common method bias by promising respondent anonymity and reducing evaluation apprehension: We informed all respondents that their answers would be anonymous, that there were no right or wrong answers, and that responses would be used solely for research purposes. Second, we also attempted to control method bias by improving the scale items: We avoided using ambiguous or unfamiliar terms, complicated syntax, and inconsistent questions (Podsakoff et al., 2003). Finally, we conducted a full-collinearity test following guidelines of Kock (2015). Results showed that all values are well below the threshold of 5. Thus, common method bias does not present a serious concern to our study.

3.5.2 Operationalization of Survey Instruments

The measurement instruments consisted of items drawn from extant literature. We assessed perceived input control using four reflective items (Croitor & Benlian, 2019), perceived usefulness using four reflective items (Agarwal & Karahanna, 2000), satisfaction using three reflective items (Bhattacherjee, 2001), and continuance intention using three reflective items (Bhattacherjee, 2001). Additionally, to measure both dimensions of PIC (i.e., Complementor-PIC and Complement-PIC), we adapted four formative items for each construct (Croitor & Benlian, 2019). All items were measured on a seven-point Likert-type scale, ranging from 1 (strongly disagree) to 7 (strongly agree). The questionnaire items are provided in Table A6 of the Appendix. Additionally, we measured control variables in the prediction of the dependent variable (i.e., continuance intention). We controlled the dependent variable for gender, age, education, country of residence, experience and number of developed extensions (see Table A5 of the Appendix for more details).

3.5.3 Survey Data Analysis and Results

We used structural equation model with partial least squares (PLS-SEM) using SmartPLS 3.2.8 (Ringle et al., 2015) to examine our measurement models and to assess the structural model (Hair et al., 2020; Hair et al., 2019a). PLS-SEM is the most appropriate technique for the present study for several reasons. First, the use of PLS-SEM is quite useful for exploratory research that examines the early stage of the theory development (Hair et al., 2019a). Second, PLS-SEM is preferred approach when formatively measured constructs are included in the structural model (Hair et al., 2019b). Third, PLS-SEM is a causal predictive method that underscores prediction in estimating statistical model (Hair et al., 2019b). Lastly, our selection of the analysis technique is in line with recent methodological approaches within the IS discipline on the use of PLS-SEM over other analysis techniques (e.g., Addas & Pinsonneault, 2018; Venkatesh et al., 2019). Following guidelines on analysis and evaluation of PLS-SEM results (Hair et al., 2019a), we first examine our measurement models and then we assess the structural model.

For our measurement model assessment, we first examined all reflective and thereafter all formative constructs (Hair et al., 2019a). The first step in assessment of reflective constructs involves examination of indicator loadings. The outer loadings values ranged from 0.77 to 0.94 and were therefore above the recommended level of 0.70. Second, to assess internal consistency reliability we measured Cronbach's alpha, Rho_A and composite reliability. These high values indicated high internal consistency reliability. Third, we assessed the convergent validity of each construct through examination of average variance extracted (AVE). As presented in Table

3-4, all AVE values were above the threshold of 0.50, indicating a satisfactory converged validity.

Construct	**Factor loadings**	**Cronbach's Alpha**	**Rho_A**	**Composite reliability**	**Average variance extracted**
PIC	0.86 – 0.94	0.93	0.94	0.95	0.84
PU	0.85 – 0.92	0.91	0.92	0.94	0.78
SAT	0.89 – 0.94	0.90	0.90	0.94	0.87
CI	0.77 – 0.93	0.84	0.85	0.90	0.76

Table 3-4: Results of the Measurement Assessment of Reflective Constructs

In the fourth step we assessed discriminant validity of our reflective constructs. Discriminant validity is defined as the degree to which measures of different latent variables are unique (O'Leary-Kelly & J. Vokurka, 1998) and can be tested using Heterotrait-Monotrait (HTMT) analysis. As presented in Table 3-5, the results were below the recommended threshold of 0.9 (Henseler et al., 2015). Hence, these results demonstrated that our reflectively measured constructs had a good discriminant validity.

Construct	CI	PIC	PU
PIC	0.69 (0.54 - 0.80)		
PU	0.65 (0.48 - 0.78)	0.32 (0.12 - 0.49)	
SAT	0.70 (0.55 - 0.83)	0.64 (0.48 - 0.76)	0.60 (0.44 - 0.74)

Table 3-5: Heterotrait-monotrait (HTMT) Analysis of Discriminant Validity

To validate our formatively measured constructs, we first assured factor weights of indicators (Petter et al., 2007), which were all significant ($p < 0.05$) and ranged from 0.11 to 0.54. Second, we measured variance inflation factors (VIF) for the indicators. VIF values ranged from 1.86 to 2.61 and were thereby below the recommended threshold of 3.33 (Cenfetelli & Bassellier, 2009).

Hence, the reliability and validity of reflective and formative constructs in our quantitative study were established. These procedures ensured that the measures of constructs are valid and we can proceed to draw conclusions about the relationships between the constructs (Hulland, 1999).

After establishing reliability and validity of the construct measures, the study assessed the structural model, which involves examining the model's predictive capabilities and the relationships between the constructs (Hair et al., 2014). The results of the structural model analysis, including standardized path coefficients and their statistical significance are displayed in Figure 3-2. We first analyzed the relationship between control variables and the dependent variable. We did not find any significant effects of gender, age, education, country, experience or number of developed extensions on continuance intention (all p > 0.05).

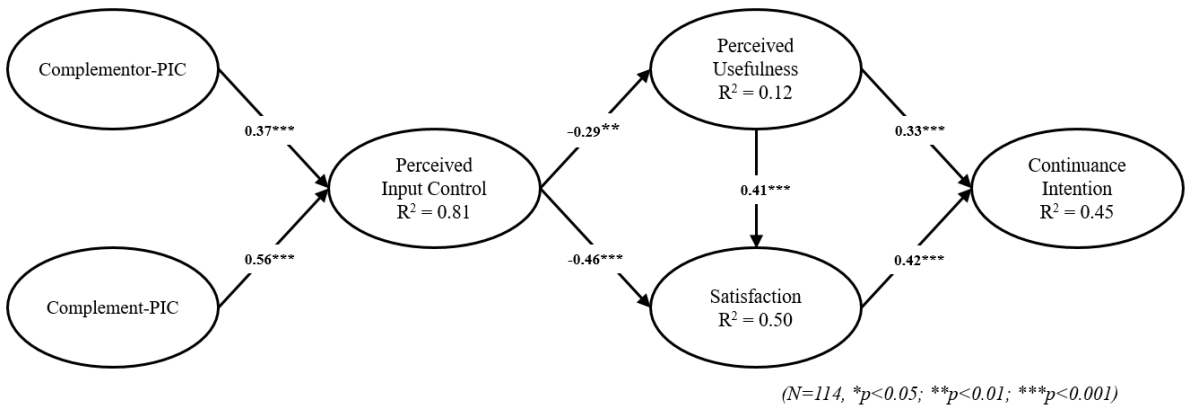

Figure 3-2: Model Testing Results

The structural model successfully explained a considerable proportion of variance in perceived input control (R^2 = 81%), satisfaction (R^2 = 50%) and continuance intention (R^2 = 45%) and smaller portions of variance in perceived usefulness (R^2 = 12%). Complementor-PIC and Complement-PIC had both a positive and significant effect on PIC ($\beta = 0.37$, $\beta = 0.56$, $p < 0.001$), **supporting H1a and H1b**. Moreover, PIC had a negative and significant effect on perceived usefulness ($\beta = -0.29$, $p < 0.01$) and satisfaction ($\beta = -0.46$, $p < 0.001$), **supporting H2a and H2b.** Additionally, our results are in line with previous studies on the IS continuance model: The effects of perceived usefulness and satisfaction on continuance intention were both positive and significant ($\beta = 0.33$, $\beta = 0.42$, $p < 0.001$). Perceived usefulness had a significant positive effect on satisfaction ($\beta = 0.41$, $p < 0.001$).

A PLSpredict technique was performed to determine model's predictive relevance (Shmueli et al., 2016; Shmueli et al., 2019). Since PLS-SEM errors were distributed symmetrically, we based our predictive power assessment on the root mean squared error (RMSE). As shown in Table 3-6, for all three indicators of the endogenous variable (i.e., continuance intention), PLS model has lower RMSE values than the linear model (LM). Thus, the model has a high predictive power.

Indicators	PLS		LM		RMSE (PLS-LM)
	RMSE	Q^2_predict	RMSE	Q^2_predict	
CI1	1.216	0.074	1.263	0.019	-0.047
CI2	1.231	0.027	1.253	0.013	-0.022
CI3	1.169	0.091	1.264	0.067	-0.095

Table 3-6: Summary of Predictive Power Analysis

We used PLS-SEM approach to test our mediation hypotheses. Following the recent guidelines (Sarstedt et al., 2020), we conducted inferential tests for the indirect effect paths based on 5,000 bootstrap samples generating 95% bootstrap bias corrected confidence intervals (LLCI = lower limit, ULCI = upper limit of confidence interval), as presented in Table 3-7. First, the indirect effect of perceived input control through perceived usefulness on continuance intention was statistically significant, **in support of H3a**. Additionally, the results confirmed that satisfaction significantly mediated the effect of perceived input control on continuance intention, **supporting H3b**. Lastly, our results also showed a significant indirect effect of perceived input control through perceived usefulness and satisfaction on continuance intention, **supporting H3c.**

Hypothesis	Indirect effect path	Indirect effect	LLCI	ULCI	Support
H3a	PIC→PU→CI	-0.100*	-0.209	-0.037	Yes
H3b	PIC→SAT→CI	-0.199***	-0.311	-0.100	Yes
H3c	PIC→PU→SAT→CI	-0.053*	-0.100	-0.016	Yes
*Note: *p < 0.05, **p < 0.01, ***p < 0.001.*					

Table 3-7: Summary of Mediation Testing Results

3.6 Qualitative Study (Interviews)

3.6.1 Interview Structure and Data Collection

The purpose of the qualitative study was to confirm and complement the results of the quantitative study and to gain further insights on the proposed relationships. For the semi-structured interviews, which allowed the interviewer to maintain a natural flow throughout the conversation, we prepared an interview guideline that was based on the survey results and our research model (see Table A7 of the Appendix for the interview questions). We contacted 330 extension developers through multiple channels (i.e., Firefox store, Chrome store, GitHub,

LinkedIn, and Xing). When choosing developers, we ensured that they did not participate in our quantitative study. Of 330 developers contacted, 22 agreed to participate in an interview. The profiles of the interview participants are presented in Table A8 of the Appendix. All interview partners had experience on both web-browser platforms (i.e., Chrome and Firefox). Interviews were conducted in April 2020 using Skype and ranged in duration from 25 to 60 minutes.

3.6.2 Interview Data Analysis and Results

After collecting the interview responses, two of the authors independently coded the transcriptions by using a multiple classification scheme (Bhattacherjee & Premkumar, 2004). After the initial coding and discussion, we used consensus coding to confirm codes and to match transcribed quotes with codes derived from the analysis. The process was concluded when no significant additional insights were obtained from additional data and theoretical saturation was achieved. To develop a consensus between the quantitative and qualitative findings, we used the bridging approach, which is the process of strengthening the findings from the quantitative study with the results from the qualitative study (Venkatesh et al., 2013).

We found that the qualitative study supports all of the hypotheses that we tested through quantitative analysis. We situate the findings from the qualitative study within the results obtained from the quantitative study to delineate the corroborated meta-inferences.

Similar to the results of the quantitative study, the results of the qualitative study suggest that PIC has a negative effect on perceived usefulness. For example, five respondents commented:

"They are very restrictive on both platforms. Especially about privacy. A little bit too much. I would say like, especially in our case, we're very user privacy focused. And they prevent us from doing simple analysis." (R22)

"Well, it's very different than my normal work because on my normal work I use all kinds of tools, developer tools, and build tools that are abstractions on top of the actual code. But when I'm building extensions, I've felt like I just avoid all of that, because I want to keep it very lightweight and I don't want to have any approval hang-ups. So I changed my workflow just to be simpler and more traditional. Just to keep it lightweight and make it approved. As easy as possible approved." (R9)

"So I used foreign libraries and integrated them into the extension. I tried to publish that extension, but then it was rejected because it didn't abide by some policies." (R4)

"They charge a registration fee from you to publish on the store, which is kind of funny because, I'm not charging anything for it, so it's like I have to pay for it. You know, for something that I'm releasing for free." (R17)

"Registration costs a one-time fee, but that wasn't super much. I think the thing that stopped me the most from registration was reading through these documents that contain all these guidelines about what you have to stick to." (R22)

Our results also suggest that PIC negatively affects satisfaction with a platform. As four interviewees commented:

"You actually have to pay to register, which surprised me. I can somehow understand that they want to try to limit the people who publish something. But is that the right choice that you have to pay something to offer people something? I don't like that and I don't think it's such a good idea." (R13)

"I think the hardest part for me was that I can make it all work technically. However, they asked for a lot of screenshots and not only screenshot, but like images, they asked for icons and they ask for icons in different sizes. So just making that I think was for me the hardest, because I'm not used to do that. So that was a lot of trouble." (R1)

"Submitting first version is not piece of cake, because you have to do all these, descriptions and the pictures, icons, and all this stuff that are not programming. And I hate doing not programming stuff, like marketing, you know." (R6)

"I would say the frustrating part was that they were not allowing a certain code and permissions." (R4)

Regarding continuance intention, some interviewees experienced a high level of input control, which led to dissatisfaction with the platform and subsequently the abandonment of the platform. Commenting on this issue, three interviewees remarked:

"So in the beginning, everything was fine. But then all of a sudden, we got kicked from the store for some reason, we still don't know why. […] I'm not going to resubmit again, because after we got rejected from the store, and we tried like 10 times to submit our extension. It was like a bit demotivating, and so I stopped with that." (R1)

"But where it kind of gets in the way is where the system can't really tell you specifically why it got rejected and you have a hard time reaching, any sort of live person that could explain it to you. So in the case with my extension, I went back and forth for a few days trying to make updates and it was getting replies that it was being rejected for different reasons. And I ended up giving up on that one and just pulled it from the store." (R2)

"I don't think that I will create any new extensions in the future, because that review process just left a bad taste in my mouth." (R9)

We also found out that, regardless of the level of input control, complementors want input control mechanisms to be more "complementor-friendly" wherever possible (e.g., make faster

access decisions and make the input control process more transparent). For example, three respondents commented:

"I think it's good that they have requirements and do checks on extensions. But, I would hope that it'd be a fast process too, that you'd be able to get some really detailed information of here's why it was rejected, here's specifically what you have to do to fix it, to get it into the store. That's where the slowdown occurs. And that's where the frustration appliers, that it is not a fast process and it's not a very clear process." (R2)

"I would really like to have clear requirements. You can do this, but you can't do that. So like a list of the things. And when you get kicked, that they clearly say like, what is the one thing in your extension, that is wrong. And not just, you violated this rule, but they don't explain why and you have no clue. So it's just a guessing game." (R1)

"I got an automated email saying that after I tried publishing an update, they were concerned about something, but it did not spell out what. And so I took a look at it and tried making some changes and published it again. And I get another automated email that it's blocked for a different reason. I think it's a good thing that they're trying to protect the end user, but it's not always easy as a developer to understand what they're looking for you to fix." (R3)

Overall, we observe that the results from the qualitative study not only confirm the results of the quantitative study, but also provide rich explanations of the findings, thereby complementing the results obtained from the quantitative study (Venkatesh et al., 2013).

3.7 Discussion

3.7.1 Key Findings

Research on input control on platforms is in its early stages and little is known about how PIC – differentiated between Complementor-PIC and Complement-PIC - affects complementors' beliefs (i.e., perceived usefulness), attitudes (i.e., satisfaction), and behavioral intentions (i.e., continuance intentions). The objective of this paper was to address these gaps in research and provide insights to better understand the effects of PIC on complementors' reactions. Two key findings can be derived from our studies. First, our findings show that both Complementor-PIC and Complement-PIC affect complementors' overall perception of input control on digital platforms. Second, our studies show that complementors' perceived usefulness of and satisfaction with a digital platform serve as an important driving force through which perceived input control affects complementors' continuance intentions.

Overall, the results from both studies support all of our hypotheses and revealed that complementors' perception of input control indeed negatively affects their perceived usefulness, satisfaction and continuance intentions.

3.7.2 Theoretical Contributions

Our paper mainly provides three contributions to IS governance literature in general and to IS control literature in particular (Cram et al., 2016; de Reuver et al., 2018). First, prior research on input control has subsumed Complementor-PIC within Complement-PIC without explicitly defining them as two separate dimensions (Thies et al., 2018; Tiwana, 2015a). In contrast to previous studies, which primarily investigated the effects of Complement-PIC, we demonstrate that both Complementor-PIC and Complement-PIC positively affect complementors' overall PIC. Second, our paper complements previous IS control literature by demonstrating that PIC on platforms is negatively related to complementors' continuance intentions. As previous studies on IS control have mainly focused on traditional control modes (e.g., Choudhury & Sabherwal, 2003; Kirsch et al., 2002), we thus expand the understanding in research by showing how PIC affects complementors' willingness to keep contributing to digital platforms. Third and lastly, where previous studies investigated PIC in context of mobile application platforms (Croitor & Benlian, 2019), our research provides insights on effects of PIC in a new platform context (i.e., web-browser platforms) (Hong et al., 2014; Johns, 2006). As such, our paper responds to a research call by Croitor and Benlian (2019) to investigate the effects of PIC in a yet unexplored platform context. More broadly, our insights are important beyond the context of web-browser platforms, as input control is a critical and ubiquitous element of platform governance.

3.7.3 Practical Implications

Beyond the theoretical contributions, our paper provides platform providers with valuable insights on how their input control affects complementors. As platform providers want to keep complementors contributing complements to their platforms, it is important for them to grasp that opening up their platforms by reducing input control may help them in improving perceived usefulness, satisfaction, and willingness to contribute with complements to a platform ecosystem. Moreover, our empirical results revealed that platform providers need to consider both Complementor-PIC (e.g., during registration) and Complement-PIC (e.g., during complement submission) when thinking about input control. This distinction may help platform providers allocate their attention and budgets more effectively into different input control mechanisms on their platforms.

3.7.4 Limitations and Directions for Future Directions

We recognize limitations in our paper, which provide opportunities for future research. First, one should be cautious when extrapolating our findings beyond web-browser platforms. Particularly, one should be cautious to generalize our results to platforms with high market share, as platform's market share might be by far the most significant driver of complementors' continuance intention. To strengthen further the external validity of our finding, future research can explore PIC in other platform contexts (e.g., games, e-marketplaces, crowdfunding, and accommodations) and reveal the relative importance of the Complementor-PIC and Complement-PIC. Second, our sample includes web-browser extension developers from the United States and the United Kingdom. Future research can test the model with developers from other countries in order to increase the generalizability of the results. Lastly, we did not examine differences between professional extension developers, part-time commercial developers, and hobbyists or open-source developers. Comparisons between these groups could provide interesting insights and reveal the boundaries of generalizability for our research.

Chapter 4: Control Modes on Crowdfunding Platforms

Title: The Effects of Control Mechanisms on Complementors' Behavioral Intentions: An Empirical Study of Reward-Based Crowdfunding Platforms (2021)

Authors: Evgheni Croitor, Technical University of Darmstadt, Germany
Dominick Werner, Technical University of Darmstadt, Germany
Alexander Benlian, Technical University of Darmstadt, Germany

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Abstract

Although Information Systems research has been increasingly exploring the role of control mechanisms on digital platforms, empirical research on the effects of control mechanisms on complementors' behavioral intentions in platform ecosystems is sparse. Control mechanisms refer to measures employed by platform providers to influence desirable behaviors of complementors and thus to manage dynamics, growth, and evolution of their digital platforms. Drawing on IS control literature and goal attainment theory, we conducted an online survey with 116 complementors from two major reward-based crowdfunding platforms, Kickstarter and Indiegogo. Our findings reveal that input control (self control) decreases (increases) complementors' intention to stay on their respective digital platform. Furthermore, we shed light on the role of complementors' perceived effort, perceived usefulness and satisfaction in shaping these relationships. Thus, our findings contribute to the literature on digital platforms in general and control mechanisms in particular.

Keywords: Input Control, Self Control, Control Modes, Goal Attainment Theory, Continuance Intention, Switching Intention

4.1 Introduction

Digital platforms and their corresponding ecosystems have fundamentally changed the way products and services are created, distributed, and consumed (Constantinides et al., 2018). Platform providers deliberately open up their ecosystems and enable complementors to provide complements to their digital platforms, thereby increasing platforms' diversity and innovation (de Reuver & Bouwman, 2012; Ghazawneh & Henfridsson, 2013). For example, the overall number of projects submitted on Kickstarter and Indiegogo has increased from 270,000 to over 1,200,000 between 2013 and 2019 (Indiegogo, 2019; Kickstarter, 2019).

As digital platforms and their number of complementors and complements grow, platform providers need to employ control modes (i.e., input, behavior, output, self and clan control) to align their interests and strategies with those of the complementors (Wiener et al., 2016). In particular, two control modes are becoming increasingly important for platform providers: input control and self control. Input control can be described as the set of mechanisms used by the platform provider that screen and sort out complementors and their complements before entering the digital platform's ecosystem (Croitor & Benlian, 2019). Consider, for example, the input control on the Kickstarter platform: project creators must verify their identity and provide proof that their business is registered in the respective country. Furthermore, all projects must comply with platform provider-set rules and policies, thereby limiting the scope of projects allowed to be submitted (Kickstarter, 2020). Self control, on the other hand, occurs when platform providers encourage complementors to exercise self-regulation by providing tools for self-management and by structuring the platform environment appropriately (Ouchi, 1979). For example, to reinforce project creators' self-regulation, Indiegogo provides several tools which support project creators in project management, marketing, PR, and post campaign strategies.

Researchers have repeatedly investigated the effects of control modes on digital platforms (Croitor et al., 2020; Croitor & Benlian, 2019; Goldbach & Benlian, 2015a, 2015b; Goldbach et al., 2018; Goldbach et al., 2014; Thies et al., 2018; Tiwana, 2015a; Wessel et al., 2017) (an overview of these studies is presented in Table 4-1). However, prior IS research on control modes exhibits four particularly noteworthy shortcomings. First, although prior IS control research acknowledges the importance of investigating different control modes in combination (Choudhury & Sabherwal, 2003; Goldbach et al., 2018; Kirsch, 1997), particularly the effects of the increasingly important input control on digital platforms were thus far only investigated in isolation. Second, our understanding is incomplete as to why the effects of input and self control unfold and how perceived effort, perceived usefulness and satisfaction shape these relationships. Third, the extent literature on complementors' behavioral intentions focuses

primarily on the effects of control modes on complementors' continuance intention (e.g., Croitor et al., 2020; Croitor & Benlian, 2019; Goldbach et al., 2018), but neglected to investigate complementors' switching intention, which is an equally important factor for platforms' success and sustainability (Tiwana, 2015b). Lastly, previous studies on control modes in the context of crowdfunding platforms (e.g., Thies et al., 2018; Wessel et al., 2017) focused on the overall success of projects and thus, comprehensive insights from complementors' perspective are still missing.

Authors	Control Modes				
	Input	Behavior	Output	Self	Clan
Goldbach et al. (2014)	-	X	X	X	-
Goldbach and Benlian (2015a)	-	-	-	-	X
Goldbach and Benlian (2015b)	-	-	-	X	X
Tiwana (2015a)	X	-	-	-	-
Wessel et al. (2017)	X	-	-	-	-
Goldbach et al. (2018)	-	X	X	X	-
Thies et al. (2018)	X	-	-	-	-
Croitor and Benlian (2019)	X	-	-	-	-
Croitor et al. (2020)	X	-	-	-	-

Table 4-1: Prior Studies of Control Modes on Digital Platforms

To address these shortcomings, we seek to bridge the gap in understanding how input control and self control affect complementors' behavioral intentions (i.e., continuance and switching intentions) on digital platforms. Moreover, we intend to shed light on why the effects of control modes unfold. In sum, we investigate the following research question:

RQ: How and why do perceptions of input control and self control affect complementors' continuance and switching intentions on digital platforms?

To answer this research question, we conducted an online survey with 116 complementors from Kickstarter and Indiegogo, which are the two main reward-based crowdfunding platforms. Crowdfunding platforms are an established context to explore effects of control modes on complementors and their complements (Thies et al., 2018; Wessel et al., 2017), and thus is well-suited for our empirical investigation.

Our study makes several contributions to IS research and practice. First, we contribute to IS control literature by extending knowledge on the effects of input control and self control on digital platforms. Second, our study contributes to a more nuanced understanding of factors that explain complementors' behavioral intentions. Third, through the use of goal attainment theory, we shed light on factors through which the effects of control modes unfold on digital platforms (i.e., perceived usefulness, perceived effort and satisfaction). In terms of practical contributions, our research offers platform providers valuable insights on how their control mechanisms affect complementors' perceptions and thus their willingness to stay on and keep contributing to digital platforms, thereby nurturing platform health and sustainability.

4.2 Theoretical Background

4.2.1 Digital Platforms

Consistent with previous studies in IS and strategic management research we refer to digital platforms as infrastructure that mediates interactions between complementors and end-users (Eisenmann et al., 2011; Foerderer et al., 2018; McIntyre & Srinivasan, 2017). Complementors, as the focus of our research, are external parties that supply complements to the platform ecosystem, but are not directly related to the platform provider (Wiener et al., 2020). End-users, on the other hand, are individuals that use complements available in the platform ecosystem (Parker et al., 2017). For example, while Kickstarter and Indiegogo enable transactions by connecting project creators and backers, Steam links game developers with players. Platform providers design, develop, and govern the platform and thereby manage interactions between complementors and end-users.

Cross-side network effects play a crucial role in the sustainability of digital platforms, as they drive the evolution and growth of digital platforms. Specifically, the more complementors provide complements, the more end-users access the respective digital platform (Thies et al., 2018). In this regard, maintaining attractiveness for complementors is an important aspect for digital platforms to succeed in today's dynamic environment (Benlian et al., 2015). In order to increase complementors' intention to keep contributing to the platform and to decrease complementors' intention to leave the platform, platform providers exercise various forms of control modes.

4.2.2 Control Modes

Control modes represent the most important part of platform governance (Wiener et al., 2016) and are essential for platform success (Ghazawneh & Henfridsson, 2013). Control modes enable platform providers to align their interests and strategies with those of the complementors. IS

Control literature makes an explicit distinction between formal and informal control modes (Kirsch, 1997; Ouchi, 1979; Wiener et al., 2016).

Formal control modes (i.e., input, behavior and output control) are enforced by platform providers through specification and evaluation (Cardinal et al., 2004). In terms of input control, platform providers use specified gatekeeping and screening procedures to decide which complementors and complements are allowed to enter the respective platform (Croitor & Benlian, 2019). In terms of behavior control, platform providers evaluate complementors' behaviors on a digital platform to guide them toward desired outcomes. In contrast, under output control, complementors' performance targets are pre-specified as objectives, which are then evaluated, rewarded or punished by a platform provider.

Informal control modes (i.e., self and clan control), on the other hand, are built on meanings of self-regulation or shared norms and values of groups or individuals (Wiener et al., 2016). Self control occurs when platform providers encourage complementors to exercise self-regulation by providing tools for self-management and by structuring the platform environment appropriately (Ouchi, 1979). In contrast, clan control occurs when complementors' behavior is motivated by shared norms and values among groups with a common goal (Ouchi, 1979).

Both formal and informal control modes have been studied in the context of digital platforms and have been proven to be effective governance mechanisms for platform providers to align their interests and strategies with those of the complementors. However, our understanding of the effects of the combination of different control modes (i.e., input control and self control) is still limited. To understand why perception of input control and self control affect complementors' behavioral intentions, we examine how these control modes influence complementors' satisfaction as an important antecedent to complementors' behavioral intentions.

4.2.3 Goal Attainment Theory

In this section, we draw upon goal attainment theory (Briggs et al., 2006; Reinig, 2003) as the theoretical underpinning to develop our research model. Goal attainment theory (Briggs et al., 2006; Reinig, 2003) posits that individuals' satisfaction of attaining a certain goal is determined not solely based on what they gain, but according to the tradeoff between perceived benefits and perceived costs. Specifically, the goal attainment theory postulates the mediating role of perceived net goal attainment between perceived benefits, perceived costs and satisfaction. As such, the theory posits that perceived benefits and costs influence satisfaction not directly but through net goal attainment as the trade-off between these two aspects, which means that high levels of perceived benefits are not necessarily related to high levels of satisfaction. Likewise,

high levels of perceived costs are not necessarily related to low levels of satisfaction. Goal attainment theory is usually accompanied by a cost-benefit framework (Briggs et al., 2006). Within this framework, positive factors affecting perceived net goal attainment are considered benefits, whereas negative factors are considered costs. In our study, we conceptualize perceived usefulness as the benefit factor and perceived effort as the cost factor.

4.3 Research Model and Hypothesis Development

In this section, we draw on goal attainment theory (Briggs et al., 2006; Reinig, 2003) as the theoretical underpinning to develop our research model, as presented in Figure 4-1. In this model, perceived costs (i.e., perceived effort) and perceived benefits (i.e., perceived usefulness) are considered antecedents of perceived net goal attainment, which in turn influences complementors' satisfaction.

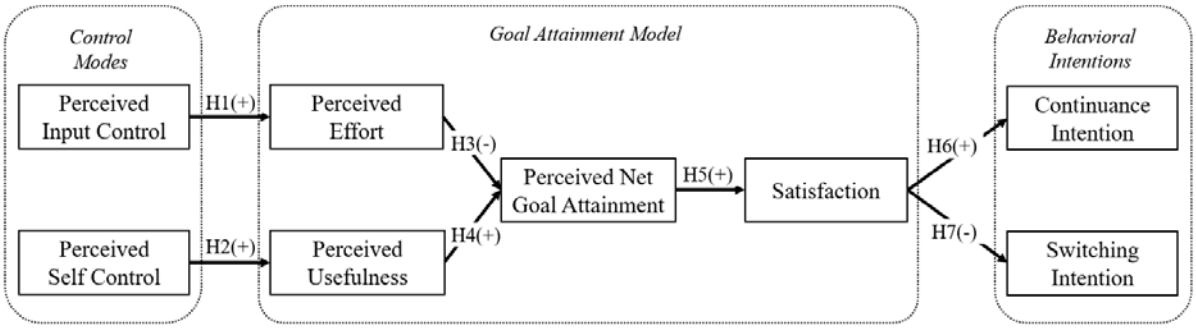

Figure 4-1: Research Model

We propose that perceived input control has a positive effect on perceived effort (H1) and perceived self control has a positive effect on perceived usefulness (H2). Furthermore, we propose that perceived effort has a negative effect on perceived net goal attainment (H3), whereas perceived usefulness has a positive effect on perceived net goal attainment (H4). We also propose that perceived net goal attainment positively influences satisfaction (H5). Lastly, we posit that satisfaction has a positive effect on continuance intention (H6) and a negative effect on switching intention (H7).

In the context of digital platforms, perceived effort is defined as the extent to which complementors believe providing a complement to a digital platform is associated with effort (Venkatesh et al., 2012). Complementors must fulfill requirements to provide sufficient information for the platform providers to individually decide whether or not to allow the submitted complement to enter the digital platform (Croitor & Benlian, 2019; Tiwana, 2015a). Both the collection as well as the submission of such information requires effort by the complementor. The higher the level of input control, the higher we expect the quantity and quality of information required, causing effort to rise. Thus, we hypothesize:

H1: Perceived input control has a positive effect on complementors' perceived effort.

We refer to perceived usefulness as the extent to which a platform is perceived as useful by complementors for their activities (Davis, 1989). Self control enables complementors to set their own goals and to regulate themselves concerning their activities. In this regard, complementors' perceptions of self-regulation have been found to relate to higher intrinsic motivation, perceived usefulness and satisfaction (Deci & Ryan, 2002; Pearce Craig et al., 2003). If complementors provide complements to a platform which supports complementors' self-interests and self-regulation, they are more likely to perceive the platform as useful for their activities. Therefore, we hypothesize:

H2: Perceived self control has a positive effect on complementors' perceived usefulness.

According to goal attainment theory, costs reduce individuals' perceived net goal attainment (Briggs et al., 2006; Reinig, 2003). In the context of digital platforms, complementors are confronted with costs in the form of effort to fulfill the platforms' requirements. Accordingly, the higher complementors' perceived effort is, the lower is their perceived net goal attainment, as higher effort is an obstacle for complementors to fulfill their objectives on the platform. Hence, we hypothesize:

H3: Perceived effort has a negative effect on complementors' perceived net goal attainment.

Goal attainment theory also posits that benefits increase individuals' perceived net goal attainment (Briggs et al., 2006; Reinig, 2003). In the context of digital platforms, benefits relate to complementors' perception of the usefulness of the platform. Accordingly, the higher complementors' perceived usefulness is, the higher is their perceived net goal attainment, as higher usefulness aids complementors in their objectives on the platform. Thus, we hypothesize:

H4: Perceived usefulness has a positive effect on complementors' perceived net goal attainment.

A key proposition of goal attainment theory is that perceived net goal attainment determines individuals' satisfaction (Sun et al., 2014). Satisfaction refers to complementors' evaluation and affective response to the overall experience with the platform (Oliver, 1980). Previous studies have empirically shown this positive effect on individuals' satisfaction in different settings (Briggs et al., 2006; Reinig, 2003). Applied to the context of digital platforms, the higher complementors' perceived net goal attainment is, the more satisfied do they feel using a digital platform, as a more positive balance between costs and benefits improves complementors' experience with the platform. Therefore, we hypothesize:

H5: Perceived net goal attainment has a positive effect on complementors' satisfaction.

In the context of digital platforms, continuance intention refers to complementors' intention to keep contributing complements to a respective digital platform (Bhattacherjee, 2001). Previous studies have shown that complementors' satisfaction is a decisive predictor of their continuance intention (Croitor et al., 2020; Kim et al., 2016). Consequently, we suggest that complementors' satisfaction with a digital platform leads to higher continuance intentions. Hence, we hypothesize:

H6: Satisfaction has a positive effect on complementors' continuance intentions.

We refer to complementors' switching intentions as complementors' intentions to stop contributing complements to the current platform and their simultaneous intention to instead provide their complements to other (rival) platforms (Antón et al., 2007). Previous studies have shown that dissatisfaction, which refers to individuals' state of not being satisfied, has a positive effect on individuals' switching intentions (Tang et al., 2019). Accordingly, we suggest that complementors' satisfaction with a digital platform leads to lower switching intentions. Thus, we hypothesize:

H7: Satisfaction has a negative effect on complementors' switching intentions.

4.4 Methodology

Our empirical setting comprises two major reward-based crowdfunding platforms, Kickstarter and Indiegogo. Generally, reward-based crowdfunding is used for creative projects (Wessel et al., 2017). On Kickstarter and Indiegogo, project creators collect monetary support from backers all over the world by offering different forms of reward (Wessel et al., 2019) (e.g., future product, usually with a discount in price or early delivery). Kickstarter employs the so-called "all or nothing" business model, in which a minimum campaign goal is specified, and a limited time period is given to achieve this goal. The project creator receives the funds pledged to his or her project only if the specified amount is reached within the respective time period. Indiegogo, on the other hand, allows project creators to choose between "all or nothing" and "flexible funding". Flexible funding enables project creators to receive the pledged funds that they accumulated throughout the duration of the project even if the project has failed (i.e., does not reach the specified amount within the predefined time period).

Kickstarter and Indiegogo offer ideal settings for our empirical analyses for several reasons: First, reward-based crowdfunding platforms are typical digital platforms with complementors (i.e., project creators) offering complements (i.e., projects) to end-users (i.e., backers). Second, since the policy change in June 2014 on Kickstarter (i.e., removal of manual evaluation that

was mandatory for each project) (Wessel et al., 2017), both platforms employ similar input and self control mechanisms, allowing to investigate both digital platforms from the complementors' perspective at the same time. Finally, during the past few years, over 1,200,000 total projects were submitted on Kickstarter and Indiegogo, which enabled project creators to collect billions of dollars.

4.4.1 Data Collection and Sample Description

To test our research model, we developed and conducted an online survey addressing complementors on Kickstarter and Indiegogo over a period of two months. Complementors were contacted via chat forums and social media channels, such as Facebook and Reddit. As an incentive, we assured to fund the planting of a tree for every completed survey. After removing five cases due to an implausibly short response time (less than 100 seconds compared to an overall mean of 257 seconds), we received 116 valid responses. The majority of our respondents were project creators on Kickstarter (67.2%), whereas the rest was using Indiegogo (32.8%). Sample demographics are presented in Table 4-2.

Item	Category	N	%
Gender	Male	82	70.7
	Female	34	29.3
Age	18 – 24	10	8.6
	25 – 34	41	35.3
	35 – 44	29	25.0
	45 – 54	20	17.2
	55+	16	13.8
Education	No schooling completed	2	1.7
	High school graduate	29	25.0
	Bachelor's degree	43	37.1
	Master's degree	37	31.9
	Doctorate degree	5	4.3
Country	United States	38	32.8
	Germany	13	11.2
	United Kingdom	12	10.3
	Other	53	45.7

Table 4-2: Sample demographics (N = 116)

As we collected self-reported data from a single data source, common method bias might be a potential concern. We performed several steps to reduce any common method bias that might arise (Podsakoff et al., 2003). First, we informed all respondents that their answers would be anonymous, that there were no right or wrong answers, and that responses would be used solely for research purposes. Second, we also employed the marker-variable technique (Malhotra et al., 2006) and included a marker-variable (blue attitude) in our survey. This variable did not create any significant change in the variance explained in the dependent variables. These procedures gave us confidence that common method bias is not a major concern in this study.

4.4.2 Measurement

All measures in our study were based on established scales from previous studies. Consistent with previous studies on digital platforms, we measured perceived input control (PIC) using four items (Croitor & Benlian, 2019), perceived self control (PSC) using three items (Tiwana & Keil, 2009), perceived effort (PE) using four items (Venkatesh et al., 2012), perceived usefulness (PU) using four items (Agarwal & Karahanna, 2000), perceived net goal attainment (PNGA) using four items (Sun et al., 2014), satisfaction (SAT) using four items (Bhattacherjee, 2001), continuance intention (CI) using three items (Schlosser et al., 2006), and switching intention (SI) using three items (Lin et al., 2012). All items were measured on a 7-point Likert-type scale, ranging from 1 (strongly disagree) to 7 (strongly agree). The final questionnaire consisted of 29 items (see Table A9 of the Appendix). In addition, we included control variables to account for alternative explanations. We measured complementors' gender, age, education, and country of residence (see Table 4-2).

4.5 Analysis and Results

We used structural equation modeling with partial least squares (PLS) using SmartPLS 3.2.8 to evaluate the measurement models and to test our research hypotheses (Hair et al., 2014). Consistent with prior research using PLS models, we first assess our measurement model and then evaluate our structural model (Hulland, 1999).

4.5.1 Measurement Model Assessment

Following guidelines of Bhattacherjee and Premkumar (2004), we analyzed our constructs regarding convergent validity and discriminant validity. Convergent validity was evaluated using three criteria recommended by Fornell and Larcker (1981) (see Table 4-3). First, the factor loadings of all items were above the threshold of 0.70 and significant ($p < 0.001$) (Carmines & Zeller, 1979). Second, composite reliability (CR) of all constructs was above the threshold of 0.80 (Bagozzi & Yi, 1988). Lastly, average variance extracted (AVE) of all

constructs was above 0.50 (Gounaris & Dimitriadis, 2003). Hence, these results demonstrate that our measurement model has adequate convergent validity.

Constructs	Mean (SD)	Factor loadings	CR	AVE
PIC	3.65 (1.61)	0.82-0.93	0.91	0.70
PSC	5,81 (1.42)	0.83-0.84	0.90	0.76
PE	3.89 (1.72)	0.85-0.88	0.92	0.75
PU	5.18 (1.61)	0.83-0.88	0.92	0.74
PNGA	5.61 (1.48)	0.88-0.93	0.95	0.84
SAT	5.12 (1.39)	0.89-0.95	0.95	0.84
CI	5.47 (1.70)	0.93-0.96	0.96	0.90
SI	3.04 (1.76)	0.94-0.95	0.96	0.90

Table 4-3: Results of the Convergent Validity Analysis

Discriminant validity describes the extent to which measurement constructs differ from one another (O'Leary-Kelly & J. Vokurka, 1998) and can be tested using Heterotrait-Monotrait (HTMT) analysis. The highest HTMT value of 0.75 was between perceived usefulness and perceived net goal attainment (see Table 4-4). Since all values were below the recommended threshold of 0.90 (Henseler et al., 2015), we conclude that our measurement model has good discriminant validity. After establishing reliability and validity of the constructs, we continue with the assessment of our structural model, which involves examining the relationships between the constructs (Hair et al., 2014).

	PIC	PSC	PE	PU	PNGA	SAT	CI
PSC	0.25						
PE	0.60	0.19					
PU	0.16	0.13	0.10				
PNGA	0.10	0.16	0.21	0.75			
SAT	0.17	0.08	0.10	0.66	0.65		
CI	0.10	0.24	0.27	0.55	0.60	0.56	
SI	0.13	0.14	0.21	0.52	0.59	0.31	0.44

Table 4-4: Results of the Discriminant Validity Analysis

4.5.2 Structural Model Assessment

The results of the structural model analysis, including standardized path coefficients and their statistical significance levels, are displayed in Figure 4-2. We first tested for alternative explanations by analyzing the effects of our control variables, but did not find any significant impact of gender, age, education or country of residence on complementors' continuance intention or switching intention (all $p > 0.05$).

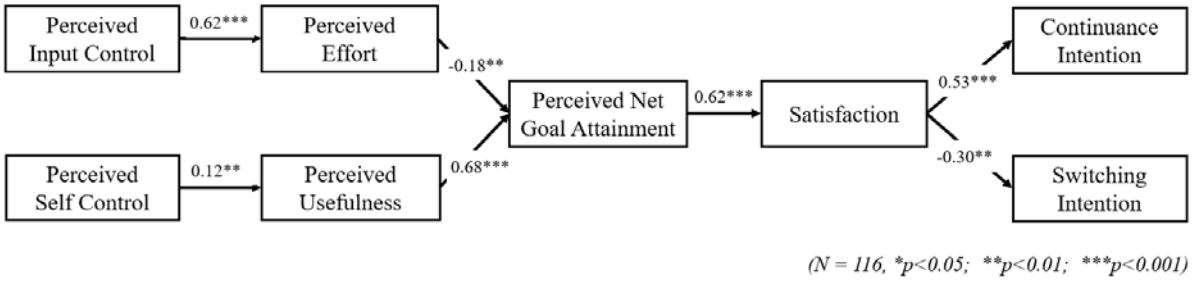

Figure 4-2: Model Testing Results

Based on the structural analysis, our model explained 39% of the variance in perceived effort, 34% of the variance in perceived usefulness, 51% of the variance in perceived net goal attainment, 38% of the variance in satisfaction, 28% of the variance in continuance intention, and 9% of the variance in switching intention.

Perceived input control had a positive significant effect on perceived effort ($\beta = 0.62$, $p < 0.001$), **supporting H1**. Perceived self control had a positive significant effect on perceived usefulness ($\beta = 0.12$, $p < 0.01$), **supporting H2**. Furthermore, we also found a negative significant effect of perceived effort on perceived net goal attainment ($\beta = -0.18$, $p < 0.01$) and a positive significant effect of perceived usefulness on perceived net goal attainment ($\beta = 0.68$, $p < 0.001$), **supporting H3 and H4**. Perceived net goal attainment had a positive significant effect on satisfaction ($\beta = 0.62$, $p < 0.001$), **supporting H5**. Finally, we found a positive significant effect of satisfaction on continuance intention ($\beta = 0.53$, $p < 0.001$) and a negative significant effect of satisfaction on switching intention ($\beta = -0.30$, $p < 0.01$), **supporting H6 and H7**.

4.6 Discussion

The main objective of this study was to investigate whether and why perceptions of input control and self control affect complementors' intention to stay on and keep contributing complements to a platform. Four key findings can be derived from this study. First, we find that perceived input control increases complementors' perceived effort due to the collection and submission of information required by platform providers. Second, perceived self control increases complementors' perceived usefulness of a digital platform, as setting one's own goals aids complementors to regulate themselves and thus thrive on the platform. Third, perceived

effort and perceived usefulness, the two opposing factors evaluated by complementors when interacting with the platform, jointly affect overall perceived net goal attainment. Lastly, consistent with previous studies (Reinig, 2003; Sun et al., 2014), we show that perceived net goal attainment exerts a positive impact on complementors' satisfaction, reflecting complementors' importance of attaining their goal. Furthermore, our study confirms the relationship between satisfaction and the behavioral intentions of continuance intention (Croitor et al., 2020) and switching intention (Liang et al., 2018). In summary, we demonstrate a link between perceptions of input control and self control mechanisms on complementors' continuance and switching intentions.

Our study makes several contributions to IS research and practice. First, we contribute to IS control literature by extending knowledge on the consequences of different control modes. Specifically, we increase our understanding of control modes by showing how perceived input control and perceived self control affect complementors' behavioral intentions on digital platforms. Second, whereas extent literature focuses primarily on the effects of control modes on complementors' continuance intention (e.g., Croitor et al., 2020; Croitor & Benlian, 2019; Goldbach et al., 2018), we contribute by extending the research scope to complementors' switching intention, which is an equally important factor for a platform's success and sustainability (Tiwana, 2015b). A third contribution of this study relates to the explanation of why perceived input control and perceived self control affect complementors' behavioral intentions on digital platforms. By identifying perceived usefulness, perceived effort, and satisfaction as underlying variables, our study contributes to a more nuanced understanding of factors that explain complementors' behavioral intentions.

In terms of practical contributions, our research offers platform providers valuable insights on how their control mechanisms affect complementors' perceptions and thus their willingness to stay on and keep contributing to digital platforms. Whereas input control deters complementors' participation, platform providers can apply intensified self control to increase complementors' continuance intention and thereby nurture platform health and sustainability.

Despite valuable contributions, our study has some limitations which provide opportunities for future research. First, our study was conducted in the context of reward-based crowdfunding platforms. We call for future studies to replicate our findings in other platform contexts to confirm generalizability. Second, in our study, we focused only on input and self control modes. Future studies may extend this article's model by including and comparing perceptions of further types of control modes (e.g., behavior, output and clan control). Finally, we measured complementors' behavioral intentions rather than actual behaviors. However, prior studies have

shown that behavioral intentions correlate with actual behaviors (Venkatesh et al., 2012). Therefore, measuring continuance and switching intentions may provide adequate indication of complementors' actual behaviors. In conclusion, we believe that our study offers unique insights into the various effects and dynamics a platform provider can evoke when managing control mechanisms.

Chapter 5: Control Modes on E-Marketplace Platforms

Title: Opposing Effects of Input Control and Clan Control for Sellers on E-Marketplace Platforms (2021)

Authors: Evgheni Croitor, Technical University of Darmstadt, Germany
Dominick Werner, Technical University of Darmstadt, Germany
Martin Adam, Technical University of Darmstadt, Germany
Alexander Benlian, Technical University of Darmstadt, Germany

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Abstract

E-marketplace platforms focus on attracting and retaining sellers to secure the platform's long-term viability and success. Although sellers' behavioral intentions have been linked to control modes deployed on e-marketplace platforms, little is known about how and why perceptions of input control and clan control affect sellers' crucial behavioral outcomes. Drawing on IS control literature, we conducted two online surveys with sellers on Amazon (n = 286) and Etsy (n = 185). Our results revealed that perceived input control had a negative effect on sellers' perceived usefulness, satisfaction, and continuance intentions, whereas positive effects were observed with perceived clan control. In addition, we find that intrinsic motivation mediates the observed direct effects. Our study contributes to the literature by introducing control modes in the context of e-marketplace platforms and examining the effects of input control and clan control on sellers' beliefs, attitudes, and behavioral intentions. Furthermore, our study has important practical implications for platform providers in how to apply different control mechanisms and increase complementors' willingness to keep contributing to e-marketplace platforms, thereby nurturing platform health and sustainability.

Keywords: Input Control, Clan Control, E-Marketplace Platforms, Intrinsic Motivation, Continuance Intention

5.1 Introduction

Over the past decade, digital platforms (e.g., Amazon, GoFundMe, Airbnb, and Android) have emerged as some of the most successful business models and venues of innovation (de Reuver et al., 2018; Tan et al., 2015), fundamentally changing the way products and services are created, distributed, and maintained (Constantinides et al., 2018; de Reuver et al., 2018). Hereby, the platforms' economic viability and success primarily results from complementors (e.g., sellers, campaign organizers, developers, and accommodation owners) and their provided complements (e.g., products, crowdfunding campaigns, accommodations, and mobile apps) (Boudreau, 2012; Huang et al., 2017; Thies et al., 2016). In this regard, attracting complementors to a digital platform is considered important due to cross-side network effects: The higher the number of complementors offering complements on a platform, the higher the number of end-users who access the platform, thereby increasing the value of the platform as a whole (Galbreth et al., 2005; Katz & Shapiro, 1985). For example, on Etsy, an e-marketplace platform for handcrafted and vintage products, between 2013 and 2019 the number of sellers (i.e., complementors on e-marketplace platforms) more than doubled from 1.1 million to 2.7 million active sellers, while during the same period, the number of buyers (i.e., end-users on e-marketplace platforms) more than tripled from 14.0 million to 45.7 million active buyers (Etsy, 2019).

As the number of complementors and offered complements grow, platform providers need to exercise control to align their interests and strategies with those of the complementors (Saunders et al., 2020). To manage complementors and their complements, platform providers draw on control modes (i.e., the set of mechanisms to control complementors and their complements on digital platforms) (Tiwana et al., 2010). IS scholars started to investigate control modes on digital platforms with a focus on contexts such as mobile apps (Croitor & Benlian, 2019; Goldbach et al., 2018), web browsers (Croitor et al., 2020; Tiwana, 2015a), and crowdfunding (Thies et al., 2018; Wessel et al., 2017).

Yet surprisingly, IS research has hitherto neglected the key role of control modes on e-marketplace platforms, which offer a unique and intriguing context for two main reasons: First, the prevalence and size of e-marketplace platforms have led to a tremendous relevance in the digital era (Li et al., 2019; Sun et al., 2020). Part of their central role is attributed to transactions on e-marketplace platforms typically being of higher value than transactions on other digital platforms such as for mobile apps and web browser, where many complements are offered free of charge. As such, stakes are high for buyers on e-marketplace platforms, thereby making effective control mechanisms ever more important to ensure adequate quality of complements.

Second, e-marketplace platforms offer largely physical goods as complements, compared to primarily digital complements on mobile apps, web browser and crowdfunding platforms. Consequently, platform providers need to control complementors more intensely to ensure high complement quality immediately upon publication, as subsequent updates for physical (vs. digital) goods are much harder to provide. In addition, for platform providers to evaluate a complement, access to the complement's information is required (Kirsch, 1996), which is more difficult in case of physical instead of digital goods, forcing platform providers to change their control implementation (e.g., the quality of a complement cannot be reviewed in an automatized, instantaneous review process as is commonplace for mobile apps and web browser extensions). Taken together, control on e-marketplace platforms differs in its role, importance and implementation from previously investigated platform contexts and thus requires a more nuanced understanding by IS research.

In the context of e-marketplace platforms, two control modes are particularly important for platform providers and have been highlighted in previous calls for research (Goldbach et al., 2018): input control and clan control (Boon et al., 2015; Tiwana, 2015a; Zifla & Wattal, 2019). Input control can be described as the set of mechanisms used by the platform provider to screen and sort out sellers and their products before entering the e-marketplace platform (Croitor & Benlian, 2019; Tiwana, 2015a). Consider, for example, the input control on the Etsy platform: Sellers have to (1) sell products that are made or designed only by them, (2) describe every person involved in the making of a product, and (3) use their own photographs of these products. Input control is especially relevant in loosely coupled organizational structures, such as e-marketplace platforms, where it is less viable for platform providers to control sellers' product creation process (Ouchi, 1979; Tiwana, 2015a). Clan control, on the other hand, refers to the set of mechanisms used by the platform provider to establish shared norms, values and strong affiliation feelings among complementors (Ouchi, 1979, 1980). For example, to reinforce seller participation, knowledge sharing and content curation, Etsy provides IT-features for sellers to give feedback to other sellers, to promote other sellers' products and to join seller groups (Zifla & Wattal, 2019). Clan control is especially relevant on digital platforms that strive to build and nurture communities, such as e-marketplace platforms, where sellers rely on long-term relationships (Kirsch et al., 2002; Kohli & Kettinger, 2004). For platform providers who are trying to attract and motivate sellers to contribute to their e-marketplace platform, it is important to understand whether and how input and clan control influence seller participation: Will input and clan control undermine or amplify sellers' continuance intentions and do they have similar or opposing effects?

Furthermore, although previous studies have investigated the effects of control modes on complementors' behavioral intentions on digital platforms, research has provided little explanation about *why* input control and clan control affect complementors' behavioral intentions. In this regard, a factor repeatedly mentioned to relate to sellers' intentions to continue selling products is their motivation (Sun, 2010). Given that, in the context of e-marketplace platforms, sellers are afforded fairly great freedom to choose what and how much they offer on which platform, sellers' continuance intentions are likely to be driven primarily by their intrinsic motivation. Although intrinsic motivation is well studied as an important factor influencing sellers' beliefs, attitudes and behavioral intentions on e-marketplace platforms (Sun, 2010), research considering its potentially mediating role to explain the mechanism of input control and clan control is still absent.

In summary, we lack important knowledge on *how* perceptions of input control and clan control affect sellers' beliefs (i.e., perceived usefulness), attitudes (i.e., satisfaction) and behavioral intentions (i.e., continuance intentions) on e-marketplace platforms. Moreover, our understanding is incomplete as to *why* the effects of these control modes unfold and to what extent intrinsic motivation serves as a mediator. As such, we set out to investigate our research question:

RQ: How and why do perceptions of input control and clan control affect sellers' beliefs, attitudes and behavioral intentions on e-marketplace platforms?

To answer our research question, we draw on IS control literature and conducted two online surveys with sellers on the e-marketplace platforms Amazon and Etsy, which both apply input control and clan control and therefore offer a highly suitable context for our research. The results of our empirical study show that sellers' perceptions of input control and clan control have opposing effects on sellers' beliefs, attitudes, and behavioral intentions and that these effects are mediated by intrinsic motivation. Furthermore, by testing our hypotheses on two platforms, we were able to ensure that our results are robust across platforms of different sizes and different product portfolios.

Our study makes several contributions to research on platform control. First, by studying control modes on e-marketplace platforms, our work extends the research scope of increasing literature on platform control (Croitor et al., 2020; Goldbach et al., 2018; Wessel et al., 2017) by the unique and thus far disregarded context of e-marketplace platforms. Therefore, our work advances the literature by empirically testing the influence of control modes on complementors' crucial behavioral outcomes on digital platforms in general and e-marketplaces in particular. Table A10 of the Appendix presents a list of previous studies of control modes on digital

platforms and shows how our study extends prior research. Second, by studying effects of both input control and clan control on complementors' beliefs, attitudes, and behavioral intentions, our study extends prior research on platform control that has examined the effects of input control and clan control separately. Third, we shed light on the mechanisms through which the effects of input control and clan control affect complementors' beliefs, attitudes, and behavioral intentions by revealing intrinsic motivation as a mediator for both control modes. We also provide practical implications that are critical for platform providers to develop different control mechanisms, which can increase complementors' willingness to stay on and keep contributing to e-marketplace platforms, thereby nurturing platform health and sustainability.

5.2 Theoretical Background

5.2.1 Control on E-Marketplace Platforms

Prior IS and strategic management research has defined and conceptualized e-marketplace platforms as infrastructure that mediates interactions between sellers and buyers (Eisenmann et al., 2011; Foerderer et al., 2018; McIntyre & Srinivasan, 2017). Unlike intermediaries on traditional markets (e.g., retail stores), platform providers of e-marketplace platforms do not take ownership of the products and services transacted (Hagiu & Yoffie, 2009). Instead, e-marketplace platforms generate value for sellers and buyers by facilitating their transactions with one another, hence improving correspondence between supply and demand and thus enhancing market efficiency (Hagiu, 2006).

One important objective of platform providers of e-marketplace platforms is to increase their base of sellers, which consequently attracts more buyers due to cross-side network effects (Galbreth et al., 2005; Katz & Shapiro, 1985; Thies et al., 2018). However, growing a large group of sellers offering a broad variety of products also creates risks, as products that exhibit low quality or that are a misfit to the platform may harm the quality and reputation of the platform (Tiwana et al., 2010; Wareham et al., 2014). Therefore, a major challenge for platform providers on such e-marketplace platforms refers to governance in general (Song et al., 2018) and control over sellers' and their products in particular (Tiwana et al., 2010). In the context of e-marketplace platforms, control refers to means through which platform providers ensure that sellers and their products are aligned with what is in the interests of the e-marketplace platform (Wiener et al., 2019). IS control literature draws a fundamental distinction between control modes, which can be divided into formal and informal types of control (Kirsch, 1997; Ouchi, 1979; Wiener et al., 2016). Formal control modes (i.e., input control, behavior control, and outcome control) are enforced by platform providers through specification and evaluation (Cardinal, 2001; Cardinal et al., 2004). In contrast, informal control modes (i.e., self control

and clan control) are built on meanings of self-regulation or shared norms and values of groups or individuals (Wiener et al., 2016). In this study, we investigate input control and clan control, as both control modes have been emphasized to increase in importance for e-marketplace platforms (Boon et al., 2015; Tiwana, 2015a; Zifla & Wattal, 2019).

Input control refers to platform providers using gatekeeping and screening procedures to decide which sellers and products are allowed to enter the respective platform (Croitor & Benlian, 2019). Recently, IS research has paid more attention to input control in a broad context of platforms: Within crowdfunding, relaxing input control has been linked to decreasing quality and increasing quantity of submitted campaigns (Thies et al., 2018; Wessel et al., 2017), whereas in the context of web browsers (Croitor et al., 2020; Tiwana, 2015a) and mobile applications (Croitor & Benlian, 2019) developers' perceptions of higher input control negatively impacted their continuance intentions. Input control becomes especially relevant in loosely coupled organizational structures, such as e-marketplace platforms, where it is less viable for platform providers to control sellers' product creation process (Ouchi, 1979; Tiwana, 2015a). Within the context of e-marketplace platforms, platform providers exercise input control by setting a range of requirements: Amazon, for example, requires its sellers to ensure legality of the products, to adhere to predefined product categories, and to provide pictures that exceed a minimum resolution (Amazon, 2020). Another example, the e-marketplace platform Etsy, asks its sellers to exclusively sell products that are made or designed by them, to describe every person involved in the making of a product, and to use their own photographs of these products (Etsy, 2020).

The second control mode investigated in this study, clan control, takes an informal approach to direct, influence or regulate sellers to achieve e-marketplace platform goals by drawing on sellers as a clan. A clan is a culturally homogeneous group whose members share common beliefs, norms and values (Ouchi & Price, 1978). Unlike input control, which relies on formal power or organizational authority, exercising clan control builds on regular interactions and information sharing among sellers to spread these shared beliefs, norms and values (Chua et al., 2012). IS research investigating clan control on platforms thus far found positive effects on product performance as well as success (Goldbach & Benlian, 2015a), and found indication that perceived clan control increases sellers' continuance intention (Goldbach & Benlian, 2015b). Clan control is especially relevant for groups, such as sellers on e-marketplace platforms, when outcomes (e.g., product sales) can vary substantially and when behavior (e.g., how sellers should create their products) is hard to specify (Kirsch, 2004; Kohli & Kettinger, 2004). E-marketplace platforms harness clan control to reinforce seller participation, knowledge sharing

and content curation: The platform Etsy, for example, encourages its sellers to give feedback to other sellers, to select their favorite products of other sellers and to join seller groups (Zifla & Wattal, 2019).

Although prior studies have investigated effects of input control and clan control in different platform contexts, the effects of control modes on e-marketplace platforms have been largely overlooked. Furthermore, our understanding of the mechanism of the combination of input control and clan control is still limited, as previous research investigated the effects of input control or clan control separately. To understand why perceptions of both control modes affect sellers' perceived usefulness, satisfaction, and continuance intentions, we examine how control influences sellers' intrinsic motivation as an important antecedent to sellers' behavioral intentions (Sun, 2010).

5.2.2 Sellers' Intrinsic Motivation

Intrinsic motivation refers to individuals' motivation to complete a task or perform an action out of own interest, enjoyment and for the sake of the activity itself (Deci & Ryan, 1985). Intrinsic motivation is explained by self-determination theory, which considers individuals' fundamental needs for autonomy, relatedness and competence (Gagné & Deci, 2005; Ryan & Deci, 2000; Sheldon Kennon et al., 2003). The need for autonomy is an individual's innate psychological desire to be free to choose their course of action. Any restriction to individuals' autonomy, for example through formal requirements, reduces individuals' intrinsic motivation (Thatcher et al., 2012). The need for relatedness refers to individuals' desire to experience a sense of belonging or connectedness to other individuals. Any measures promoting a sense of relatedness, for example by communicating shared norms and values, increase individuals' intrinsic motivation (Sheldon Kennon et al., 2003). Finally, the need for competence is individuals' innate psychological desire of being effective in dealing with the environment in which a person finds oneself.

Previous IS studies investigated the influence of intrinsic motivation as a driver of individuals' behavior on platforms in various contexts, such as completing tasks on crowdsourcing platforms (Kaufmann et al., 2011), sticking with e-learning platforms (Ho, 2010), competing in co-creation platforms (Zheng et al., 2011), developing apps for social software platforms (Hilkert et al., 2010) and sharing knowledge in enterprise social media platforms (Rode, 2016). Moreover, first studies have linked intrinsic motivation to platform control: In the context of mobile application platforms, developers' intrinsic motivation has been identified to explain why informal control modes increase application quality (Goldbach & Benlian, 2015b). Nevertheless, these findings are limited in that they cannot explain the mechanisms when both

formal and informal control modes are employed simultaneously. As such, research has yet to investigate whether intrinsic motivation can explain why perceptions of both input control and clan control affect sellers' beliefs (i.e., perceived usefulness), attitudes (i.e., satisfaction) and behavioral intentions (i.e., continuance intentions) on e-marketplace platforms. Given that e-marketplace platforms benefit from sellers who are eager to invest their time and effort into selling on the platform, we focus on the role of sellers' intrinsic motivation in order to analyze the effects between perceptions of control modes and sellers' crucial behavioral outcomes.

5.3 Research Model and Hypothesis Development

5.3.1 Research Model

In this section, we develop our research model as illustrated in Figure 5-1. Following guidelines by Hong et al. (2014) on developing context-specific models, we adopted the established model of IS continuance by Bhattacherjee (2001). This model is particularly suitable for our study for two reasons: First, in line with our objective of investigating sellers' long-term intentions, the IS continuance model captures sellers' post-adoption behaviors (i.e., continued use rather than first-time use of the e-marketplace platform). Second, the model improves our ability to explain sellers' continuance intentions based on both beliefs (i.e., perceived usefulness) and attitudes (i.e., satisfaction) of sellers.

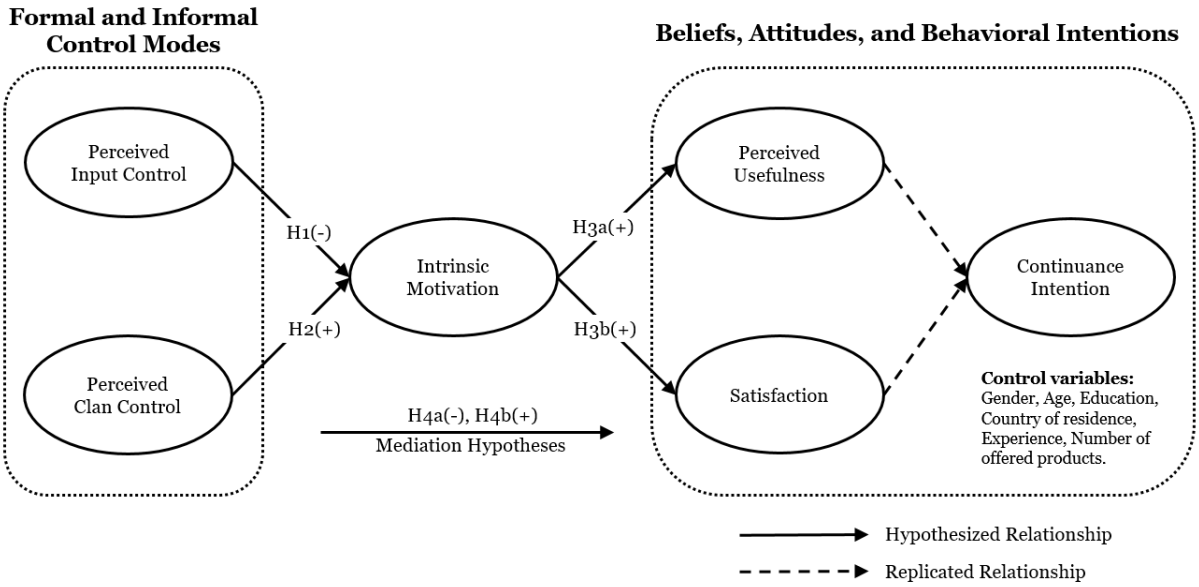

Figure 5-1: Research Model

We propose that perceived input control has a negative effect on sellers' intrinsic motivation (H1), whereas perceived clan control is expected to exert a positive effect on sellers' intrinsic motivation (H2). Furthermore, we propose that sellers' intrinsic motivation affects sellers' beliefs (i.e., perceived usefulness, H3a) and attitudes (i.e., satisfaction, H3b). Consequently, we argue that intrinsic motivation mediates the effect of perceptions of both control modes on

sellers' beliefs (i.e., perceived usefulness) and attitudes (i.e., satisfaction) and subsequently behavioral intentions (i.e., continuance intention, H4a,b). We do not hypothesize for any effect between perceived usefulness, satisfaction and continuance intention, as prior IS research has consistently shown that individuals' intentions to contribute to a platform is affected by their satisfaction with and perceived usefulness of the platform (e.g., Croitor et al., 2020; Kim et al., 2016).

5.3.2 Hypothesis Development

To first derive how perceived input control and perceived clan control affect sellers' intrinsic motivation, we consider how intrinsic motivation emerges. According to self-determination theory, intrinsic motivation is the result of the fulfilment of the three psychological needs autonomy, competence and relatedness (Gagné & Deci, 2005; Ryan & Deci, 2000; Sheldon Kennon et al., 2003). In the case of perceived input control, we focus on sellers' sense of autonomy, which refers to whether individuals feel that they define and control the manner in which tasks are executed (Hall, 1968). Autonomy is particularly important to individuals when tasks require specialized knowledge (e.g., managing a portfolio of products) and individuals believe they are the only ones qualified to decide how their work should be performed. Any restriction of individuals' autonomy is expected to impact their intrinsic motivation (Thatcher et al., 2012) of performing a task.

Linking to individuals' autonomy, perceived input control in the context of e-marketplace platforms primarily describes sellers' perceptions of barriers complicating the release of new products on the platform through gatekeeping and screening procedures. If sellers are restricted in their freedom to choose which products they are allowed to sell, part of their psychological need for autonomy is unmet. In turn, their intrinsic motivation is impaired. The higher the level of perceived input control, the less autonomous will sellers feel and the less will they experience intrinsic motivation. Therefore, we hypothesize:

H1: Perceived input control has a negative effect on sellers' intrinsic motivation.

Aside from autonomy, individuals' experience of intrinsic motivation is also determined by their need for relatedness, which describes the desire to experience a sense of belonging or connectedness to other individuals (Ryan & Deci, 2000). To this end, the perception of clan control is particularly relevant. Clan control is based on communicating shared beliefs, norms and values and on reducing differences in individuals' views (Chua et al., 2012; Kirsch, 1997). Clan control is achieved when individuals internalize the common goals and strategies exchanged through regular interactions, thereby becoming part of the clan (Kirsch et al., 2002).

Members of a clan typically share knowledge and discuss issues openly, affording each member the possibility to express their competence and share their expertise (Gopal & Gosain, 2010). Additionally, working with individuals with similar mindsets and goals fosters commitment to a group and a homelike feeling (Das & Teng, 2001; Ouchi, 1980).

Applied to the context of e-marketplace platforms, the perception of clan control based on common beliefs, norms and values between sellers facilitates a sense of relatedness and belonging to the seller community. According to self-determination theory, satisfying sellers' need for relatedness increases sellers' intrinsic motivation of selling products. Therefore, we hypothesize:

H2: Perceived clan control has a positive effect on sellers' intrinsic motivation.

We consider intrinsic motivation to link to the antecedents of the IS continuance model. We start with the link to sellers' beliefs in the form of perceived usefulness. We refer to perceived usefulness as the extent to which a platform is perceived as useful by sellers for their selling performance (Davis, 1989). Previous studies indicate that perceived usefulness is subject to individuals' intrinsic motivation: Intrinsically motivated individuals spend more time on tasks and exhibit increased deliberation and thoroughness of cognitive processing (Bagozzi et al., 1999; Mano, 1992). In turn, this higher level of involvement enhances individuals' perceptions of usefulness (Batra & Ray, 1986; Venkatesh et al., 2002).

Applied to the context of e-marketplace platforms, if sellers are intrinsically motivated and enjoy selling products on the platform, they are more likely to perceive the platform as useful for selling their products. This logic is supported by previous studies indicating that sellers' perceived enjoyment increases their perceptions of usefulness of online markets (Sun, 2010). Thus, we conclude:

H3a: Intrinsic motivation has a positive effect on sellers' perceived usefulness.

We furthermore contend that intrinsic motivation influences sellers' satisfaction. Generally, satisfaction describes individuals' emotional reaction to their experiences (Igbaria & Chidambaram, 1997). According to Bhattacherjee (2001), satisfaction with an IS system results from the repeated use of the system. The assessment of the system's performance in comparison to the individuals' expectations then determines the level of satisfaction experienced. This assessment is influenced by individuals' intrinsic motivation: As individuals experiencing higher levels of intrinsic motivation strive to complete a task out of own interest and for the sake of the activity itself (Deci & Ryan, 1985), they are likely to engage more intensely with the IS system and to thus harness its capabilities to a greater extent. Together with the positive

affective state induced by intrinsic motivation, individuals therefore evaluate the system's performance more positively, leading to greater satisfaction.

In the context of e-marketplace platforms, where sellers' satisfaction refers to their evaluation and affective response to the overall experience with the platform (Oliver, 1980), we therefore expect that sellers who are intrinsically motivated will experience a greater sense of satisfaction of using the e-marketplace platform to sell their products. This is further corroborated by previous research in organizational contexts implying that workers' intrinsic motivation drives feelings of job satisfaction (Ambrose & Kulik, 1999; Dinger et al., 2015). Therefore, we conclude:

H3b: Intrinsic motivation has a positive effect on sellers' satisfaction.

In line with the arguments presented above, we believe that sellers perceiving high input control experience lower perceived usefulness as well as lower satisfaction, driven by reduced intrinsic motivation. Furthermore, we believe that sellers perceiving high clan control experience higher perceived usefulness as well as higher satisfaction, driven by increased intrinsic motivation. Considering that the IS continuance model proposes perceived usefulness to improve satisfaction and that both perceived usefulness and satisfaction influence continuance intentions, we thus conclude:

H4a: Intrinsic motivation mediates the effect of perceived input control on sellers' perceived usefulness, satisfaction and subsequently continuance intentions.

H4b: Intrinsic motivation mediates the effect of perceived clan control on sellers' perceived usefulness, satisfaction and subsequently continuance intentions.

5.4 Methodology

To empirically validate our research model, we conducted online surveys with sellers of two popular e-marketplace platforms. We elaborate on details of the empirical setting, the data collection procedure, the construct operationalization and the assessment of common method variance in each of the following subsections.

5.4.1 Empirical Setting

We decided to focus our empirical setting on Amazon and Etsy, which have similar institutional structures. Amazon, the largest U.S. online retailer, allows third-party sellers to sell products on its e-marketplace platform. As such, the platform offers a wide range of mass products. In contrast, Etsy facilitates the sale of unique handcrafted and vintage products. Its focus on cultural goods is reflected in its product categories that range from art and collectibles over

jewelry and accessories to clothing and shoes. Etsy launched in 2005 in the United States and is continuously growing ever since (Etsy, 2019).

Three reasons informed our choice of Amazon and Etsy to study the effects of control modes on sellers' continuance intentions: First, Amazon and Etsy are typical and thus representative e-marketplace platforms that are accessible to the public and that facilitate sales by connecting sellers and buyers online. Second, Amazon and Etsy apply input control mechanisms on their e-marketplace platforms. Amazon requires its sellers to ensure legality of the products, to adhere to predefined product categories and to provide pictures that exceed a minimum resolution (Amazon, 2020). Etsy, on the other hand, requires sellers to only offer products they made or designed themselves, to describe every person involved in the making of a product and to use their own photographs. Only if all requirements are met are sellers allowed to distribute their products. Third, Amazon and Etsy exercise clan control. Amazon provides IT-features that enable sellers to write blog posts for other sellers. Etsy, on the other hand, provides IT-features that enable sellers to give feedback to other sellers, to promote other sellers' products, and to join seller groups. These features help sellers cultivate relationships with peers in order to gain status in the e-marketplace and become successful in the long term (Bourdieu & Nice, 1980). Fourth, Amazon with 2.2. million active sellers (MarketplacePulse, 2020) and Etsy with 2.7 million active sellers (Etsy, 2019) rank among the largest e-marketplace platforms worldwide (Digitalcommerce, 2020). As such, findings derived from Amazon and Etsy concern a large audience of sellers on e-marketplace platforms. Lastly, testing our hypotheses on two platforms allows us to see whether our findings are robust across platforms of different sizes and different product portfolio focus. In conclusion, Amazon and Etsy provide a suitable context for examining the relationships between perceived input control as well as perceived clan control and sellers' continuance intentions on e-marketplace platforms.

5.4.2 Data Collection

To test our hypotheses, we developed and conducted two online surveys addressing sellers on Amazon and Etsy over a period of 3 months. We used chat forums and social media to contact sellers who had experience with selling products on one of the platforms. As an incentive, we assured to fund the planting of a tree for every completed survey. In total, 300 sellers on Amazon and 210 sellers on Etsy completed the survey. We dropped 39 participants due to an implausibly short response time or an incorrect answer to an attention check question. This removal resulted in our final sample of 286 respondents from Amazon and 185 respondents from Etsy. In the Amazon sample, sellers were largely male (74.1%). In contrast, sellers in Etsy sample were largely female (82.2%). The largest fractions of our respondents lived in Germany

and the United States, followed by the United Kingdom. Sample demographics are shown in Table A11 of the Appendix.

5.4.3 Construct Operationalization

To design our survey, we screened policies and terms and conditions of various e-marketplace platforms for different forms of control. Based on these results, we adapted survey items using established measures from existing scales in platform literature (see Table A12 of the Appendix). In line with previous studies on e-marketplace platforms (e.g., Croitor et al., 2020; Goldbach & Benlian, 2015b; Goldbach et al., 2018), we assessed perceived input control (Croitor & Benlian, 2019), perceived clan control (Kirsch et al., 2002) and intrinsic motivation (Deci & Ryan, 2002). Additionally, we measured the three constructs of the IS continuance model: perceived usefulness (Agarwal & Karahanna, 2000), satisfaction (Bhattacherjee, 2001) and continuance intention (Bhattacherjee, 2001). All constructs in our survey were measured reflectively with items measured on a seven-point Likert-type scale, ranging from 1 (strongly disagree) to 7 (strongly agree). In addition, we measured control variables in the prediction of the dependent variables. We controlled the dependent variables for gender, age, education, country of residence and experience in years and number of offered products.

5.4.4 Common Method Variance

We performed several steps to reduce any common method bias that might arise because of the use of a single data source (Podsakoff et al., 2003). First, during the design of the study's procedures, we strove to minimize method bias by protecting respondents' anonymity and reducing evaluation apprehension: We informed all respondents that their answers would be anonymous, that there were no right or wrong answers, and that responses would be used solely for research purposes. Second, we applied caution in the selection and phrasing of our scale items: We avoided using ambiguous or unfamiliar terms, complicated syntax, or inconsistent questions (Podsakoff et al., 2003). Finally, we also employed the marker-variable technique (Podsakoff et al., 2003) and included a marker-variable (i.e., blue attitude) in our survey. The results showed that the average correlation between marker-variable and the principal construct (i.e., continuance intention) was insignificant in the Amazon sample ($\beta = 0.11$, $p > 0.05$) and Etsy sample ($\beta = 0.07$, $p > 0.05$). These procedures gave us confidence that common method bias is not a major concern in this study.

5.5 Analysis and Results

5.5.1 Results of Measurement Model Testing

For our measurement model assessment, we examined all constructs regarding indicator loadings, internal consistency reliability, convergent validity and discriminant validity (Hair et al., 2019a). First, the loadings of all indicators were above the recommended level of 0.70, thus providing acceptable item reliability (see Table A13 of the Appendix). Second, composite reliability and Cronbach's alpha of all constructs were considerably above the threshold of 0.70, indicating a high internal consistency reliability. Third, average variance extracted of all constructs was above 0.50, demonstrating adequate convergent validity. Lastly, discriminant validity is defined as the degree to which measures of different latent variables are unique (O'Leary-Kelly & J. Vokurka, 1998) and can be tested using Heterotrait-Monotrait (HTMT) analysis. All HTMT values were below the threshold of 0.80 (Hair et al., 2019a) (see Table A14 of the Appendix). Therefore, our constructs had acceptable discriminant validity.

5.5.2 Results of Hypotheses Testing

To test our hypotheses, we conducted hierarchical regression analysis with SPSS 27. The results of the hierarchical regression analysis, including standardized path coefficients and their statistical significance levels, are displayed in Figure 5-2. We first tested for the effects of our control variables on the model's dependent variables. We did not find any significant effects of gender, age, education, country of residence, experience or number of offered products on sellers' continuance intentions (all $p > 0.05$).

The results (A = Amazon; E = Etsy) showed that the model explained satisfactory variance in intrinsic motivation (A: 16.3%; E: 19.2%), perceived usefulness (A: 48.4%; E: 36.7%), satisfaction (A: 58.6%; E: 46.2%), and continuance intention (A: 56.1%; E: 43.1%). Perceived input control had a negative significant effect on intrinsic motivation (A: $\beta = -0.16$, $p < 0.01$; E: $\beta = -0.23$, $p < 0.01$), **supporting H1**. Perceived clan control had a positive significant effect on intrinsic motivation (A: $\beta = 0.35$, $p < 0.001$; E: $\beta = 0.33$, $p < 0.001$), **supporting H2**. Furthermore, we also found a positive significant effect of intrinsic motivation on perceived usefulness (A: $\beta = 0.70$, $p < 0.001$; E: $\beta = 0.75$, $p < 0.001$) and on satisfaction (A: $\beta = 0.76$, $p < 0.001$; E: $\beta = 0.68$, $p < 0.001$), **supporting H3a and H3b**. Finally, our research model reconfirms the IS continuance model. The effects of perceived usefulness (A: $\beta = 0.49$, $p < 0.001$; E: $\beta = 0.35$, $p < 0.001$) and satisfaction (A: $\beta = 0.32$, $p < 0.001$; E: $\beta = 0.36$, $p < 0.001$) on continuance intention were both positive and significant.

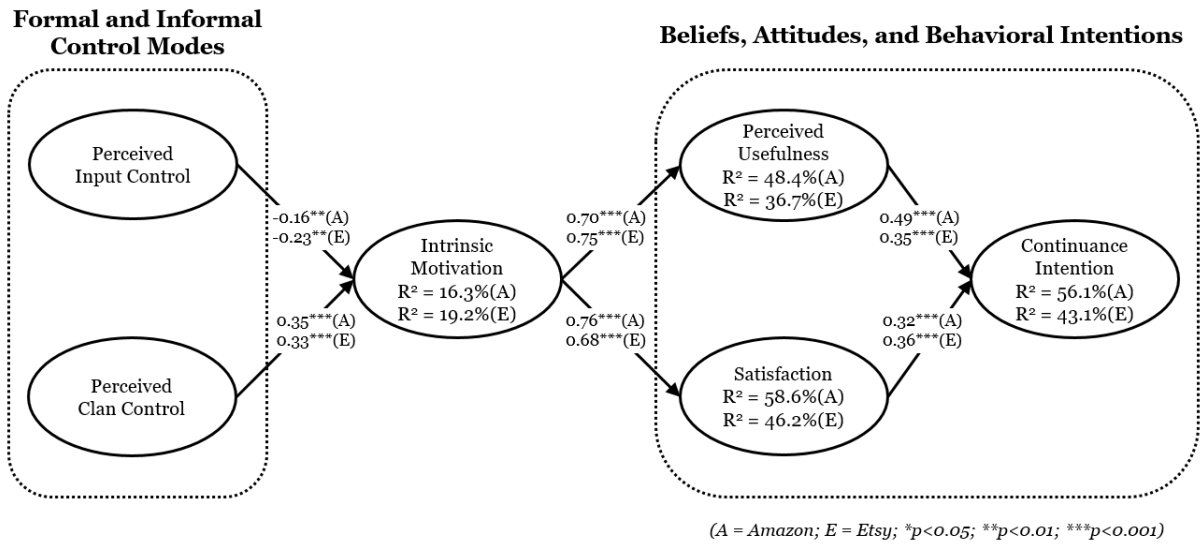

Figure 5-2: Model Testing Results.

We also tested the mediating role of intrinsic motivation using the PROCESS macro method (model 81) suggested by Hayes (Hayes, 2013). We used confidence intervals generated by bootstrapping (i.e., 5,000 bootstrap samples generating 95% bias-corrected bootstrap confidence intervals) as criteria to check whether the indirect effects were significantly different from zero (see Table A15 of the Appendix). First, we found that intrinsic motivation mediated the positive effect of perceived input control on sellers' perceived usefulness, satisfaction and subsequently continuance intention, **supporting H4a**. Second, we also found that intrinsic motivation mediated the negative effect of perceived clan control on sellers' perceived usefulness, satisfaction, and subsequently continuance intention, **supporting H4b**.

Lastly, we conducted between-group comparisons to identify potential differences between our two samples (i.e., Amazon and Etsy). Results of this analysis revealed significant differences in sellers' perceived input control, perceived clan control, intrinsic motivation, and satisfaction (see Table A16 of the Appendix). In particular, our results confirmed the widely acknowledged difference in how control mechanisms are applied on both e-marketplace platforms (i.e., strict input control and loose clan control on Amazon/ loose input control and strict clan control on Etsy).

5.6 Discussion

IS research on e-marketplace platforms increasingly acknowledges the role of sellers in platforms' long-term viability and success. As such, examining how sellers perceive and react to control exercised by platform providers gains in importance. The main objective of this study was to investigate how and why perceived input control and perceived clan control affect sellers' beliefs, attitudes and behavioral intentions on e-marketplace platforms. To answer our research question, we collected survey data from Amazon (n = 286) and Etsy (n = 185), two of

the largest e-marketplace platforms with a different product portfolio focus. The two quantitative survey studies offer several key findings. First, we find that perceived input control reduces sellers' intrinsic motivation, as complying with requirements inhibits sellers' autonomy and freedom. Second, contrary to perceived input control, perceived clan control leads to higher intrinsic motivation, as sellers derive joy from the opportunity to engage with other sellers and to be part of the community. Third, intrinsic motivation enhances perceived usefulness, given that intrinsically motivated sellers process the available features of the e-marketplace platform more thoroughly. Fourth, we find that intrinsic motivation leads to improved satisfaction with the e-marketplace platform, reflecting the sensation of joy inherent to intrinsic motivation. Moreover, we successfully replicated the IS continuance model and were able to demonstrate a link between perceptions of both control modes and sellers' continuance intentions.

5.6.1 Theoretical Contributions

Our study offers several important contributions to IS literature on e-marketplace platforms in general and on platform control in particular. First, by studying control modes on e-marketplace platforms, our work extends the research scope of increasing literature on platform control by the important and unique context of e-marketplace platforms (Hong et al., 2014; Johns, 2006). Although prior studies have investigated effects of control modes in different platform contexts, such as mobile app platforms (Croitor & Benlian, 2019; Goldbach & Benlian, 2015a, 2015b; Goldbach et al., 2018), web-browser platforms (Croitor et al., 2020; Tiwana, 2015a), and crowdfunding platforms (Thies et al., 2018; Wessel et al., 2017), the effects of control modes on e-marketplace platforms have been largely overlooked. As such, our paper responds to several research calls to investigate the effects of control modes in a thus far underexplored platform context (Croitor et al., 2020; Croitor & Benlian, 2019; Goldbach et al., 2018; Wessel et al., 2017). More broadly, our insights are important beyond the context of e-marketplace platforms, as control is a critical and ubiquitous element of platform governance.

Second, by analyzing effects of both input control and clan control on digital platforms, our study extends prior research on platform control that has examined the effects of input control and clan control separately. To the best of our knowledge, our study is the first one to examine effects of input control and clan control on digital platforms in combination. In the context of e-marketplace platforms, input control and clan control are particularly important for platform providers to align their interests with those of the sellers and have been highlighted in previous calls for research (Goldbach et al., 2018). To this end, we bring to light the opposing effects that perceived input control and perceived clan control exert on sellers' continuance intentions

when sellers are subject to both types of control. As such, we additionally advance our understanding of the consequences of the two control modes input control and clan control.

A third contribution of this study relates to the explanation of why perceived input control and perceived clan control affect sellers' beliefs, attitudes and behavioral intentions. Only recently have studies started to unravel the explanatory mechanisms underlying the relationship between perceptions of control modes and behavioral intentions, thus far pointing at perceived autonomy as a mediator in complementors' continuance intentions (Goldbach et al., 2018). Our study extends knowledge on the underlying mechanisms that explain the relationship between perceptions of control and complementors' beliefs, attitudes and behavioral intentions. In particular, we find that intrinsic motivation mediates the relationship between perceptions of both input control and clan control and complementors' perceived usefulness, satisfaction and continuance intentions. We thus contribute to a more nuanced understanding of factors that explain complementors' intentions to stay on and keep contributing to digital platforms (Benlian et al., 2015).

5.6.2 Practical Implications

Given that attracting and retaining sellers is becoming increasingly important (Galbreth et al., 2005; Sun, 2010), our results also provide insightful implications for practitioners. For platform providers who are trying to attract and motivate sellers' to contribute to their e-marketplace platform or who are trying to sustain sellers' commitment, it is important to understand which types of control modes are likely to generate higher seller participation. Whereas input control deters sellers to continue using the platform, platform providers can harness clan control to free two birds with one key: align their interests and strategies with those of the sellers *and* increase the retention of sellers through greater intrinsic motivation, perceived usefulness and satisfaction. Therefore, we provide valuable guidance for platform providers how to best exercise control without hurting their objective of sustaining a large group of sellers.

5.6.3 Limitations and Directions for Future Research

This study should be interpreted in light of its limitations, which provide opportunities for future research. The first limitation is that we collected our data through a single survey design that captured both dependent and independent variables. Even though formal tests for common method bias in the results section indicated no substantial concern, future research could further validate our findings and thereby also confirm causality of our model through experimental research designs both in the lab as well as in the field.

While our study is, to the best of our knowledge, the first to investigate control modes on e-marketplace platforms, we call for research to extend our findings to other platforms and

contexts. For example, future research may verify our propositions on e-marketplace platforms with greater competition among sellers than observed on Amazon and Etsy, particularly to compare whether the positive effect of clan control remains. Furthermore, investigating input control and clan control in diverse platform contexts (e.g., accommodations, shops, games and crowdfunding) could advance the generalizability of our results. Moreover, future research may extend this study's model by including and comparing further types of control (e.g., self control, behavior control and output control) and further types of outcome (e.g., perceived performance), as well as by testing for additional mediators that could be conceptually related to control (e.g., perceived fairness and perceived effort).

We acknowledge that platform providers may consider sellers' continuance intentions as just one out of several objectives. Platform providers could also aim to maximize total platform sales volume, for example through enhancing competitiveness among sellers (Li et al., 2019). Imposing control, despite potential positive effects on sellers' continuance intentions, may hereby reduce sellers' performance and thus harm platform providers' objective, as first evidence in the case of clan control suggests (Zifla & Wattal, 2019). As such, we urge future studies to investigate how different control modes affect the success of e-marketplace platforms beyond sellers' continuance intentions.

The conceptual model was developed considering only negative effects of perceived input control. However, recent studies on platform governance pointed out potential positive effects of input control, such as increased knowledge sharing among platform participants (Zhang et al., 2020) as well as an improvement in their performance (Tiwana, 2015a; Wessel et al., 2017). Therefore, future research should extend and adapt our model to investigate both positive and negative effects of input control on sellers' continuance intentions on e-marketplace platforms.

Lastly, although our measurement scales were adopted from existing works, we recognize the potential threat of acquiescence bias (i.e., participants' tendency to agree with positively formulated items) (Billiet & McClendon, 2000). We advise future research to replicate our study using balanced scales (Billiet & Davidov, 2008), in which half of the items are framed negatively and half are framed positively.

Chapter 6: Perceived Input Control on Amazon

Title: Exploring the Relationship between Perceived Input Control and Complementors' Perceived Performance: An Empirical Study on Amazon (2021)

Authors: Evgheni Croitor, Technical University of Darmstadt, Germany

Dominick Werner, Technical University of Darmstadt, Germany

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Abstract

Despite the growing body of research on how control modes shape platform governance, little is known about how and why input control (i.e., the set of mechanisms that screen and sort out complementors and their complements before entering the digital platform's ecosystem) affects complementors' perceived performance. Drawing on platform governance literature, we conducted an online survey with 286 sellers on Amazon, one of the largest e-marketplace platforms worldwide. Our results reveal that perceived input control decreases complementors' performance and that this effect is explained through intrinsic motivation. Furthermore, input control fairness moderates the impact of perceived input control on complementors' intrinsic motivation. Counterintuitively, perceived input control has no direct effect on complementors' performance when accounting for intrinsic motivation. Thus, our findings extend literature on platform governance and offer practical insights for platform providers on how to manage their input control mechanisms for the success and sustainability of their digital platforms.

Keywords: Input Control, Perceived Performance, Platform Governance, Intrinsic Motivation, Digital Platforms

6.1 Introduction

Digital platforms describe infrastructures that mediate interactions between complementors (e.g., sellers, producers, game developers) and end-users (e.g., buyers, consumers, players) (McIntyre & Srinivasan, 2017). Digital platforms are becoming ever more important due to their substantial growth fueled by the digital era (Li et al., 2019; Sun et al., 2020). Amazon, for example, a digital platform that connects sellers and buyers by offering an e-marketplace infrastructure, grew to one of the most successful digital platforms worldwide, exceeding 280 billion U.S. dollars in annual net revenue (Amazon, 2019). Although IS researchers studying digital platforms and their success predominantly focused on complementors' behavioral intentions (e.g., continuance intentions) (Croitor et al., 2020; Croitor & Benlian, 2019; Goldbach et al., 2018), research increasingly underscores the need to address complementors' performance outcomes (i.e., perceived performance) (Mora-Monge et al., 2019; Rietveld et al., 2020; Wang & Cavusoglu, 2015). Maximizing complementors' perceived performance is an important goal for both complementors and platform providers, since (1) complementors' performance reflects their revenues and thus one of the primary objectives of their business activity and because (2) complementors' performance is a key enabler for digital platforms' overall success and sustainability (Wang et al., 2012).

As digital platforms and their number of complementors and complements grow, platform providers need to exercise control (i.e., a central element of platform governance) to align their interests and strategies with those of the complementors (Ghazawneh & Henfridsson, 2013; Goldbach & Benlian, 2015b; Goldbach et al., 2014). To manage access, behaviors, and outcomes of complementors, platform providers can draw on various control modes (i.e., the set of mechanisms to control complementors and their complements on digital platforms) (Tiwana et al., 2010). IS governance literature makes a fundamental distinction between formal (i.e., input control, behavioral control and output control) and informal control modes (i.e., self control and clan control) (Kirsch, 1997; Wiener et al., 2016). On digital platforms, input control is increasing in importance as a formal control mode for both platform providers and researchers (Tiwana, 2015a). Input control is defined as *"the set of mechanisms used by the platform provider that screen and sort out complementors and their complements before entering the digital platform's ecosystem"* (Croitor & Benlian, 2019). Consider, for example, input control on the Amazon platform: Sellers must prove legality of their products, adhere to predefined product categories, and provide pictures that meet specified properties (Amazon, 2020).

Previous studies on platform governance investigating the effect of input control have focused on platforms' network effects (Thies et al., 2018), platforms' revenues (Wessel et al., 2017) and

complementors' behavioral intentions (i.e., continuance intentions) (Croitor et al., 2020; Croitor & Benlian, 2019). However, our knowledge of the consequences of input control for complementors' perceived performance is limited in three ways: First, little is known on how input control affects complementors' perceived performance. Previous research indicated that input control can lead to both positive and negative reactions of complementors (Croitor et al., 2020; Tiwana, 2015a; Wessel et al., 2017). Therefore, it is unclear whether input control actually enhances or impairs complementors' perceived performance. Second, we lack understanding of the mechanism through which perceived input control affects complementors' perceived performance on digital platforms. In this regard, a factor repeatedly mentioned to relate to complementors' perceived performance is complementors' intrinsic motivation (e.g., Bande et al., 2016; Cerasoli & Ford, 2014; Dysvik & Kuvaas, 2011). Previous research indicated that intrinsic motivation of complementors mediates the effect of control modes on complementors' perceived performance (Goldbach & Benlian, 2015b). Thus far, this relationship was only investigated in the context of the two informal control modes of self control and clan control. However, informal control modes are known to elicit different responses than the formal control mode of input control (Remus et al., 2020), thereby calling for an investigation into the mediating role of intrinsic motivation between specifically input control and complementors' perceived performance. Third, our understanding of which factors influence the effect of input control is incomplete. To this end, previous IS research on digital platforms suggests that input control fairness (i.e., the degree to which platforms' input control mechanisms are perceived as fair) affects complementors' satisfaction (Kim et al., 2016). Although these insights emphasize input control fairness as an important influencing factor for complementors' perceptions, it is unclear how this factor relates to the relationship between input control and the distinct outcome of complementors' perceived performance. We therefore require further investigation into the moderating role of input control fairness in the context of complementors' perceived performance. In conclusion, we lack important knowledge on *how* perceived input control affects complementors' perceived performance. Moreover, our understanding is incomplete as to *why* the effect of perceived input control unfolds. Therefore, we set out to investigate the following research question:

RQ: How and why does perceived input control affect complementors' perceived performance on digital platforms?

To answer our research question, we draw on platform governance literature and conducted an online survey with 286 sellers on Amazon, one of the largest e-marketplace platforms worldwide. The results of our empirical study show that complementors' perceived input

control has a negative effect on complementors' perceived performance and that this effect is mediated by intrinsic motivation. Furthermore, our empirical results reveal a moderating effect of perceived input control fairness: When input control fairness is high (vs. low), intrinsic motivation is also high, regardless of the level of applied input control. Contrary to our assumptions, perceived input control exerts no significant direct effect on complementors' perceived performance when accounting for the indirect effect of intrinsic motivation.

Our study offers important contributions to IS literature on platform governance in general and on input control in particular. First, we contribute to the body of knowledge on platform governance by increasing our understanding of the effects of input control on the crucial outcome of complementors' perceived performance. Second, we shed light on the mechanisms through which the effects of perceived input control on complementors' perceived performance unfolds by revealing intrinsic motivation as a mediator. Third, our study enhances our understanding of how input control fairness moderates the relationship between perceived input control and complementors' intrinsic motivation. Beyond these theoretical contributions, our study offers platform providers valuable insights on how their input control mechanisms affect complementors' perceived performance and thus the success and sustainability of their digital platforms.

The reminder of this article is organized as follows. The next section presents the theoretical background on main constructs of our research, followed by sections on the development of our hypotheses. Finally, we present the methodology, analysis and results of our study, followed by the discussion of our results and the implications for research and practice.

6.2 Theoretical Background

6.2.1 Platform Governance and Input Control

Following prior work in IS literature on digital platforms, we use the term platform governance to refer to fundamental decisions of platform providers concerning decision rights, ownership, and control (Foerderer et al., 2018; Song et al., 2018; Tiwana, 2015a). Applied to digital platforms, control constitutes means through which platform providers assert that complementors and complements are aligned with the platform's interests (Tiwana, 2015a). As one specific form of control, platform providers apply control mechanisms that manifest in control modes (Kirsch, 1997). IS Literature on control makes a fundamental distinction between formal and informal control modes (Kirsch, 1997; Remus et al., 2020; Wiener et al., 2016). Formal control modes (i.e., input control, behavior control, and outcome control) are enforced by platform providers through specifications and evaluations (Cardinal, 2001; Cardinal et al.,

2004). In comparison, informal control modes (i.e., self control and clan control) are built on meanings of self-regulation and shared norms among complementors (Wiener et al., 2016). In this study, we focus our investigation on input control, as this control mode has been emphasized to play a crucial role on digital platforms (Croitor & Benlian, 2019; Tiwana, 2015a; Zhang et al., 2020).

As already introduced earlier, in case of input control, platform providers use gatekeeping and screening procedures to decide which complementors and complements can enter the respective platform (Croitor et al., 2020; Croitor & Benlian, 2019). Recently, research has paid more attention to input control in a broad context of platforms, as presented in Table 6-1.

Platform Context	**Study**	**Journal**	**Key Findings**
Web-Browsers (i.e., Chrome and Firefox)	Tiwana (2015a)	Information System Research	Input control in combination with complement modularization has a positive effect on complements' evolution.
	Croitor et al. (2020)	Journal of Decision Systems	Perceived input control has a negative effect on complementors' perceived usefulness, satisfaction and continuance intentions.
Mobile Applications (i.e., Android and iOS)	Croitor and Benlian (2019)	Journal of Decision Systems	Perceived input control has a negative effect on complementors' continuance intentions.
	Zhang et al. (2020)	Strategic Management Journal	Input control has a positive effect on knowledge sharing among complementors.
Crowdfunding (i.e., Kickstarter)	Wessel et al. (2017)	Journal of Information Technology	Input control has a positive effect on platforms' revenues and a negative effect on the complementors' participation.
	Thies et al. (2018)	Information Systems Journal	Input control has a positive effect on the cross-side network effects between complementors and end-users.
SDK Extensions (i.e., Eclipse)	O'Mahony and Karp (2020)	Strategic Management Journal	Findings regarding the effect of input control on complementors' intention to join were inconclusive.

Table 6-1: Review of Literature on Input Control on Digital Platforms

Recent research on input control further indicated that regardless of the level of input control, complementors require input control mechanisms to be fast, transparent and fair (Croitor et al., 2020). In our study, we therefore introduce input control fairness as the degree to which complementors evaluate input control mechanisms on a digital platform as fair. Within the context of mobile application platforms, input control fairness has been linked to increased

complementors' satisfaction (Kim et al., 2016), indicating the need for further investigation of the role of input control fairness in relation to input control.

Although researchers studying input control on digital platforms uncovered comprehensive insights on the effect of input control on complementors' behavioral intentions (e.g., continuance intentions) (Croitor et al., 2020; Croitor & Benlian, 2019), our knowledge of the consequences of input control for complementors' performance is still limited.

6.2.2 Perceived Performance

Within this study, we refer to perceived performance as complementors' evaluation of their financial and overall operations on a digital platform (Wade & Nevo, 2005). Prior literature on complementors' performance outcomes identified three factors that are relevant in this regard: end-user-related factors, complementor-related factors, and platform-related factors (Rietveld et al., 2020).

First, a complementor's performance is intuitively linked with the number of end-users on a digital platform. This is simply because a large audience enables complementors to provide their complements to a greater potential pool of customers (Boudreau & Jeppesen, 2015; Rietveld & Eggers, 2018). Second, an increase in the number of complementors on a digital platform leads to intensified competition among complementors (Clements & Ohashi, 2005; Markovich & Moenius, 2009). Such heightened competition can negatively affect complementors' performance, especially when competitive complementors provide complements from the same category (Boudreau, 2012). Third, research identified the platform itself as an important source of variation in how complementors perform. For example, complementors on mobile application platforms are more likely to sustain a position of superior performance when they collected greater platform-specific experience (Kapoor & Agarwal, 2017; Tavalaei & Cennamo, 2020).

To understand why perceived input control affects complementors' perceived performance, we examine how input control influences complementors' intrinsic motivation as an important antecedent to complementors' performance (e.g., Bande et al., 2016; Cerasoli & Ford, 2014; Dysvik & Kuvaas, 2011).

6.2.3 Intrinsic Motivation

Generally, intrinsic motivation refers to individuals' motivation to complete a task or perform an action out of own interest, enjoyment and for the sake of the activity itself (Deci & Ryan, 1985). Intrinsic motivation is explained by self-determination theory, which considers individuals' fundamental needs for autonomy, relatedness and competence (Gagné & Deci,

2005; Ryan & Deci, 2000; Sheldon Kennon et al., 2003). The need for autonomy is an individual's innate psychological desire to be free to choose their course of action. Any restriction to individuals' autonomy, for example through formal requirements, reduces individuals' intrinsic motivation (Thatcher et al., 2012).

IS scholars analyzed the influence of intrinsic motivation as a determinant of complementors' outcomes on digital platforms in multiple contexts, such as exchanging knowledge in enterprise social media platforms (Rode, 2016), programming apps for social software platforms (Hilkert et al., 2010), addressing tasks on crowdsourcing platforms (Kaufmann et al., 2011), sticking to learning platforms (Ho, 2010) and competing in co-creation platforms (Zheng et al., 2011). Furthermore, first studies have associated intrinsic motivation with control modes on digital platforms. For instance, in the context of mobile application platforms, developers' intrinsic motivation is believed to be responsible for why informal control modes increase application quality (Goldbach & Benlian, 2015b).

Nevertheless, these findings are limited in that they cannot explain the effect of perceived input control on digital platforms. Given that digital platforms benefit from complementors who are eager to invest their time and effort into using the platform, we focus on the role of complementors' intrinsic motivation in order to analyze the effect between perceived input control and complementors' perceived performance.

6.3 Research Model and Hypothesis Development

6.3.1 Research Model

In this section, we develop our research model as illustrated in Figure 6-1. We propose that perceived input control has a negative effect on complementors' intrinsic motivation (H1), while simultaneously exerting a positive effect on complementors' perceived performance (H2). Furthermore, we propose that input control fairness positively moderates the effect of perceived input control on complementors' intrinsic motivation (H3). We do not hypothesize the effect between intrinsic motivation and perceived performance, as prior research has consistently shown a strong positive effect of intrinsic motivation on perceived performance (e.g., Bande et al., 2016; Cerasoli & Ford, 2014; Dysvik & Kuvaas, 2011).

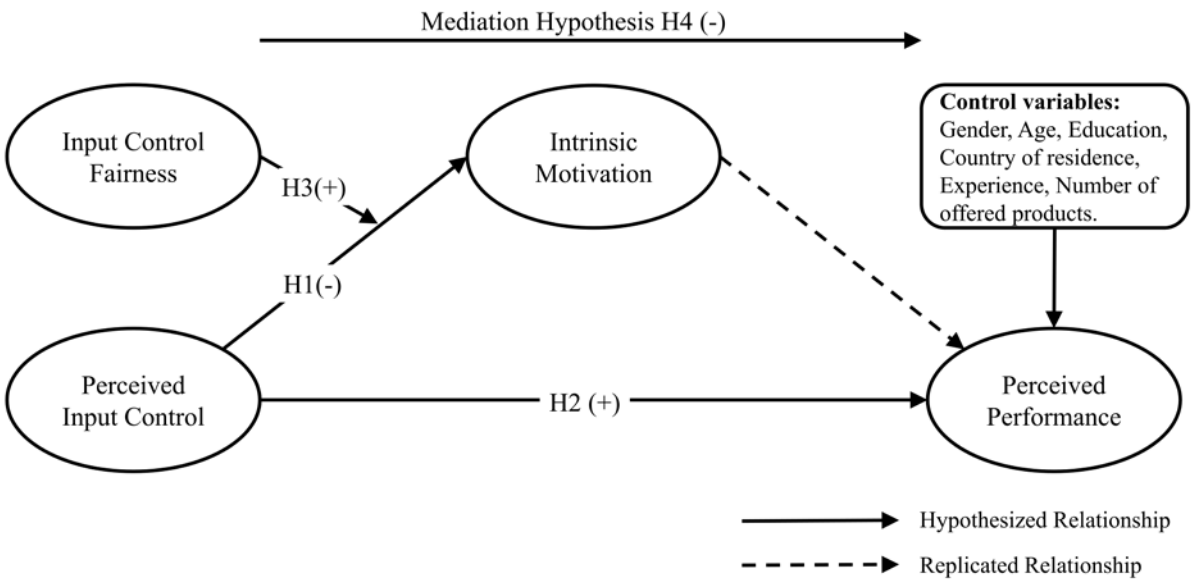

Figure 6-1: Research Model

6.3.2 Hypothesis Development

To assess the relationship between perceived input control and complementors' intrinsic motivation, we need to understand how intrinsic motivation emerges. According to self-determination theory, intrinsic motivation is formed when the three psychological needs competence, relatedness and autonomy are fulfilled. Considering perceived input control, we concentrate on complementors' sense of autonomy, which reflects whether individuals have the impression they define and control the manner in which tasks are executed (Hall, 1968). Autonomy is particularly relevant to individuals when activities require specialized knowledge (e.g., managing a product portfolio) and individuals think they are the only ones qualified to decide how their task should be done. Restricting individuals' autonomy leads to a reduction of their intrinsic motivation of performing a task (Thatcher et al., 2012).

Related to individuals' autonomy, perceived input control on digital platforms refers to complementors' perceptions of obstacles complicating the submission of complements on the platform through gatekeeping and screening mechanisms. When complementors are restricted in their freedom to select which complements they are permitted to submit, part of their psychological need for autonomy is not fulfilled. Consequently, their intrinsic motivation is impaired. The greater the perceived input control, the less autonomous will complementors experience their interaction with the platform and the less will they develop intrinsic motivation. Therefore, we hypothesize:

H1: Perceived input control has a negative effect on complementors' intrinsic motivation.

We draw on signaling theory to explain a direct effect of perceived input control on complementors' perceived performance. Signaling theory refers to transactions characterized

by information asymmetry between two parties (e.g., complementors and platform providers), in which individuals seek informational cues that enable them to infer the quality of the other party's offer (Spence, 1973, 1974). Depending on what level of quality is inferred, individuals' trust in their counterpart increases and they engage in the transaction (Benlian & Hess, 2011).

In the context of digital platforms, input control represents an influential tool for platform providers to signal high quality of the platform. If complementors perceive that input control is high, they likely conclude that the platform deters low-quality complements, which in turn increases the overall quality of the platform. To this end, complementors conclude that high platform quality heightens the number of end-users that procure and use the available complements. As a result, complementors enjoy high benefits of using the platform, including perceptions of high performance (Wessel et al., 2015). Conversely, if complementors perceive low input control, they regard the platform to lack quality and thus attract less end-users, which restricts complementors' benefits of using the platform. Accordingly, complementors' perceived performance is curbed. Therefore, we hypothesize:

H2: Perceived input control has a positive effect on complementors' perceived performance.

To improve our understanding of the conditions under which the effects of input control unfold, we need to consider the role of input control fairness. According to fairness theory, individuals judge an event as fair when a more favorable outcome would not have resulted if events had played out differently, for instance because the decision-maker's actions are considered morally correct (Folger & Cropanzano, 1998, 2001). When a process is deemed fair, positive emotions such as joy and happiness arise. If, however, individuals feel they are treated unfairly because an authority should have acted differently, negative emotions such as anger, blame and resentment come to the forefront (Cropanzano et al., 2000). According to Schwarz and Clore (1983), individuals consider such affective states as information to evaluate how they feel about a given stimulus . Specifically, stimuli are appraised more positively when experiencing positive affect, while a negative affect causes individuals to appraise stimuli more negatively (Zapata-Phelan et al., 2009).

In the context of input control fairness, we expect a change in emotional state to alter how input control relates to the emotional experience of intrinsic motivation. As argued above, the reduction of intrinsic motivation with perceptions of increasing input control is based on the restriction of complementors' autonomy. Yet, Vansteenkiste and Deci (2003) note that to be autonomous does not mean to be independent of others, but rather it means to feel a sense of willingness when acting and responding to a request from others. To this end, we argue that when complementors judge the input control to be fair (vs. unfair), they develop more positive

emotions toward the input control mechanism and thus feel less restricted by the requirements they face. Consequently, if input control fairness is high, the negative effect of perceived input control on intrinsic motivation is reduced. Conversely, if input control fairness is low, the negative emotions resulting from the perception of being treated unfairly deteriorate the perceived restriction in autonomy, causing complementors' intrinsic motivation to suffer more strongly. Therefore, we hypothesize:

H3: Input control fairness positively moderates the relationship between perceived input control and complementors' intrinsic motivation.

Complementors' perceived performance as their evaluations of their financial and overall operations on a platform is not just determined by the level of input control. Instead, previous research has consistently demonstrated that intrinsic motivation plays an important role in fostering perceived performance (e.g., Bande et al., 2016; Cerasoli & Ford, 2014; Dysvik & Kuvaas, 2011). At the same time, we argue that intrinsic motivation is subject to complementors' perceived input control. Considering both these effects, we therefore hypothesize:

H4: The effect of perceived input control on complementors' perceived performance is mediated by complementors' intrinsic motivation.

6.4 Methodology

To empirically validate our research model, we conducted an online survey with sellers on Amazon, the largest e-marketplace platform in the USA. Three reasons informed our choice of Amazon to study the effects of input control on complementors' performance outcomes: First, Amazon is a typical and thus representative digital platform that facilitates sales by connecting complementors and end-users online. Second, Amazon applies input control mechanisms by requiring its sellers to ensure legality of the products, to adhere to predefined product categories and to provide pictures that exceed a minimum resolution (Amazon, 2020). Only if all requirements are met are sellers allowed to distribute their products. Third, at 2.2. million active sellers (MarketplacePulse, 2020), Amazon ranks among the largest digital platforms worldwide (Digitalcommerce, 2020). As such, findings derived from Amazon concern a large audience of complementors on digital platforms. In conclusion, Amazon provides a suitable context for examining the relationships between perceived input control and complementors' perceived performance on digital platforms.

6.4.1 Data Collection and Sample Description

To test our hypotheses, we developed and conducted an online survey addressing sellers on Amazon over a period of 3 months (between November 2019 and January 2020). We used chat

forums and social media to contact sellers who had experience with selling products on Amazon. As incentives, participants were entered into a lottery for three Amazon gift cards of 50 EUR each. In total, 300 sellers completed the survey, from which we removed 14 cases due to an implausibly short response time or an incorrect answer to an attention check question. This removal resulted in our final sample of N=286. Sample demographics are presented in Table 6-2.

Variables	Category	N	%
Gender	Female	74	25.9
	Male	212	74.1
Age	18-24	12	4.2
	25-34	88	30.8
	35-44	86	30.1
	45-54	66	23.1
	> 54	34	11.9
Education	High school or below	73	25.5
	Bachelors	88	30.8
	Masters	113	39.5
	Ph. D.	12	4.2
Country of residence	Germany	124	43.4
	United States	70	24.5
	United Kingdom	25	8.7
	Other	67	23.4
Experience (offered products)	1-5 products	17	5.9
	5-25 products	38	13.3
	25-100 products	38	13.3
	100-1,000 products	103	36.0
	> 1,000 products	90	31.5
Experience (years)	< 1 year	13	4.5
	1-2 years	41	14.3
	2-3 years	56	19.6
	3-4 years	30	10.5
	4-5 years	21	7.3
	> 5 years	125	43.7

Table 6-2: Demographic Distribution of the Survey Respondents (N=286)

6.4.2 Measurements

For the design of our survey, we screened policies and terms and conditions of various digital platforms for different forms of input control. Based on these results, we adapted survey items using established measures from existing scales in platform literature (see Table 6-3). In line

with previous studies on digital platforms (e.g., Croitor et al., 2020; Goldbach & Benlian, 2015b; Goldbach et al., 2018), we assessed perceived input control using four items (Croitor & Benlian, 2019) and intrinsic motivation using three items (Deci & Ryan, 2002). Additionally, we measured input control fairness using four items (Kim et al., 2016) and performance outcome using two items (Wade & Nevo, 2005). Most constructs in our survey were measured reflectively with items based on a seven-point Likert-type scale, ranging from 1 (strongly disagree) to 7 (strongly agree), with the exception of perceived performance items, which were measured on a seven-point bipolar scale, ranging from 1 (not good) to 7 (very good). In addition, we controlled the dependent variable for gender, age, education, country of residence and experience in both years as well as number of offered products.

Construct	**Items**	**Source**
Perceived Input Control (PIC)	It is burdensome for me to comply with all requirements to be granted access to the platform.	Adapted from Croitor and Benlian (2019)
	Overall, the platform sets strict formal criteria for access approval.	
	Getting access to the platform is subject to stringent screening processes.	
	In my opinion, it is hard to get access to the platform to sell my products.	
Intrinsic Motivation (IM)	I enjoy selling my products on the platform.	Adapted from Deci and Ryan (2002)
	I would describe selling products on the platform as very interesting.	
	Selling products on the platform is fun to do.	
Input Control Fairness (ICF)	All requirements to be granted access to the platform are transparent.	Adapted from Kim et al. (2016)
	The procedures to accept or reject sellers on the platform are applied fairly across all sellers.	
	Access approval procedures on the platform are justified.	
	The procedures to accept or reject products on the platform are applied consistently across all products.	
Perceived Performance (PP)	How would you rate the overall performance of your Amazon operations?	Adapted from Wade and Nevo (2005)
	How would you evaluate the return on investment for your Amazon operations?	

Table 6-3: Construct Measurements

6.4.3 Common Method Variance

We performed several steps to reduce any common method bias that might arise due to the use of a single data source (Podsakoff et al., 2003). First, during the design of the study's

procedures, we strove to minimize method bias by protecting respondents' anonymity and reducing evaluation apprehension: We informed all respondents that their answers would be anonymous, that there were no right or wrong answers, and that responses would be used solely for research purposes. Second, we applied caution in the selection and phrasing of our scale items: We avoided using ambiguous or unfamiliar terms, complicated syntax, or inconsistent questions (Podsakoff et al., 2003). Finally, we also employed the marker-variable technique (Podsakoff et al., 2003) and included a marker-variable (i.e., blue attitude) in our survey. The results showed that the average correlation between marker-variable and the principal construct was insignificant ($\beta = 0.02$, $p > 0.05$). These procedures gave us confidence that common method bias is not a major concern in this study.

6.5 Analysis and Results

We used structural equation modelling with partial least squares (PLS) using SmartPLS 3.2.8 (Ringle et al., 2015) to evaluate the measurement models and to test our research hypotheses (Hair et al., 2014). Our selection of the analysis technique is in line with recent methodological approaches within the IS discipline on the use of PLS over other analysis techniques (e.g., Addas & Pinsonneault, 2018; Venkatesh et al., 2019). Consistent with prior research using PLS models, we analyzed our model in a two-step approach (e.g., Bhattacherjee & Premkumar, 2004; Gefen & Straub, 2005) by first assessing our measurement model and then analyzing our structural model (Hulland, 1999). This sequence ensures that the measures of our constructs are valid before attempting to draw conclusions about the relationships between these constructs.

6.5.1 Measurement Model Assessment

For our measurement model assessment, we examined all reflective constructs regarding convergent validity and discriminant validity following guidelines from (Bhattacherjee & Premkumar, 2004). We evaluated convergent validity for all constructs by using three criteria recommended by Fornell and Larcker (1981) (see Table 6-4). First, the loadings of all items are above the recommended level of 0.70 (Carmines & Zeller, 1979), and all are significant ($p < 0.001$). Second, composite reliability of all constructs is considerably above the threshold of 0.80, indicating a high internal consistency reliability. Average variance extracted (AVE) of all constructs is above 0.50. Hence, these results demonstrated that our measurement model has adequate convergent validity.

Constructs	**Mean**	**S.D.**	**Factor Loadings**	**Composite Reliability**	**Average Variance Extracted**
Perceived Input Control	4.08	1.42	0.80-0.90	0.92	0.74
Intrinsic Motivation	4.02	1.27	0.73-0.91	0.88	0.71
Input Control Fairness	3.08	1.50	0.80-0.88	0.91	0.72
Performance Outcome	4.78	1.43	0.91-0.92	0.90	0.84

Table 6-4: Results of the Measurement Model Assessment (Convergent Validity)

Discriminant validity is defined as the degree to which measures of different latent variables are unique (O'Leary-Kelly & J. Vokurka, 1998) and can be tested using Heterotrait-Monotrait (HTMT) analysis. The highest HTMT value of 0.65 is between intrinsic motivation and perceived performance (see Table 6-5), hence all values are below the recommended threshold of 0.85 (Henseler et al., 2015). Thus, the test results demonstrate that our measurement models has good discriminant validity.

Constructs	Perceived Input Control	Intrinsic Motivation	Input Control Fairness	Perceived Performance
Perceived Input Control				
Intrinsic Motivation	0.18			
Input Control Fairness	0.20	0.50		
Perceived Performance	0.15	0.65	0.27	

Table 6-5: Results of the Measurement Model Assessment (Discriminant Validity)

6.5.2 Structural Model Assessment

After establishing reliability and validity of the construct measures, we assessed the structural model, which involves examining the model's predictive capabilities and the relationships between the constructs (Hair et al., 2014). The results of the structural model analysis, including standardized path coefficients and their statistical significance levels, are displayed in Figure 6-2. We first analyzed the relationship between control variables and the dependent variable (i.e., perceived performance). We did not find any significant effects of gender, age, education, country of residence, experience or number of offered products on complementors' perceived performance (all $p > 0.05$).

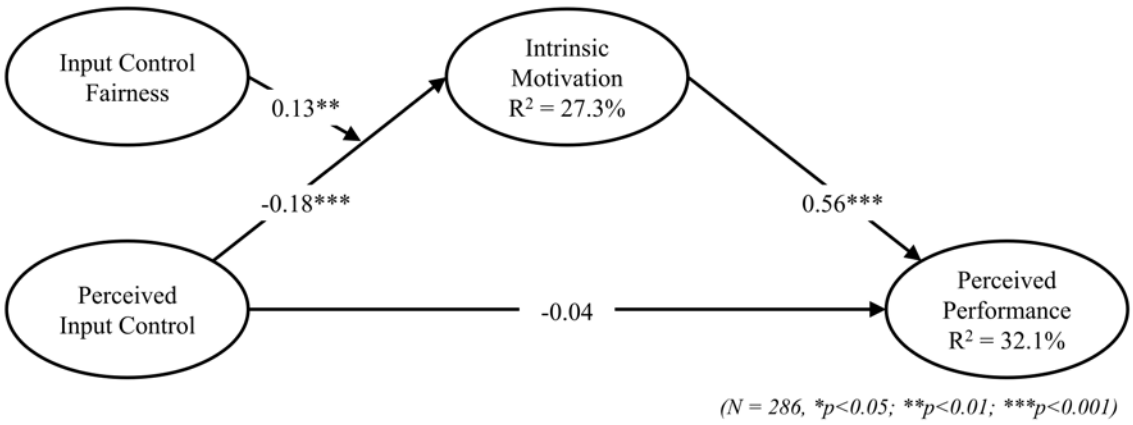

Figure 6-2: Model Testing Results

The model explained 27.3% of the variance in intrinsic motivation and 32.1% of the variance in performance outcome. Perceived input control had a negative significant effect on intrinsic motivation ($\beta = -0.18$, $p < 0.001$), **supporting H1**. However, we found that perceived input control had no impact ($\beta = -0.04$, $p > 0.05$) on complementors' perceived performance. Thus, our results **do not support H2**. Furthermore, we found a positive significant moderating effect of input control fairness on the relationship between perceived input control and intrinsic motivations ($\beta = 0.13$, $p < 0.005$), **supporting H3**. We further validated the moderating effect using Cohen's f^2 (Chin et al., 2003), which compares the R^2 values of the interaction effect on the main effect. In our case, the Cohen's f^2 value of (0.27 - 0.13)/(1 - 0.13) = 0.16 indicates a medium effect size (Chin et al., 2003). This result further support our hypothesis H3.

To further illustrate the moderating effect of input control fairness on the relationship between perceived input control and complementors' intrinsic motivation, we plotted the interaction and analyzed the slope. The plot in Figure 6-3 illustrates the moderating effect, with low (high) values referring to values that are 1.0 standard deviations below (above) the sample mean. As indicated by the slope analysis of the moderation results, when there is a strong perception of input control fairness, perceived input control has only a weak negative effect on complementors' intrinsic motivation. Conversely, perceived input control has a strong negative effect on complementors' intrinsic motivation when input control fairness is low. Overall, these results further support our moderation hypothesis H3.

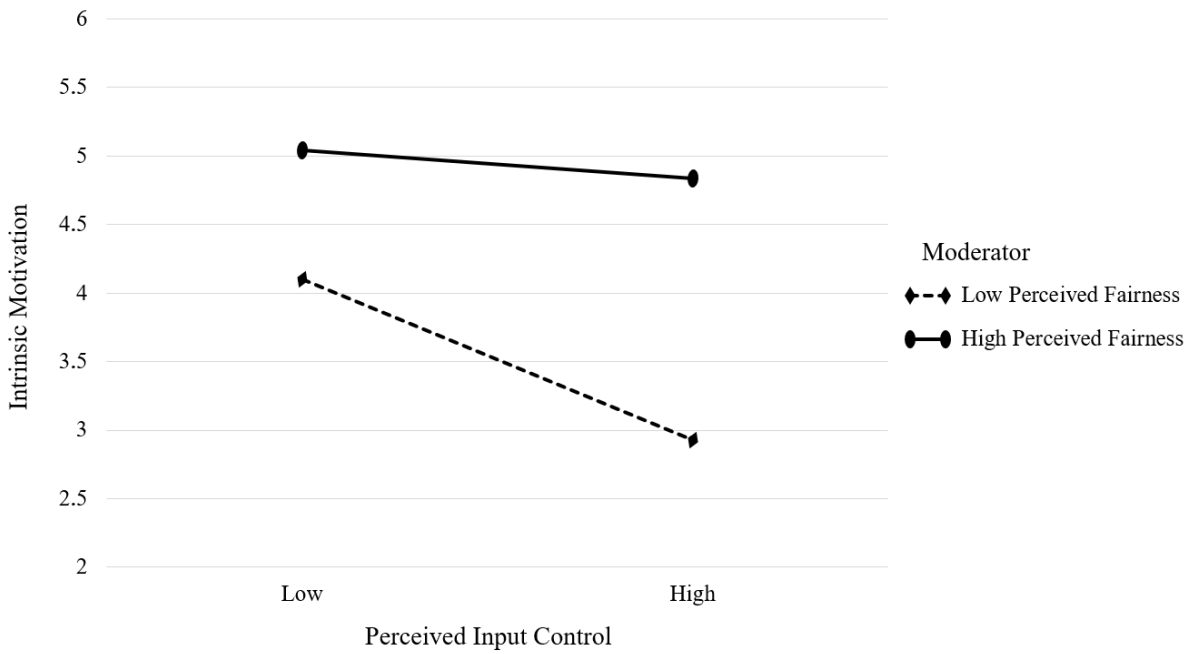

Figure 6-3: Moderating Effect of Input Control Fairness

To validate the mediation effect of intrinsic motivation, we conducted a mediation analysis using a bootstrapping approach (Cheung & Lau, 2008). The results from mediation analysis, based on 5000 bootstrapping samples generating 95% confidence intervals, revealed a significant negative indirect effect (Perceived Input Control → Intrinsic Motivation → Perceived Performance, $\beta = -0.11$, $p < 0.005$, lower confidence interval = -0.15, upper confidence interval = -0.04), **supporting H4.**

Lastly, our research model reconfirms the significant positive effect of intrinsic motivation on complementors' perceived performance ($\beta = 0.56$, $p < 0.001$).

6.5.3 Robustness Checks

We conduct several analyses to increase the confidence in the robustness of our results. First, to verify that the use of PLS is adequate, we analyzed our data using a traditional ordinary least squares method. The pattern of our results remained qualitatively the same in terms of significance, direction, and relative magnitude of coefficients. Second, we recognize the potential concern that our measurement of perceived performance through two reflective items is inadequate. Thus, we additionally ran a robustness test by using an alternative operationalization of perceived performance (Wade & Nevo, 2005), which consisted of three second-order constructs: Competition, Operations, and Sustainability. The results were consistent with the findings reported in the main analysis. This suggests that our results are robust to different measures of perceived performance.

6.6 Discussion

IS research on digital platforms acknowledges the role of governance mechanisms to secure platforms' success and sustainability. As such, examining how complementors perceive and react to control mechanisms is becoming increasingly important. The main objective of this study was to investigate how and why perceived input control affects complementors' perceived performance on digital platforms. Four key findings result from our study. First, we find that perceived input control negatively affects complementors' intrinsic motivation as complementors feel restricted in their autonomy. Second, our results show that intrinsic motivation negatively mediates the effect of perceived input control on complementors' perceived performance. Third, we find that input control fairness positively moderates the relationship between perceived input control and complementors' intrinsic motivation. Specifically, if input control mechanisms on a digital platform are perceived to be fair, input control is less likely to decrease complementors' intrinsic motivation, as complementors evaluate the requirements with a more positive affect. Lastly, our results surprisingly reveal that perceived input control has no direct effect on complementors' perceived performance when accounting for intrinsic motivation. To explain this counterintuitive finding, we conjecture that complementors may view high input control not only as a positive indicator for platform quality, but also as a cumbersome barrier to submit further complements. As such, high input control may obstruct complementors in achieving their full potential, causing them to stagnate in perceived performance. This counterintuitive finding further supports Rietveld et al. (2020) findings that the consequences of platform governance mechanisms are anything but straightforward and can lead to either positive or negative performance outcomes for complementors.

6.6.1 Contributions

Our study offers three important contributions to IS literature on platform governance in general and on input control in particular. First, we contribute to the body of knowledge on platform governance by advancing our understanding of the effects of input control on digital platforms. Whereas previous studies investigated the effects of input control on platforms' network effects (Thies et al., 2018), platforms' revenue (Wessel et al., 2017) and complementors' behavioral intentions (i.e., continuance intentions) (Croitor et al., 2020; Croitor & Benlian, 2019), the effect of perceived input control on complementors' perceived performance remained unclear. To this end, our study advances the platform governance literature by highlighting the effect of perceived input control on complementors' performance outcomes.

Second, we shed light on the mechanisms through which the effects of perceived input control on complementors' perceived performance unfolds. Only recently have studies started to unravel the explanatory mechanisms underlying the relationship between perceptions of control modes and complementors' behavioral outcomes (e.g., Goldbach et al., 2018). Our study extends knowledge on the underlying mechanisms that explain the relationship between perceived input control and complementors' perceived performance by revealing intrinsic motivation as a mediator. We thus contribute to a more nuanced understanding of factors that explain complementors' perceived performance on digital platforms (Bande et al., 2016; Cerasoli & Ford, 2014; Dysvik & Kuvaas, 2011).

Third, our study enhances our understanding of how input control fairness moderates the relationship between perceived input and complementors' intrinsic motivation. Previous IS scholars investigating the effect of control modes on complementors' experiences (e.g., intrinsic motivation) thus far largely overlooked moderating factors (Goldbach & Benlian, 2015b), despite first research emphasizing the potential influence of input control fairness (Kim et al., 2016). Our study contributes to our understanding of the conditions under which input control unfolds by introducing input control fairness as a moderator. We thus extend knowledge on the consequences of input control on digital platforms.

Beyond these theoretical contributions, our study offers valuable insights for platform providers. Specifically, we demonstrate how perceptions of input control affect complementors' perceived performance, linking to the success and sustainability of digital platforms. Platform providers who set strict input control requirements need to ensure complementors perceive these requirements as fair to avoid crumpling complementors' intrinsic motivation. Protecting and fostering intrinsic motivation is key to lead complementors to greater performance, ultimately benefitting the platform as a whole.

6.6.2 Limitations and Directions for Future Research

This study should be interpreted in light of its limitations, which provide opportunities for future research. The first limitation is that we collected our data through a single survey that captured both dependent and independent variables. Even though formal tests for common method bias indicated no substantial concern, future research could further validate our findings and thereby also confirm causality of our model through experimental research designs (e.g., laboratory or field experiment). Second, our online survey was conducted in the context of e-marketplace platforms. Thus, researchers should be cautious when generalizing our findings to other platform contexts. We call for future studies to replicate our findings in further platform contexts to ensure generalizability. Lastly, in our study we examined complementors' self-

reported perceived performance instead of their actual performance. However, prior studies have shown that complementors' perceived performance correlates with actual performance (Brown & Perry, 1994; Kohli & Grover, 2008). Nevertheless, future research should triangulate perceived and actual performance measures to offer more robust results.

Chapter 7: Thesis Conclusion and Contributions

This thesis was motivated by growing governance challenges for platform providers and our limited understanding of input control on digital platforms in IS research. It emphasizes the growing importance of exerting input control in a well-balanced way. On the one hand, input control practices must be useful for platform providers to ensure the quality of complements. On the other hand, input control mechanisms must also be complementor-friendly (e.g., fast, fair and transparent) to maintain complementors' willingness to keep contributing to the platform. As such, the purpose of the thesis was to showcase the role and importance of input control and to provide a deeper and more comprehensive understanding of how and why complementors perceive and react to input control mechanisms on digital platforms. Against this backdrop, six studies in five research articles have been published. Each study contributes to answering the overarching research questions and examining the role of input control in different platform contexts from diverse angles.

7.1 Theoretical Contributions

This thesis was guided by three overarching research questions. In the following, each research question as well as theoretical contributions obtained from answering the corresponding question are discussed in more details.

RQ1: What is the conceptual definition of perceived input control and how can it be measured?

Previous IS research has repeatedly called for the development of a measurement scale for input control in platform contexts due to a lack of consistency on what this concept means and how it should be measured (Tiwana, 2015a; Tiwana et al., 2010). Indeed, the systematic literature review revealed that to date no study has systematically investigated the conceptual foundations of input control for digital platform settings. In this thesis, this research gap is addressed by developing a sound conceptualization and robust measurement instrument for perceived input control. The results reveal supporting evidence across the samples used in the scale development process for the psychometric properties of the scale, indicating that the measures are valid and reliable. The developed scale provides a thoroughly validated instrument to capture the particularities and nuances of perceived input control across different platform contexts and thereby contributes to a comprehensive understanding of the properties that denote complementors' perceptions of platforms' gatekeeping practices. In particular, in contrast to previous research that has exclusively focused on complement screening and approval, the presented conceptualization of perceived input control provides a more holistic account of how complementors form their perceptions about a platform's input control practices. In fact, the

conceptualization developed in this thesis acknowledges that complementors' perceptions are not only shaped by complement vetting, but also by gatekeeping and screening processes related to complementors themselves. This distinction is crucial in the context of digital platforms, given that platform providers are increasingly advised to control not only 'what' complements are allowed into their platform ecosystem but also 'who' they allow to continuously participate in this ecosystem. Thus, this thesis contributes to answering the first research question (*RQ1*) on how perceived input control is conceptualized and measured on digital platforms.

RQ2: How and why does perceived input control affect complementors' continuance intentions?
Previous studies on IS control have mainly focused on traditional control modes (i.e., behavior, output, self and clan control) (Choudhury & Sabherwal, 2003; Goldbach et al., 2018). This thesis expands research on control modes by showing how perceived input control affects complementors' willingness to keep contributing to platforms. Moreover, it enriches previous research by explaining why perceived input control affects complementors' behavioral intentions. Only recently have studies started to unravel the explanatory mechanisms underlying the relationship between perceptions of control modes and behavioral intentions, thus far pointing at perceived autonomy as a mediator in complementors' continuance intentions (Goldbach et al., 2018). This thesis extends knowledge on the underlying mechanisms that explain the relationship between perceived input control and complementors' behavioral intentions by revealing perceived usefulness and satisfaction as key mediators. As such, this thesis advances our understanding of factors that explain complementors' intentions to stay on and keep contributing to digital platforms (Benlian et al., 2015). This thesis therefore contributes to answering the second research question (*RQ2*) on how and why perceived input control affects complementors' continuance intentions.

RQ3: How and why does perceived input control affect complementors' performance?
IS researchers studying effects of control modes and the success of digital platforms thus far predominantly focused on complementors' behavioral intentions (e.g., continuance intentions) (Cram et al., 2020; Goldbach et al., 2018). However, previous research repeatedly underscored the need to go beyond behavioral intentions and address complementors' performance outcomes (Mora-Monge et al., 2019; Rietveld et al., 2020; Wang & Cavusoglu, 2015). Maximizing complementors' performance is an important goal for both complementors and platform providers, since (1) complementors' performance is tied to their revenues and thus one of the primary objectives of their business activity and because (2) complementors' performance is a key enabler for digital platforms' overall success and sustainability (Wang et

al., 2012). In this thesis, this research gap is addressed by highlighting the effects of perceived input control on complementors' performance outcomes. It identifies important factors affecting complementors' performance that to date have not been empirically investigated in the previous platform literature. Moreover, only recently have studies started to unravel the explanatory mechanisms underlying the relationship between perceptions of control modes and complementors' outcomes (e.g., Goldbach et al., 2018). This thesis sheds light on the mechanisms through which the effects of perceived input control on complementors' performance unfold by revealing intrinsic motivation as a mediator. Thus, this thesis contributes to answering the third research question (*RQ3*) on how and why perceived input control affects complementors' performance.

7.2 Practical Contributions

Beyond the theoretical contributions, this thesis also provides crucial recommendations and guidelines for platform providers. As such, platform providers may use the results of this thesis to understand how and why complementors perceive and react to input control mechanisms on their digital platforms.

First, the findings of this thesis support platform providers in selecting appropriate input control mechanisms and in obtaining a more complete picture of its underlying facets. A clear understanding of complementors' perceptions of platform input control and the possibility to measure it is an invaluable tool for platform providers to not only pinpoint missing or inadequately addressed input control facets on platforms. It is also useful to decide whether consideration or neglect of these facets can outweigh shortcomings against the background of a more or less open platform strategy. In particular, our empirical results revealed that platform providers need to consider both complementor-related input control (i.e., during registration) and complement-related input control (i.e., during complement submission) when thinking about input control. This distinction may help platform providers to allocate their attention and budgets more effectively to different input control mechanisms on their platforms.

Second, the results offer valuable insights for platform providers on the design and optimization of input control mechanisms that appeal to complementors and thus further increase complementors' continuance intentions. When designing input control mechanisms, platform providers should convince complementors that the efforts required to undergo the input control are low (e.g., displaying testimonials of complementors that perceived the requirements to be easier to meet than expected). Furthermore, platform providers should provide insights into the

approval process and communicate their access requirements as detailed as possible. Complementors whose complements have been rejected must be given a clear and unambiguous reason for the rejection, which helps them to adapt the rejected complements. Additionally, based on the results of this thesis, it is recommended to provide information on the average duration of the review process and to enable complementors to inform themselves about the latest status of the review.

Third, we demonstrate how perceptions of input control affect complementors' perceived performance, linking to the success and sustainability of digital platforms. Protecting and fostering intrinsic motivation is key to lead complementors to greater performance, ultimately benefitting the platform as a whole. Platform providers who set strict input control requirements need to ensure complementors perceive these requirements as fair to avoid crumpling complementors' intrinsic motivation. For example, platform providers that manually screen out complementors and complements on their digital platforms may switch to an automated process to increase complementors' perception of an objective and thus fair input control mechanism.

7.3 Limitations and Directions for Future Research

Despite the aforementioned theoretical and practical contributions of this research, the results should be interpreted in light of their limitations. As such, I want to point out three noteworthy limitations, which also provide avenues for future research.

First, the studies incorporated in this thesis may suffer from methodological limitations, and thus require further investigations to improve internal validity. For example, future research may conduct online experiments that observe complementors' reactions to different input control mechanisms in which the generated results are not subject to the reporting biases inherent in survey research. Moreover, laboratory experiments combine high internal validity with strong causal inferences.

Second, the selection process of participants in the presented studies can lead to selection biases (Heckman, 1979). In particular, our empirical studies were conducted only with participants who actually managed to get access to the investigated platform. As such, these studies do not take into account complementors that were affected by input control but have not joined the platform (i.e., complementors who are on the verge of joining the platform and complementors whose access to a platform was denied). Therefore, future research should strive to capture the perception of input control of diverse complementor to address this concern.

Third and lastly, while we considered various mediating factors across the thesis' studies, there are factors we did not account for. Future studies may extend the thesis' research model by including additional potential mediating factors (e.g., complementors' privacy concerns or trust in platform provider) in order to gain a deeper understanding of the effects of input control on complementors' behavioral and performance outcomes. For example, if digital platforms require complementors to disclose highly sensitive information, complementors' privacy concerns may negatively mediate the relationship between perceived input control and their continuance intentions. Similarly, trust in platform provider may be an additional mediating factor associated with input control on digital platforms where a trustworthy climate between complementors and end-users is necessary to sustain successful interactions. Furthermore, we encourage researchers to explore further complementors' intentions and outcomes affected by a platform's input control mechanisms. For example, it is important to understand how input control affects complementors' intention to join (Kathuria et al., 2020), given that complementors seeking to join a digital platform often evaluate the requirements they have to fulfill to be granted access. Moreover, the ongoing challenge to comply with automated input control mechanisms may influence complementors' well-being (e.g., causing technostress) (Benlian, 2020; Cram et al., 2020). As such, future studies need to investigate the effect of input control on technostress in the context of digital platforms. These research opportunities may further contribute to our understanding of the effects of input control on digital platforms.

Overall and to the best of my knowledge, this thesis provides the first attempt to systematically examine input control on digital platforms from the complementors' perspective. It is an initial step towards understanding of how and why complementors perceive and react to input control mechanisms on digital platforms. Therefore, this thesis extends prior IS research on the role of control mechanisms that are essential for platform providers in establishing platforms' long-term health and success. I hope that my results will encourage future studies to further advance the IS control research and platform governance literature beyond the current body of knowledge.

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Appendix

	Complementor	Complement
Financial Barrier	(1) It is expensive to register as a developer on the platform.	(1) The high cost of publishing an application is an obstacle to get access to the platform.
	(2) The fee for registration on the platform as a developer is high.	(2) The application submission fee is quite expensive.
	(3) I have to pay a high registration fee to enter the platform.	(3) The costs for getting an application published on the platform are high.
Regulatory Requirements	(1) Adhering to the regulatory terms and conditions is hard for me to fulfill.	(1) It is cumbersome to get through and abide by all regulatory guidelines and rules that are specified by the platform provider.
	(2) Complying with all regulatory requirements is a high entry barrier to the platform for me.	(2) It is hard to comply with application-related regulatory requirements (e.g., copyright, privacy, or safety) imposed by the platform provider.
	(3) There are laws and regulations that complicate my access to the platform.	(3) The platform provider controls an application's adherence to regulatory guidelines, which have to be considered during the development process.
Technical Requirements	(1) It was hard to fulfill all technical requirements to receive a developer account.	(1) Technical requirements, which are imposed by the platform, restrict the features I want to add.
	(2) Technical requirements for registering as developer (e.g., specific bank account, email, or phone number) are an entry barrier to the platform.	(2) It is hard to comply with application-related technical requirements (e.g., performance, design, or security) demanded by the platform provider.
	(3) The procedural barriers to get access to the platform as a developer are hard to overcome.	(3) My application's functionality needed to go through a stringent technical verification process before my application could enter the platform.
Temporal Expenditure	(1) I had to spend a lot of time to comply with the platform's registration requirements.	(1) Before my application could be published on a platform, it had to go through a long review process.
	(2) It takes a long time until the developer registration procedure is concluded.	(2) The long review process of the application deterred me from entering the platform.
	(3) The platform provider has a slow developer authentication process.	(3) I have to wait long for the results of the application review process.
Overall Perception	(1) In my opinion, it is hard to get access to the platform to publish my applications.	
	(2) Overall, the platform provider sets strict formal criteria for access approval.	
	(3) Getting access to this platform is subject to stringent screening processes.	
	(4) It is burdensome for me to comply with all requirements to be granted access to this platform.	

Table A1: List of PIC Dimensions and Items

Continuance Intention	As an application developer of the platform…
	(1) … I plan to use the platform for application development in the future.
	(2) … I intend to continue using the platform for application development in the future.
	(3) … I expect my use of the platform for application development to increase in the future.

Table A2: Measurement of Continuance Intention

AMCIS	Americas Conference on Information Systems
AMJ	Academy of Management Journal
AMR	Academy of Management Review
DSS	Decision Support Systems
ECIS	European Conference on Information Systems
EJIS	European Journal of Information Systems
ICIS	International Conference on Information Systems
ISJ	Information Systems Journal
ISR	Information Systems Research
JAIS	Journal of the Association for Information Systems
JDS	Journal of Decision Systems
JIT	Journal of Information Technology
JMIS	Journal of Management Information Systems
JMS	Journal of Management Studies
JSIS	Journal of Strategic Information Systems
JOM	Journal of Operations Management
MISQ	Management Information Systems Quarterly
MS	Management Science
OrgSc	Organization Science
OrgSt	Organization Studies
SMJ	Strategic Management Journal

Table A3: Conference and Journal Title Abbreviations

Web of Science	TS=("input control" OR "screening" OR "vetting" OR "gatekeeping") AND SO=(INFORMATION SYSTEMS JOURNAL OR INFORMATION SYSTEMS RESEARCH OR MIS QUARTERLY OR EUROPEAN JOURNAL OF INFORMATION SYSTEMS OR JOURNAL OF INFORMATION TECHNOLOGY OR JOURNAL OF MANAGEMENT INFORMATION SYSTEMS OR JOURNAL OF STRATEGIC INFORMATION SYSTEMS OR JOURNAL OF THE ASSOCIATION FOR INFORMATION SYSTEMS OR JOURNAL OF DECISION SYSTEMS OR DECISION SUPPORT SYSTEMS OR ACADEMY OF MANAGEMENT JOURNAL OR ACADEMY OF MANAGEMENT REVIEW OR INFORMATION "AND" ORGANIZATION OR JOURNAL OF STRATEGIC INFORMATION SYSTEMS OR JOURNAL OF MANAGEMENT STUDIES OR STRATEGIC MANAGEMENT JOURNAL OR MANAGEMENT SCIENCE OR ORGANIZATION SCIENCE OR ORGANIZATION STUDIES OR JOURNAL OF OPERATIONS MANAGEMENT)
AIS electronic Library	abstract:(input control) OR title:(input control) OR subject:(input control) OR abstract:screening OR title:screening OR subject:screening OR abstract:vetting OR title:vetting OR subject:vetting OR abstract:gatekeeping OR title:gatekeeping OR subject:gatekeeping

Table A4: Applied Search Strings

	%		%		%
Gender:		Education:		Experience:	
• Male	68.4	• High school graduate	10.6	• less than 1 year	4.4
• Female	31.6	• Associate degree	4.4	• 1 to 3 years	17.5
Age:		• Bachelor’s degree	50.9	• 3 to 5 years	25.4
• below 25	2.6	• Master’s degree	28.9	• 5 to 7 years	15.8
• 25 – 34	31.6	• Professional degree	2.6	• more than 7 years	36.9
• 35 – 44	33.3	• Doctorate degree	2.6	Extensions developed:	
• 45 – 54	32.5	Country:		• one	5.3
• over 54	0.0	• United Kingdom	36.0	• two	29.8
		• USA	64.0	• three	22.8
				• more than three	42.1

Table A5: Demographic Distribution of the Survey Respondents (N = 114)

Perceived Input Control (7-point Likert-type scale adapted from Croitor and Benlian (2019)). 1. In my opinion, it is hard to get access to the platform to publish my extension. 2. Overall, the platform provider sets strict formal criteria for access approval. 3. Getting access to this platform is subject to stringent screening processes. 4. It is burdensome for me to comply with all requirements to be granted access to this platform.
Complementor-PIC (7-point Likert-type scale adapted from Croitor and Benlian (2019)). 1. The registration costs and corresponding expenses for registering on this platform as an extension developer are high. 2. There are laws and regulations that complicate my access as a developer to the platform. 3. The procedural barriers to get access to the platform as a developer are hard to overcome. 4. It takes a long time until the developer registration procedure is concluded.
Complement-PIC (7-point Likert-type scale adapted from Croitor and Benlian (2019)). 1. The cost of publishing an extension is an entry barrier to the platform. 2. It is cumbersome to get through and abide by all regulatory guidelines and rules that are specified by the platform provider. 3. My extension's functionality needed to go through a stringent technical verification process before my extension could enter the platform. 4. Before my extension could be published on a platform, it had to go through a long review process.
Satisfaction (7-point Likert-type scale adapted from Agarwal and Karahanna (2000)). 1. I feel satisfied with using the platform. 2. I feel contended with using the platform. 3. I feel pleased with using the platform.
Perceived usefulness (7-point Likert-type scale adapted and modified from Bhattacherjee (2001)). 1. Using the platform improves my performance in distributing extensions. 2. Using the platform increases my productivity in distributing extensions. 3. Using the platform enhances my effectiveness in distributing extensions. 4. Overall, the platform is useful in distributing extensions.
Continuance intention (7-point Likert-type scale adapted from Bhattacherjee (2001)). 1. I plan to use the platform for extension distribution in the future. 2. I intend to continue using the platform for extension distribution in the future. 3. I expect my use of the platform for extension distribution to increase in the future.

Table A6: Measurement Scales

1. On which platforms did you publish your extensions?
2. Why did you choose those platforms for extension publishing?
3. How hard or easy was it to register as a developer on the platform?
4. How hard or easy was it to submit an extension on the platform?
5. What do you think about the developer registration requirements?
6. What do you think about the extension submission requirements?
7. How would you improve the registration or submission process?
8. Do you perceive platform requirements as useful? Why or why not?
9. Are you satisfied with platform requirements? Why or why not?
10. How do you foresee your future use of the platform?
11. Would you like to add something we did not talk about during the interview?

Table A7: Interview Questions

Resp. #	**Gender**	**Age**	**Experience (Years)**	**Experience (Extensions)**	
				Firefox	**Chrome**
1.	Male	30-34	2	1	1
2.	Male	40-44	5	2	5
3.	Male	40-44	9	1	1
4.	Male	40-44	10	8	5
5.	Male	35-39	1	1	1
6.	Male	30-34	2	8	6
7.	Male	35-39	6	1	1
8.	Male	20-24	2	2	2
9.	Male	30-34	7	1	2
10.	Female	35-39	3	3	1
11.	Male	30-34	3	25	10
12.	Male	25-29	2	12	1
13.	Male	20-24	4	1	1
14.	Male	35-39	5	1	2
15.	Male	25-29	5	1	1
16.	Male	25-29	6	2	2
17.	Male	30-34	3	2	2
18.	Male	25-29	2	1	1
19.	Male	25-29	9	12	1
20.	Male	25-29	4	1	1
21.	Male	25-29	6	1	1
22.	Male	35-39	7	1	1

Table A8: Demographic Profile of Interview Respondents

Perceived Input Control (PIC) (Croitor & Benlian, 2019)
(PIC1) It is burdensome for me to comply with all requirements to publish campaigns on the crowdfunding platform. (PIC2) Overall, the crowdfunding platform sets strict formal criteria for publication approval. (PIC3) Publishing campaigns on the crowdfunding platform is subject to stringent screening processes. (PIC4) In my opinion, it is hard to publish campaigns on the crowdfunding platform.
Perceived Self Control (PSC) (Tiwana & Keil, 2009)
(PSC1) I self-manage my campaign activities on the crowdfunding platform. (PSC2) I set specific goals for my campaigns without involvement of the crowdfunding platform. (PSC3) I define specific procedures for my campaign activities without involvement of the crowdfunding platform.
Perceived Effort (PE) (Venkatesh et al., 2012)
(PE1) When publishing a campaign on the crowdfunding platform, complying with the publication requirements is time consuming for me. (PE2) When publishing a campaign on the crowdfunding platform, complying with the publication requirements is burdensome for me. (PE3) When publishing a campaign on the crowdfunding platform, complying with the publication requirements is costly for me. (PE4) When publishing a campaign on the crowdfunding platform, complying with the publication requirements is effortful for me.
Perceived Usefulness (PU) (Agarwal & Karahanna, 2000)
(PU1) I am sure the crowdfunding platform is able to help me get funds for my campaigns. (PU2) The crowdfunding platform helps me to raise funds for my campaigns. (PU3) The crowdfunding platform increases my productivity in obtaining funds for my campaigns. (PU4) Using the crowdfunding platform increases my chances of getting funds for my campaigns.
Perceived Net Goal Attainment (PNGA) (Sun et al., 2014)
(PNGA1) Publishing on the crowdfunding platform is worth the effort that I put in. (PNGA2) The things that I accomplish with publishing my campaigns on the crowdfunding platform warrant my effort. (PNGA3) The results of publishing my campaigns on the crowdfunding platform are worth the time I invest. (PNGA4) The value I receive from the published campaigns on the crowdfunding platform justifies my efforts.
Satisfaction (SAT) (Bhattacherjee, 2001)
(SAT1) My experience of using the crowdfunding platform is very satisfied. (SAT2) My experience of using the crowdfunding platform is very pleased. (SAT3) My experience of using the crowdfunding platform is very contented. (SAT4) My experience of using the crowdfunding platform is very encouraged.
Continuance Intention (CI) (Schlosser et al., 2006)
(CI1) It's likely that I would publish another campaign on the crowdfunding platform.

(CI2) It's possible that I would publish another campaign on the crowdfunding platform. (CI3) It's probable that I would publish another campaign on the crowdfunding platform.
Switching Intention (SI) (Lin et al., 2012)
(SI1) I intend to switch to other (rival) platforms in the near future. (SI2) I plan to switch to other (rival) platforms in the near future. (SI3) I predict I will switch to other (rival) platforms in the near future.

Table A9: Construct Measures

Platform context	Study	Control modes					Unit of analysis		
		Input	Behavior	Output	Clan	Self	Complementor	Complement	Platform
Mobile app platforms (e.g., Android and iOS)	(Goldbach & Benlian, 2015a)	-	-	-	X	-	-	Performance	-
	(Goldbach & Benlian, 2015b)	-	-	-	X	X	Continuance intention	Quality	-
	(Goldbach et al., 2018)	-	X	X	-	X	Continuance intention	Quality	-
	(Croitor & Benlian, 2019)	X	-	-	-	-	Continuance intention	-	-
Web browser platforms (e.g., Chrome and Firefox)	(Tiwana, 2015a)	X	-	-	-	-	-	Performance	-
	(Croitor et al., 2020)	X	-	-	-	-	Continuance intention	-	-
Crowdfunding platforms (e.g., Kickstarter and Indiegogo)	(Wessel et al., 2017)	X	-	-	-	-	-	Success	Revenue
	(Thies et al., 2018)	X	-	-	-	-	-	-	Network effects
	(Croitor et al., 2021)	X	-	-	-	X	Continuance intention	-	-
Gig Economy platforms (e.g., Uber)	(Cram et al., 2020)	X	X	X	-	-	Continuance intention	-	-
E-Marketplace platforms (e.g., Amazon and Etsy)	This study	X	-	-	X	-	Continuance intention	-	-

Table A10: Selected Studies Focusing on Control Modes on Digital Platforms

Variables	Category	Amazon (n = 286)	Etsy (n = 185)
Gender	Female	74	152
	Male	212	33
Age	18-24	12	10
	25-34	88	64
	35-44	86	60
	45-54	66	48
	> 54	34	3
Education	High school or below	73	70
	Bachelors	88	66
	Masters	113	42
	Ph. D.	12	7
Country of residence	Germany	124	90
	United States	70	54
	United Kingdom	25	17
	Other	67	24
Experience (offered products)	1-5 products	17	7
	5-25 products	38	31
	25-100 products	38	70
	100-1,000 products	103	70
	> 1,000 products	90	7
Experience (years)	< 1 year	13	12
	1-2 years	41	22
	2-3 years	56	24
	3-4 years	30	45
	4-5 years	21	11
	> 5 years	125	71

Table A11: Demographic Distribution of the Survey Respondents

Construct	Items	Source
Perceived Input Control (PIC)	It is burdensome for me to comply with all requirements to be granted access to the platform.	Adapted from Croitor and Benlian (2019)
	Overall, the platform sets strict formal criteria for access approval.	
	Getting access to the platform is subject to stringent screening processes.	
	In my opinion, it is hard to get access to the platform to sell my products.	
Perceived Clan Control (PCC)	I attempt to be a regular member of the platform community.	Adapted from Kirsch et al. (2002)
	I attempt to understand the platform's goals, values and norms.	
	I place a significant weight on understanding the platform's goals, values and norms.	
	I actively participate in seller forums, channels or groups to understand the platform's goals, values and norms.	
Intrinsic motivation (IM)	I enjoy selling my products on the platform.	Adapted from Deci and Ryan (2002)
	I would describe selling products on the platform as very interesting.	
	Selling products on the platform is fun to do.	
Perceived Usefulness (PU)	Using the platform improves my performance in selling products.	Adapted from Agarwal and Karahanna (2000)
	Using the platform increases my productivity in selling products.	
	Using the platform enhances my effectiveness in selling products.	
	Overall, the platform is useful for my business in selling products.	
Satisfaction (SAT)	My experience of selling products on the platform is very satisfied.	Adapted from Bhattacherjee (2001)
	My experience of selling products on the platform is very pleased.	
	My experience of selling products on the platform is very contented.	
	My experience of selling products on the platform is very encouraged.	
Continuance Intention (CI)	I expect my use of the platform for selling products to increase in the future.	Adapted from Bhattacherjee (2001)
	I intend to continue using the platform for selling products in the future.	
	I plan to continue using the platform for selling products in the future.	

Table A12: Construct Measures

Platform	**Construct**	**Mean**	**S.D.**	**Item Loadings**	**Composite Reliability**	**Cronbach's Alpha**	**Average Variance Extracted**
Amazon	PIC	4.08	1.42	0.80-0.90	0.92	0.88	0.74
	PCC	2.12	1.35	0.74-0.88	0.87	0.80	0.62
	IM	4.02	1.27	0.73-0.91	0.88	0.79	0.71
	PU	5.28	1.55	0.91-0.94	0.95	0.92	0.85
	SAT	4.15	1.62	0.90-0.94	0.95	0.92	0.90
	CI	5.39	1.64	0.90-0.93	0.93	0.90	0.86
Etsy	PIC	1.91	1.04	0.79-0.90	0.82	0.81	0.65
	PCC	4.55	1.39	0.77-0.86	0.83	0.73	0.66
	IM	5.47	1.30	0.90-0.95	0.93	0.91	0.86
	PU	5.27	1.62	0.89-0.94	0.93	0.90	0.82
	SAT	4.65	1.65	0.90-0.95	0.95	0.92	0.86
	CI	5.64	1.65	0.89-0.92	0.92	0.90	0.88

Table A13: Results of the Measurement Model Assessment (Convergent Validity)

Platform	Construct	PIC	PCC	IM	PU	SAT
Amazon	PIC					
	PCC	0.21				
	IM	0.35	0.47			
	PU	0.29	0.36	0.70		
	SAT	0.37	0.38	0.72	0.73	
	CI	0.28	0.32	0.66	0.66	0.65
Etsy	PIC					
	PCC	0.10				
	IM	0.18	0.42			
	PU	0.18	0.39	0.69		
	SAT	0.17	0.41	0.71	0.74	
	CI	0.10	0.39	0.66	0.71	0.70

Table A14: Results of the Measurement Model Assessment (Discriminant Validity)

	Indirect effect path	Platform	Indirect effect	LLCI	ULCI	Mediation
H4a	PIC → IM → PU → CI PIC → IM → SAT → CI	Amazon Etsy	-0.058 -0.059	-0.111 -0.126	-0.013 -0.011	Supported
		Amazon Etsy	-0.037 -0.054	-0.076 -0.121	-0.008 -0.004	
H4b	PCC → IM → PU → CI PCC → IM → SAT → CI	Amazon Etsy	0.131 0.064	0.075 0.020	0.199 0.124	Supported
		Amazon Etsy	0.084 0.059	0.037 0.006	0.144 0.119	

Table A15: Summary of Mediation Testing Results

Construct	Platform	Mean	S.D.	Mean difference	Significance
PIC	Amazon Etsy	4.08 1.91	1.42 1.04	2.17	***
PCC	Amazon Etsy	2.12 4.55	1.35 1.39	-2.43	***
IM	Amazon Etsy	4.02 5.47	1.27 1.30	-1.45	***
PU	Amazon Etsy	5.28 5.27	1.55 1.62	0.01	n.s.
SAT	Amazon Etsy	4.15 4.65	1.62 1.65	-0.50	**
CI	Amazon Etsy	5.39 5.64	1.64 1.65	-0.25	n.s.
*Note: n.s. = non-significant; *p<0.05; **p<0.01; ***p<0.001.*					

Table A16: Between-group Comparison of Amazon and Etsy