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# Control Modes on Mobile Software Platforms

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Tobias Goldbach

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Empirical Studies on the  
Importance of Informal Control

Tobias Goldbach  
Darmstadt, Deutschland

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# Abstract

Over the past few years, software platforms and their corresponding ecosystems have gained a growing importance in the software industry. Especially mobile platforms such as Apple's App Store or Google's Android Market have offered novel ways to develop and distribute software. However, it is a challenge for platform providers to find the right balance between ensuring the platform's integrity while offering enough freedom to encourage third-party developers' motivation and innovation. Control theory, with its formal and informal control modes, is a suitable framework for describing and analyzing such coordination phenomena between two parties. Although there have been several Information Systems (IS) research calls regarding how and why control modes affect third-party developers' outcomes and behaviors on software platforms, limited research has been conducted in this context. Only little attention has been paid to informal control modes (self- and clan control), which have been previously found to be of particular importance in decentralized and complex multi-project settings such as software platforms.

Against this backdrop, this thesis presents three studies across four articles conducted to investigate how control modes affect third-party developers' crucial development outcomes and behaviors, how these effects may be explained and how promising control modes may be facilitated. The first two studies draw on control theory and self-determination literature. Within the first study, a laboratory experiment reveals how self-control compared to formal controls has consistently stronger effects on developers' app quality and intention to stay on a platform. Additionally, the study shows that these effects are explainable with developers' higher autonomy perception under self-control. In a field survey, the second study focuses on the role of third-party developers' intrinsic motivation, which mediates the positive effects of self-control and clan control on developers' work efforts and intention to stay on a platform. By combining control theory and social capital theory, the third study examines in another field survey how in particular clan control could be facilitated in order to enhance third-party developers' project performance and app success. The findings demonstrate that each social capital dimension (i.e., structural, cognitive and relational) positively affects the exercise of clan control, which in turn enhances developers' project performance and app success.

Overall, the thesis highlights the importance of informal control modes on software platforms regarding their positive effects on third-party developers' outcomes and behaviors. The conducted studies could demonstrate how self-control and clan control positively affect developers' outcome performance, app quality and intentions to stay on software platforms. Moreover, the findings shed light on the underlying explanatory mechanisms of why informal

control modes can be exercised effectively on software platforms and how especially clan control may be facilitated with developers' social capital. By demonstrating how and why control modes operate on software platforms, this thesis answers to several calls for research in platform governance and IS control literature, and lays the foundation for further studies in this context. Platform providers may use the results to better understand how and why control modes affect third-party developers' outcomes and behaviors. They are advised to increasingly exercise informal control modes and find areas where such forms of control are applicable. Third-party developers may choose software platforms with more open, self-regulating and clan-based governance structures, in which they are able to benefit from their higher autonomy and freedom for intrinsic motivation.

# **Zusammenfassung**

In den letzten Jahren haben Software-Plattformen und die dazugehörigen Ökosysteme an Bedeutung in der Software-Industrie gewonnen. Vor allem mobile Plattformen wie Apples App Store und Googles Android-Markt haben neue und gewinnbringende Wege für die Entwicklung und den Vertrieb von Software ermöglicht. Allerdings stehen Plattformanbieter vor der Herausforderung, die richtige Balance zu finden zwischen der Sicherstellung der Plattformintegrität und der Zulassung von Freiheiten für Dritt-Entwickler, um deren Motivation und Innovation zu fördern. Die Control-Theorie (oder auch Kontroll- und Steuerungstheorie) mit ihren formalen und informal Control-Modi (englisch: formal and informal control modes) ist ein geeigneter Bezugsrahmen, um Dynamiken zwischen zwei Parteien zu beschreiben und zu analysieren. Trotz mehrerer Forschungsaufträge zur Untersuchung von Control-Auswirkungen auf Ergebnisse und Verhaltensweisen von externen Entwicklern wurden bisher kaum Studien in diesem Kontext durchgeführt. Noch weniger Aufmerksamkeit wurden Informal Control Modes (unterteilt in Self-Control und Clan Control) gewidmet, denen in vorangegangenen Studien besondere Bedeutung in Situationen mit dezentralisierten und komplexen Multi-Entwicklungsprojekten, wie auf Software-Plattformen vorzufinden, zugeschrieben wurde.

Vor diesem Hintergrund umfasst diese Dissertation drei Studien, die über vier Artikel veröffentlicht wurden. Die Studien wurden durchgeführt, um zu beantworten, wie sich Control-Mechanismen auf die Ergebnisse und das Verhalten von externen Entwicklern auswirken, wie diese Auswirkungen zu erklären sind und wie erfolgsversprechende Control Modes zusätzlich gefördert werden können. Die ersten beiden Studien greifen auf die Control-Theorie und die Selbstbestimmungstheorie zurück. Innerhalb der ersten Studie konnte mit einem Laborexperiment gezeigt werden, dass Self-Control stärkere positive Auswirkungen auf die App-Qualität der Entwickler sowie auf deren Absicht auf der Plattform zu bleiben hat, als im Vergleich zu Formal Control. Zusätzlich konnte die Studie darlegen, dass diese Auswirkungen durch eine höhere wahrgenommene Autonomie der Entwickler unter Self-Control erklärt werden kann. Die zweite Studie untersucht die Auswirkungen von Self-Control und Clan Control in einer Online-Umfrage mit App-Entwicklern und konnte positive Effekte auf die Anstrengungen der Entwickler und deren Absicht auf der Plattform zu bleiben aufzeigen. Dies konnte durch die intrinsische Motivation der Entwickler erklärt werden. Die dritte Studie kombiniert die Control-Theorie und die Sozialkapitaltheorie miteinander und untersucht in einer weiteren Feldstudie, wie insbesondere die Ausübung von Clan Control unterstützt werden kann, um die Projektperformance und den App-Erfolg der Entwickler zu steigern. Die Ergebnisse zeigen, dass alle drei Dimensionen von Sozialkapital

(strukturelle, kognitive und relationale Dimension) eine positive Auswirkung auf Clan Control haben, was wiederum die Projektpformance und den App-Erfolg der Entwickler steigert.

Zusammengenommen offenbart die vorliegende Dissertation die Wichtigkeit von Informal Control Modes auf Software-Plattformen, insbesondere bezüglich deren positive Auswirkungen auf Ergebnisse und Verhaltensweisen der Entwickler. Die vorgestellten Studien konnten zeigen, wie Self-Control und Clan Control einen positiven Einfluss auf die Entwickler haben, u.a. auf deren Ergebnisperformance, App-Qualität und Absicht auf der Plattform zu bleiben. Zusätzlich legt die Dissertation dar, warum Informal Control Modes effektiv auf Software-Plattformen eingesetzt werden können und wie vor allem die Ausübung von Clan Control durch das Sozialkapital der Entwickler gestärkt werden kann. Damit antwortet die vorliegende Dissertation auf verschiedene Forschungsaufträge bezüglich Plattform-Governance und der Control-Theorie und legt zudem ein Fundament für zukünftige Studien in diesem Kontext. Plattformanbieter können die Ergebnisse der Dissertation nutzen, um besser zu verstehen, wie und warum Control Modes auf Software-Plattformen die Ergebnisse und Verhaltensweisen von externen Entwicklern beeinflussen. Plattformanbietern wird empfohlen, vermehrt Informal Control Modes einzusetzen und entsprechend passende Bereiche für solche Control-Formen auf der Plattform zu finden. Externe Entwickler sollten für ihr Entwicklungsvorhaben Plattformen mit mehr Offenheit sowie selbstregulierende und Clan-basierte Governance-Strukturen wählen, um von ihrer gesteigerten Autonomie und Freiheit für intrinsische Motivation profitieren zu können.

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Darmstadt, 2016

Tobias Goldbach



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# List of Abbreviations

|        |                                                     |
|--------|-----------------------------------------------------|
| AVE    | Average Variance Extracted                          |
| CFI    | Comparative Fit Index                               |
| CI     | Confidence Interval                                 |
| FC     | Formal Control                                      |
| IEEE   | Institute of Electrical and Electronics Engineering |
| IS     | Information System(s)                               |
| IT     | Information Technology                              |
| LISREL | Linear Structural Relations                         |
| OS     | Operating System                                    |
| PLS    | Partial Least Squares                               |
| SEM    | Structural Equation Modeling                        |
| SD     | Standard Deviation                                  |
| SDK    | Software Development Kit                            |
| RMSEA  | Root Mean Square Error of Approximation             |
| RQ     | Research Question                                   |
| SC     | Self-Control                                        |
| SRMR   | Standardized Root Mean Square Residual              |