The effect of the offshoring of digital asset development on confidentiality performance

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Abstract

Digital assets, which continue to be increasing in value, are often being developed by multiple entities located in many geographic contexts. Our key question in this research is whether the sourcing of developers offshore (vs. onshore) relates to a change in confidentiality performance. We also examine the extent to which publisher experience moderates this relationship. We employ secondary data on nearly 2000 electronic video games released from 2000 to 2010. We find the offshoring weakly relates to worse confidentiality performance outcomes, but that experience positively moderates that relationship.

Keywords: global sourcing, software development, cybersecurity

Introduction

Digital assets can easily be shared across boundaries, fueling rapid increases in their global spread (Anderson & Parker 2013). This ease of sharing and distribution, however, has introduced some challenges. Perhaps most notably, it remains difficult to maintain digital *confidentiality* (NAP 2000) – the state in which a proprietary asset upholds its intended property of being kept private to authorized users (Black 2016) – as evidenced through frequent examples of digital confidentiality losses (Massimino et al. 2018). Here, we examine whether the offshoring of a digital asset's development increases the risk of a confidentiality breach. And, to what extent does a firm's experience mitigate this risk? We examine these questions employing secondary data from the electronic video game

(EVG) industry.

We assert that it is not *a priori* obvious whether digital assets will face greater confidentiality risk when developed offshore vs. domestically. Indeed, the relationship between offshoring and many other, well-studied performance dimensions does not appear to be simple, as extant literature presents many contradictory findings (Mihalache & Mihalache 2016). Scant attention has been paid to how operations and supply chain decisions relate to confidentiality outcomes (Massimino et al. 2018). We find a negative relationship between the employment of an offshore publisher and EVG confidentiality performance. We further find a positive and highly-significant interaction between experience and offshoring. Our empirical context is also generally considered to be on the leading-edge of confidentiality protections, and may therefore offer useful prescriptions for more-traditional industries progressing toward digital economies (Ben-Ner & Siemsen 2017; NAP 2000).

Hypothesis Development

In the EVG industry, publishers and developers collaborate in the design and development of a proprietary digital work (O'Donnell 2014). Publishers provide financing, strategic guidance, marketing, and distribution, whereas developers codify tacit product ideas into a functional digital form. Commonly, a developer will work for a publisher on a work-for-hire basis, with the publisher acting as the intermediary between the developer and consumers. Although ancillary and/or subcontracted companies may offer specialized contributions (e.g., audio/video production, or lending generalizable "engines" to handle commodity functions), access and oversight of any complete, functional product is typically restricted to the two organizations we consider (O'Donnell 2014). Given the importance of upholding confidentiality in this context (Décary-Hétu & Dupont 2012), we assert that each organization wishes to do so.

On one hand, offshoring may provide financial resources to invest in new protection methods or technologies (lower costs), a workforce inherently more capable of or driven to uphold confidentiality (access to best global talent), an improved ability to identify emerging global threats to confidentiality (exposure to new ideas), or increased novelty in the solutions designed to uphold confidentiality (improved innovation). These factors may lead to improved confidentiality performance (Thomson et al. 2006). Further,

protection technologies remain a necessary component of successful protections (Crossler et al. 2013); to the extent protection technologies are globally available and offer sufficient defenses against threats, the global distribution of work may not affect confidentiality performance. Further, it could be argued that nefarious actors can hack into digital systems, regardless of location. Following these points, we posit as a null hypothesis that offshoring would not harm—or, may even improve—firms' confidentiality performance; formally:

Hypothesis 1_0 ($H1_0$): Confidentiality is unaffected by the offshoring of development work.

On the other hand, achieving coordination across national boundaries can be challenging (Dibbern et al. 2008). Physical distances between organizations, for instance, lessen the communications (Sosa et al. 2002) and knowledge exchanges (Knoben & Oerlemans 2006) between them. The communication that does occur also tends to be less rich when such distances exist (Daft & Lengel 1986), retarding the development of social relationships among workers and inhibiting the exchange of tacit knowledge (Noorderhaven & Harzing 2009). National boundaries likely exacerbate these challenges, due to differences in cultural attributes, language (Gray and Massimino 2014), and institutions (Lutz 2015).

Further, keeping up with evolving threats requires firms to routinely synthesize and codify their protections into technological and procedural artifacts, and integrate these with the behavioral norms of their workforce. Until these artifacts are codified, the knowledge about how to protect confidentiality remains tacit; perhaps as a result, the speedy, consistent, and complete dissemination of protection technologies has historically eluded many companies (Venkatesh & Davis 2000). These coordination challenges can present gaps in protections; meanwhile, nefarious actors seeking access to proprietary materials often exploit weaknesses wherever they may exist (Craig 2005). Following this, we propose:

Hypothesis 1_a ($H1_a$): Confidentiality performance decreases with the offshoring of development work.

There are various reasons to think that inexperienced firms may be more prone to confidentiality breaches than more experienced ones. Inexperienced firms may be more strapped for critical resources and cash flows, leaving little operational slack to invest in other, less-salient areas of performance (Stinchcombe & March 1965). Inexperienced firms also tend to maintain a limited set of routines and formal procedures, increasing the difficulty of maintaining compliance. Perhaps relatedly, a firm's adolescence may also cause operational failures (Bruderl & Schussler 1990), spawning crises that demand immediate attention. Such operational failures suffered by novice firms may also contribute directly to confidentiality losses, by enabling opportunities for exploitation by nefarious actors.

Organizations continuously learn from their experiences (Levitt & March 1988). Actors also learn and refine heuristics — simple rules, by which to conduct their business — through their experience (Bingham & Eisenhardt 2011); effective heuristics may be critical drivers in maintaining confidentiality performance. Taken together, we expect that organizations will learn through experience how to manage the technologies, the evolving threats, and especially the often-unobservable behaviors which affect confidentiality performance; formally:

Hypothesis 2: Confidentiality performance increases with experience.

As noted in H1a, offshoring organizations face many challenges in achieving the coordination necessary to jointly ensure confidentiality. Following the broad base of literature that supports organizational learning phenomena, we posit that as organizations accrue experience, they learn to mitigate the various challenges of maintaining confidentiality when offshoring. There are a small number of extant studies jointly considering organizational learning and offshoring. Manning et al. (2008) note that "over time, the distinction between `home-based' and `foreign' operations can be expected to disappear" (p. 39) and "in particular, as companies become experienced in dealing with major offshoring challenges … they become more adept … in engaging in higher-end offshoring activities" (p. 40). Managers also often make their initial decision to offshore work in the pursuit of a variety of relatively-salient performance dimensions (e.g., lower

costs). However, the benefits of offshoring may be grossly underestimated when failing to account for learning effects (Cha et al. 2008). The act of offshoring, for instance, may present "an opportunity for strategic and organizational transformation" (Jensen 2009: 190). Offshoring may also present new modes of knowledge acquisition (Chua & Pan 2008); meanwhile, a firm's experience can enhance its absorptive capacity (Bertrand 2011). Taken together, these results suggest that experience may unlock latent performance benefits of offshoring, including confidentiality. As a result, we offer the following hypothesis:

Hypothesis 3: Experience positively moderates the effects of offshoring on confidentiality performance.

Data and Operationalization

Our context is the global electronic video game (EVG) industry. The types of unauthorized, digital distributions considered in our study represent billions of dollars in lost revenues for the industry (Craig 2005; Kerr & Moutray 2014; NAP 2000). Of particular salience to the EVG context is the Warez Scene (or simply, the "Scene") — a globally-dispersed community whose primary purpose is the unauthorized acquisition and redistribution of others' proprietary digital works. The Scene is the point of origin for the vast majority of pirated digital content (Décary-Hétu & Dupont 2012). Although the Scene has proliferated for decades (Craig 2005), it remains largely unexplored by prescriptive research (Massimino et al. 2017). For a more complete description of Scene activities, see Craig (2005); for a description our study's data collection effort, see Massimino et al. (2017).

When the Scene distributes functional Warez through a Topsite prior to a digital product's official sale, a loss of confidentiality has clearly occurred. Unauthorized versions which preempt the official launch are particularly damaging to the product's success (Danaher et al. 2014; Ma et al. 2014). Following this, we code a binary dependent variable by comparing the official release date of each EVG to the earliest, automated timestamp of creation for associated, valid Warez on a Topsite – formally, *ConfPerf* =0 if functional Warez appeared on the Scene before a product's official release, and =1 otherwise.

For offshoring, we compare each company's country of residence for our measure of offshoring: *Offshore*=0 if the publisher and developer reside in the same country, =1 otherwise. Our main analyses consider the publisher's experience as our explanatory variable of interest. We capture this *(PubExp*) as the cumulative number of EVGs released by the publisher prior to the focal EVG.

At the product level, we control for the following: (1) the year of official release (*Yr*), capturing industry and technological changes over time (when testing industry experience, we omit this control due to collinearity, ρ= .971 between Yr and IndExp); (2) indicators of the Entertainment Software Rating Board or equivalent rating (*ESRB*), capturing the target audience; (3) indicators of genre (*Genre*), capturing the style of product; (4) an indicator the platform required by the product (*Win*); (5) a quasi-continuous scale (0-to-10) indicating the rating published in a professional review at the time of EVG's official launch (*ProdPerf*), capturing the product's performance; and (6) indicators of the game's production budget (*Budget*). Additionally, we include the following controls at both publisher and developer levels: (1) the number of EVGs released by each firm within the current year (*PubGYr* and *DevGYr*, respectively); (2) the national property rights at each location (*PubNPR, DevNPR*), and (3) the level of industrial agglomeration around each firm's lcoation (*PubAglm* and *DevAglm*), respectively; and (4) the interaction between *NPR* and *Agglom* (see Massimino et al. 2017). We also include random intercepts at the publisher (ε_p) and developer (ε_d) levels.

We consider the EVG product (*g*) as the unit of analysis, considering each as associated with a publisher (*p)* and developer (*d)*. Equation 1 presents our full regression model, with *X* reflecting the covariate(s) appropriate for hypothesis testing; this model contains all variables presented in Massimino et al. (2017), plus an additional control variable (*Budget*).

Equation (1):

$$ConfPerf_g = Year_g + (ESRB\ Dummies)_g + (Budget\ Dummies)_g + (Genre\ Dummies)_g + a_1*Win_g + a_2*ProdPerf_g + a_3*(Budget_g) + a_4*ln(PubGYr_g) + a_5*ln(DevGYr_g) + a_6*ln(PubAglm_g) + a_7*ln(DevAglm_g) + a_8*(PubNPR_g) + a_9*(DevNPR_g) + a_{10}*(PubAglm_g \times PubNPR_g) + a_{11}*(DevAglm_g*DevNPR_g) + X + \varepsilon_g + \varepsilon_P + \varepsilon_D$$

We began with a sample of 3,270 products computer-based EVG released between the years 2000 and 2010. Requiring a well-populated set of control variables resulted in additional attrition: A complete product performance review reduced our sample to 2,150, while requiring the population of all other control variables removed another 203 observations. Our final sample consists of 1,947 EVG's, representing 365 distinct publisher firms and 810 distinct developers. Descriptive statistics and heat maps of the locations can be seen in a full-length version of this paper.

Analysis and Results

We present the results of our hypothesis tests in Table 1. Regarding *Offshore*, we find marginal support for H1a (Model M1: β=-.034, p=.085). In Model M2, we fail to find a significant, linear coefficient for experience (*PubExp:* β=.001, p=.485). Regarding the hypothesized interaction between experience and the offshoring of work (Model M3), we find positive and highly significant interaction terms for publisher experience (β=.070, p=.005), supporting H3 and offering partial support for $H1_a$, conditional on *Offshore*. Figure 1 provides an interaction plot of Model M3's results. Counter to our second hypothesis, we find a negative relationship between experience and confidentiality performance when development work is not offshored; we explore and discuss this result further in post-hoc analyses (detailed in the full-length paper).

*Table 1. Summary of results, main analyses. Notes: (1) Control variables included in model, but not shown; (2) + p<.10, * p<.05, ** p<.01, *** p<.001.*

Variable	Model 1 (M1) Coeff(SE)	Model 2 (M2) Coeff(SE)	Model 3 (M3) Coeff(SE)
Offshore	-.034 (.025)*	-.034 (.025)*	-.029 (.025)
PubExp		.001 (.020)	-.044 (.025)*
*Offshore*PubExp*		`	.070 (.025)***

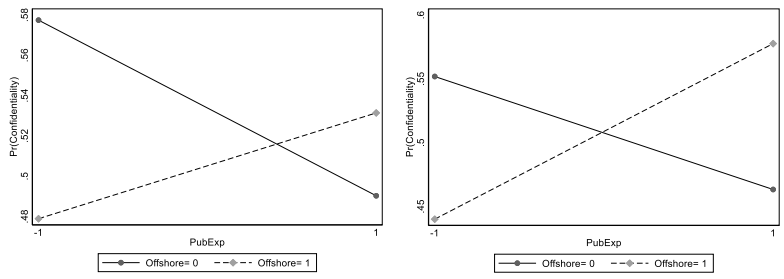

Figure 1. Interaction Plots, main analyses: (Left) Unmatched sample; (Right) Matched sample.

We believe that the extensive set of controls retained in our primary models assuages many of the alternative explanations that may be given for our results. Further, the publisher sourcing decision considers many performance dimensions (speed, capability, cost, etc.); often, confidentiality concerns are not a major factor in this choice (Bowman 2013). Nonetheless, due to the location of the partner being a choice, concerns of endogeneity (omitted variables bias) exist. To partially address these concerns, we utilized propensity score matching; the results of this analysis were consistent with the main anlaysis, and are available in the full-length version of this paper.

Discussion and Implications

Our consideration of digital confidentiality continues a small stream of research that examines the origins of unauthorized digital distributions (Ma et al. 2014) and how the likelihood of such confidentiality breaches relates to the locations at which legitimate work is performed (Massimino et al. 2017; Smith et al. 2007).

In addition to the results above, we performed post hoc analyses for different conceptualizations of offshore (e.g., language difference vs. no language difference), different subsamples (e.g., separately considering publishers in emerging markets and non-emerging markets), but space limitations prevent reporting on these here.

Protecting the confidentiality of digital assets will continue to grow in importance. Effectively accessing global talent for some important tasks will continue to be necessary for most firms to maintain global competitiveness. The digital assets that need to be shared to execute such tasks will continue to increase in value. Encouragingly, our results indicate the offshoring of EVG development does not, on average, result in reduced confidentiality performance. But, experience matters. As evidenced by our empirical study, however, it appears that the effects of experience are not entirely straightforward. We welcome any future efforts to better understand the nuances that experience may have in determining performance along this increasingly-important dimension.

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