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EMBRACING DIGITAL INNOVATION IN INCUMBENT FIRMS: HOW VOLVO CARS MANAGED COMPETING CONCERNS[1]

Fredrik Svahn
Swedish Center for Digital Innovation, Department of Applied IT, University of Gothenburg,
Forskningsgangen 6, 41756 Gothenburg, SWEDEN {fredrik.svahn@ait.gu.se}

Lars Mathiassen
Computer Information Systems, J. Mack Robinson College of Business, Georgia State University,
35 Broad Street NW, Suite 427, Atlanta, GA 30303 U.S.A. {lmathiassen@ceprin.org}

Rikard Lindgren
Swedish Center for Digital Innovation, Department of Applied IT, University of Gothenburg; Department of IT, University of Borås,
Forskningsgangen 6, 41756 Gothenburg, SWEDEN {rikard.lindgren@ait.gu.se}

Past research provides instructive yet incomplete answers as to how incumbent firms can address competing concerns as they embrace digital innovation. In particular, it offers only partial explanations of why different concerns emerge, how they manifest, and how firms can manage them. In response, we present a longitudinal case study of Volvo Cars' connected car initiative. Combining extant literature with insights from the case, we argue that incumbent firms face four competing concerns—capability (existing versus requisite), focus (product versus process), collaboration (internal versus external), and governance (control versus flexibility)—and that these concerns are systemically interrelated. Firms must therefore manage these concerns cohesively by continuously balancing new opportunities and established practices.

Keywords: Digital innovation, incumbent firms, competing concerns

Background

As incumbent firms embed digital technologies into both products and innovation processes (Tilson et al. 2010; Tiwana et al. 2010; Yoo et al. 2010), they are forced to break away from established innovation paths (Henfridsson et al. 2014; Henfridsson and Yoo 2014). Tripsas (2009) suggests that firms must shift their identity as digital technologies intertwine with the routines, procedures, and beliefs of key constituents. Lee and Berente (2012) argue that they must go beyond institutionalized architectural thinking and adopt a systems integration perspective to reshape their product development. Drawing on received empirical studies across different industries, we synthesize four competing concerns incumbent firms face as they embrace digital innovation (Table 1).

- ***Innovation capability****: existing versus requisite*. Firms must develop new capabilities without jeopardizing existing product innovation practices. This creates tensions between employees who seek to bring about change and those whose capabilities have become core rigidities. Such rigidities cause competency traps, inhibiting effective responses to digital options.

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Table 1. Evidence of Competing Concerns in Digital Innovation

Industrial Settings	Competing Concerns			
	Existing vs. Requisite Capabilities	**Product vs. Process Innovation**	**Internal vs. External Collaboration**	**Control vs. Flexible Governance**
Automotive	• Henfridsson and Yoo (2014)	• Bailey et al. (2012) • Henfridsson and Lind (2014) • Lee and Berente (2012) • Lenfle and Midler (2009)	• Henfridsson and Lindgren (2010)	• Henfridsson and Lindgren (2005) • Henfridsson et al. (2014)
Construction	—	• Boland et al. (2007)	—	—
Manufacturing	—	—	• Jonsson et al. (2009) • Jonsson et al. (2008)	—
Pharmaceuticals	—	• Dougherty and Dunne (2012)	—	—
Mining	—	—	• Westergren and Holmström (2012)	—
Photography	• Lucas and Goh (2009) • Tripsas (2009)	—	—	—
Software	—	• Woodard et al. (2013)	• Boudreau (2012) • Selander et al. (2013)	• Eaton et al. (2015) • Ghazawneh and Henfridsson (2013)
Transport	—	• Andersson et al. (2008)	• Lindgren et al. (2008)	• Andersson and Lindgren (2005)

- ***Innovation focus: product versus process***. Firms must strike a balance between developing new design and management processes and leveraging digital technology in products and services. For managers, this dilemma creates challenges such as conflicting time horizons and resource distribution across means–ends.

- ***Innovation collaboration: internal versus external***. Firms must develop the skills and relationships of the people operating within internal work arrangements while also engaging external partners and resources. Focusing internally, managers might overlook important opportunities for boundary-spanning value creation; focusing externally, they challenge the equilibrium of internal work arrangements.

- ***Innovation governance: control versus flexibility***. Firms must develop managerial practices and systems that recognize creativity and differentiation at the expense of prevailing authority structures and integration arrangements. Accordingly, managers must negotiate a balance between control and flexibility to afford exploration of digital options.

Existing studies provide few concrete answers as to how incumbent firms can address these competing concerns. In particular, because the four concerns have never been investigated in the same digital innovation context, we have limited knowledge to explain how they emerge, manifest, and interrelate, and how firms can manage them. Our research note presents a detailed case study of Volvo Car Corporation (Volvo Cars), which first experimented with telematics solutions in the late 1990s to reinforce its safety agenda. These early attempts to connect a car with an external infrastructure were technologically and functionally feasible, but covering associated costs for specific services proved difficult. In 2008, Apple's iOS and Google's Android gained momentum, which triggered the automotive industry to rethink car connectivity vis-à-vis the implications these platforms had for consumer electronics. Volvo Cars made connected cars a strategic focus area in 2010. We had the opportunity to follow this initiative from its formal initiation to the introduction of the first products in 2014. The Appendix offers a description of our approach to this engaged scholarship.

Volvo Cars' Connected Car Initiative

To guide the connected car initiative, Volvo Cars outlined a vision that would "give life" to cars beyond the time of production. New digital technology would enhance end-user experience and open up new revenue streams. By disconnecting from traditional automotive cycle plans, the technology could increase the pace of change and allow the organization to engage with external innovation ecosystems to sync with developments in consumer electronics. Leveraging connectivity by exposing the car to external developers, such as through open APIs, was expected to generate a new level of functional diversity in the automotive industry. This bold vision, however, stood in stark contrast to existing innovation practices and business models.

Establishing the Innovation Hub

In May 2010, Volvo Cars' executive team discussed how to kick-start implementation of the vision. The smartphone trend suggested car connectivity would render a new innovation focus. In contrast to pushing well-defined, incrementally improved product attributes to market through model year facelifts, a connected car had to be designed for continuous evolution across its lifetime (*product versus process focus*). To focus on means rather than ends, Volvo Cars had to build new capability for cross-fertilizing its innovation environments. However, that would require the automaker to break away from its conventional practices—which strictly applied separation of labor and specialization—to reinforce incremental, component-based innovation. To address these competing concerns (*existing versus requisite capabilities*), the executive team established the Connectivity Hub. A manager with innovation experience in various areas, who eventually became the Hub's director, said,

> *The main job was to establish a new network that didn't reflect the existing organization, but the different stakeholders expected to be involved in the design or use of connected cars.…The Hub was an opportunity to bring different parts of the firm to the same table. Before, we didn't have an integrated forum where we could discuss those things.*

By the end of 2010, the Hub included members from R&D, Global Offers, Global Marketing, Accessories, IT, Design, Product Strategy, and Customer Service (see Table 2). Hub members were updated on automotive and connectivity trends, and they were willing to critically reflecting upon existing norms and practices. Despite its promising configuration, the director was aware the Hub also needed strong top-management support. He recalled that the CEO felt personal commitment to car connectivity, while parts of the executive team (particularly the finance people) largely perceived it as a high-risk, low-return investment. Thus, the Hub director encouraged further top-level commitment by sharing information at executive team meetings and by including a vice president of the executive team as member of the Hub.

Volvo Cars soon understood it could not realize the connected car vision through an external subsidiary. Instead, it required careful internal management of the competing concerns between existing practices and requisite new capabilities. To prevent the Hub from evolving into a rival organization (potentially causing domestic turbulence), it was set up as a transient initiative and dissolved in 2012 when it had gained enough momentum to be self-sustaining.

Engaging Internal Stakeholders

The Hub orchestrated a broad internal debate about how to develop new innovation capabilities for connected cars. Initially, this created substantial pushback within the organization, and the uncertainty that followed spawned frustration and disenchantment among Hub members. As a product marketing manager put it,

> *People think you're nagging: "Here he is again with his mantras. What's coming out of it?" Unless people accept this kind of conceptual thinking, it's like a dialogue among the deaf.*

According to the Hub director, resistance was particularly strong among middle managers, who felt trapped between long-term visions requiring novel capabilities and short-term commitments related to existing practices. Volvo Cars' prevailing product focus made these managers ask about the specific functions that connectivity would render and when they would become integral parts of new cars. Unable to provide specific and adequate answers, however, the Hub members' efforts to focus on generation of functionality fell on deaf ears (*product versus process focus*). In response, they had to develop a more persuasive rhetoric for the connected car initiative, as the Hub director explicated,

> *The main problem is that we believe in this [though we lack solid arguments]! The question is: Did Google and others doing similar things see the revenue upfront? Or did they just have the guts to do it?*

Clearly, this was an issue of uncertainty and risk. Volvo Cars had traditionally relied on early selection of technologies and functions for its next generation of products, but experiences

Table 2. The Connectivity Hub

Role	Organizational Unit
Vice President, Connected Life & Intuitive UX	Executive Team
Director, The Connectivity Hub	R&D
Senior Manager, Product Marketing Strategy	Global Offers
Senior Manager, Digital Strategy	Global Marketing
Product Manager, Infotainment	Accessory
Director, Infotainment Engineering	R&D
Enterprise Architect Manager	IT
Senior Manager, Vehicle HMI	R&D
Interaction Design Manager	Design
Product Manager, Infotainment	Product Strategy
Senior Manager, Ownership Services and Brand Protection	Customer Services

with other digital innovations (such as navigation) suggested that such forecasting actually pushed in the wrong direction. The director of infotainment engineering argued,

> *We never make [proper] risk assessments. We're doing the basic math, but what if things turn out to be better than expected—or worse?*

Indeed, making decisions about car connectivity features three years ahead seemed naïve, simply because these features were generated through ongoing interplay between automakers, external developers, end-users, and public authorities. Thus, rather than refining its capability to make early commitments, Volvo Cars needed to develop new capabilities for delayed decision-making (*existing versus requisite capabilities*). The connected car vision was apparently dependent on a new set of innovation skills; to materialize it, the organization had to close some of its competency gaps. A design engineer commented,

> *We can't make sense of these things! We don't know how to play with platforms and communities to inform connected car innovation.*

Hub members therefore agreed to set up a series of workshops in August and September 2011 on three key topics: open innovation, technological platforms, and two-sided markets. The participants read selected scholarly articles and engaged in discussions of how to apply relevant concepts from the literature. These workshops resulted in Hub members entertaining new ideas and reflecting on their potential implications for Volvo Cars. Intrigued by the new concepts, their attention gradually shifted from internal collaboration within the firm to opportunities for engaging new partners (*internal versus external collaboration*). At the time, however, Volvo Cars was focused on coordinating its own resources to lower costs, improve quality, and increase product performance. Now, it also had to learn how to identify, encourage, and leverage external partners based on continuous scanning of emerging markets and technology developments. Given the complexity of this task, the Hub organized three scenario-planning workshops in October–December 2011 to spur ideas on how to effectively exploit digital options through external ecosystems. During the workshops, participants explored trends in Volvo Cars' environment and articulated them in coherent stories:

> *Software and digital technology rapidly change the premises of innovation in the automotive industry. In particular, this applies to connected cars, being inherently intertwined with external environments. When introducing this new logic for innovation, history becomes increasingly weak as a guide to the future. Our established understanding of the interplay between markets, organizations, and product architectures does not resonate with external developments in society at large. In order to understand contemporary change processes, we need to shift focus toward external environments and adopt new perspectives on a world with which we are increasingly intertwined.*

In February 2012, an enterprise architect reflected on the tension between existing and requisite capabilities and its implications for the connected car vision. He found that the scenario-planning workshops had rendered a shared understanding among Hub members of how to develop and implement the connected car vision:

> *We've created a shared value system through our discussions. Although we're not a formal unit in the*

> *organization, we're a lot tighter now….In effect, we've built a shared platform for the Hub network.*

Building a Platform Portfolio

When the Hub dissolved in 2012, Volvo Cars knew that external actors could play a key role in generating new ideas for the connected car initiative. As a result, it introduced a recurring innovation contest—the *Volvo Cars Challenge*—to involve key automotive industry actors. Further, it launched a crowdsourcing initiative on Facebook—*Volvo Idea Hub*[2]—that explored the role of innovation in its design processes. While Volvo Cars' internal practices relied on up-front specification of end-user functions, these external ecosystems called for creative leeway. Ecosystems demonstrated capability to generate specific designs over time, but Volvo Cars had to empower them by providing the necessary "raw material" for innovation (*existing versus requisite capabilities*). A senior R&D manager connected this to a product-centric innovation focus:

> *I struggle with this every day and try to challenge a function-oriented approach to development….We believe we can't sell a function if it doesn't have a button.*

This focus was reflected in the firm's engagement with product platforms. While such platforms catered to cost-efficient implementation of predefined product families, they did not allow for guided emergence of novel products and services. Therefore, to manage innovation focus concerns, Volvo Cars had to explore alternative platform approaches (*product versus process focus*). One option was Sensus Connected Touch (SCT), an Android-based infotainment platform for the aftermarket that could be retroactively mounted in cars. SCT let Volvo Cars tap into existing consumer electronics ecosystems to fulfill "modern car owners' desire to remain constantly connected" while driving.[3] The platform was encapsulated to prevent unauthorized access while allowing drivers to operate services such as Spotify and TuneIn via the steering wheel, center stack controls, and voice interaction. SCT also received the prestigious Red Dot Design Award at the 2013 Las Vegas Consumer Electronics Show. However, the initiative posed challenges because of Volvo Cars' limited influence over SCT's creative processes, functional differentiation, and business models. The automaker also realized SCT offered too few generic resources to afford requisite integration with automobile features. So, despite the platform's inherent capability to prevent unauthorized access, Volvo Cars found that SCT could not effectively stimulate external innovation for connected cars (*control versus flexible governance*). In view of these competing concerns, Volvo instead developed its own integrated infotainment platform, Sensus Connect, as a standard for its new cars. This platform provided a wide range of advanced resources for smooth integration with the car architecture. Volvo Cars decided against launching Sensus Connect as an open platform because its flexibility would expose the firm to unacceptable risks. Instead, it created the App Development Group in October 2012, which quickly grew to approximately 30 people. This group was embedded within R&D, yet given substantial autonomy (including an independent budget), and it soon evolved into a broker mechanism that enabled internal engineers to codesign platform applications with external partners.

Following this new design practice, Volvo Cars moved away from the traditional scope of automakers and began experimenting with a new class of digital platform services. Seeing the car as a platform in multisided markets would allow the firm to tap into other business transactions. As a key example, the automaker developed the digital key as a distinct platform resource it could share temporarily with couriers to allow them to deliver goods ordered online directly to a parked car. In spring 2014, this service was demonstrated in a pilot project with Sweden's main supplier of online groceries (Linas Matkasse), which led to the development of Volvo Cars' Roam Delivery Service. This general capability for multisided solutions was illustrated in a February 20, 2014, press release from Volvo Cars:

> In a groundbreaking technology move for the automotive industry, Volvo Cars demonstrates the world's first delivery of food to the car—a new form of "roam delivery" service. The service, which will be showcased at the Mobile World Congress in Barcelona, allows consumers to have their shopping delivered straight to their car, no matter where they are.

Volvo Cars continued to experiment with digital platforms to reinforce a process focus in connected car innovation. To avoid clashes with existing product innovation practices, each initiative had a limited scope and a distinct focus on a particular class of functions. Then, once established, platforms were gradually expanded to cover a broader range of applications. As such, the automaker managed competing concerns in innovation focus through a growing portfolio of increasingly generic digital platforms.

[2]Press release, Volvo Car Corporation, May 31, 2013.

[3]Press release, Volvo Car Corporation, October 11, 2013.

Implementing Volvo Cloud

A key concern for Volvo Cars was to prove its ability to identify new revenue streams and to develop appropriate ways to realize them in the car connectivity realm. However, breaking away from deeply rooted product-centric practices caused tensions, as highlighted by the Hub director:

> *When it comes to connectivity features, we typically end up discussing whether they should be standard, optional, or accessories, then we find a business model that goes beyond traditional thinking. But then: "No…it doesn't fit here." It's scary and unknown, and our finance people tell us we can't trust such revenue streams.*

Many proponents of car connectivity argued that its success resided with a viable aftermarket. As illustrated by the vice president in the Connectivity Hub, members were bold in their efforts to persuade the executive team to steer the organization in the aftermarket direction:

> *I pointed out that we invest 98 percent of our management capacity in developing new cars. That's totally wrong! We should [instead] invest more in developing the aftermarket…but we're stuck in our own model.*

Whereas Volvo Cars focused largely on internal collaboration for competitive advantage in original sales, a viable and dynamic aftermarket required external collaboration to facilitate a steady stream of novel applications and services (*internal versus external collaboration*). Several former members of the Hub mentioned this tension and explained how existing product innovation practices relied on a capability to freeze designs prior to production, while an aftermarket orientation focused on keeping design spaces open across the car's lifecycle (*existing versus requisite capabilities*). The Hub director commented:

> *Our major challenge is to grasp that the car is not completed when it leaves the plant. It won't be completed until it's taken in for scrapping.*

To manage these competing concerns, Volvo Cars exploited cloud technology. The introduction of HTML5 afforded implementation of many complex applications based on web browsers. As a connectivity strategist explained, this made functionality fundamentally detached from the car and defined in real-time through external back-end servers:

> *There's no physical intervention, and we don't even run the software in the car. We just integrate with the cloud in most cases.*

In practice, this instant delivery of software-based functions allowed Volvo Cars to shortcut existing routines. While preloaded software essentially had to submit to established processes, the cloud solution promised change and variation. This afforded opportunities to shape aftermarket business growth through economy of scope instead of economy of scale. The focus was apparently on stimulating this functional variation when Volvo Cars teamed up with Ericsson in December 2012[4] to realize the connected vehicle cloud. With its leadership in telecom network infrastructure and multimedia and its device-manufacturing legacy, Ericsson also promised to offer invaluable tentacles that could help scan external ecosystems for innovation opportunities.

Volvo Cars continued to make significant investments in developing its cloud-centric product architecture—including a firewall solution—to spur further external innovation. This architecture enabled flexible integration with existing back-end systems, while at the same time preventing unauthorized access to critical systems (*control versus flexible governance*). The Hub director commented,

> *We're extending our data warehouse to support this cloud solution, and we integrate new security functions—in cars as well as in the back-end—to prevent intrusion. A connected car will basically be integrated with the IT systems controlling finance, production, and design.*

Volvo Cars emphasized its cloud solution's inherent malleability at the 2014 consumer electronics show in Las Vegas. By keeping design spaces open without touching the car's hardware or software, the solution enabled new processes that continuously supply functions and services without jeopardizing traditional product cycle plans (*product versus process focus*). A press release explained the effects of the cloud solution's central nodes:

> These nodes enable efficient provision and communication of services and information to the cars. All in all, the 'cloud' offers great flexibility to adjust capacity and local presence of content based on end-user demands.

Reassigning Product Responsibility

The flexibility rendered by the Connected Vehicle Cloud helped Volvo Cars boost internal R&D as well as external ecosystems. It enabled rapid design and deployment of cloud-

[4]Press release, Volvo Cars Corporation, December 17, 2012.

based functions for run-time integration with predefined in-car functionality, but it also opened up a dangerous backdoor to the car. Because who to trust as a gatekeeper was unclear, designing the cloud solution for external innovators was complicated. Further, to secure overall product quality, the design process had to be aligned with internal waterfall development cycles. The director of infotainment engineering noted:

> *In one way or the other, we have to follow the consumer electronics market with its business development model. Lead time here is a lot shorter than our product development plans, but somehow we have to comply with those as well.*

To build capability for releasing novel products and services—while at the same time managing development uncertainties (*existing versus requisite capabilities*)—Volvo Cars turned its attention to the App Development Group. This group was well integrated with R&D, yet enjoyed substantial autonomy. Extending the group's responsibility to include the cloud solution thus seemed reasonable, but would it be able to focus full attention on the generation of novel products and services? Hub members feared that the rest of the organization would steamroller it and change its focus to implementing specified products (*product versus process focus*). The director argued that, because it was embedded in R&D, the App Development Group would be unable to balance these competing concerns:

> *Beyond doubt, we need a new branch for product development within the firm. It can't be integrated with existing R&D, but has to be aligned with it. I mean, it has to find interfaces to our car projects, talk the same language. It has to recognize our global product development system—work practices, methods, and tools—without being consumed by it.*

To permit fast-paced and nonlinear cloud-based innovation disconnected from traditional automotive cycle plans, Volvo Cars expanded the IT Department with a new unit in spring 2013. This unit was given responsibility for all cloud-based functions in the car, which, as noted by the appointed manager, redefined his department's role; IT had always been viewed as an internal support organization without specific product responsibility:

> *Now, the IT Department is involved in end-user functions. That's new….Suddenly, we are responsible for a number of structural functions in the car—or rather, outside the car, but as part of the product.*

Another reason for assigning the cloud infrastructure to IT was that its maintenance tradition promised inherent capability to continuously release products, services, and updates. In this way, the automaker opened itself to new design and management processes, which enabled swifter responses to demands for realized digital options. The appointed manager said,

> *R&D is project-oriented. They design a car, leave it for production, and shift focus to the next car. They don't do maintenance. They address quality problems, but they're not structured for continuous support or delivery. Being part of the IT Department, we now have that kind of structure in place.*

Introducing a Partnership Model

In 2013, the App Development Group had gained momentum in adapting consumer electronics applications to the in-car environment. The collaboration with external actors was technically fairly straightforward, but commercial issues caused repeated headaches. The group's founder recalled that existing contracts seemed to do more harm than good when, for example, adopting TuneIn as a new web radio solution:

> *We had a long list of services that we wanted, but it was obvious we had to develop a new kind of contract. Otherwise, we would never see the new services in a car.*

As managers struggled with the nature of the co-creation process and its relationship to existing innovation practices, they came to understand that external actors such as TuneIn engaged on radically different premises than traditional suppliers such as Denso and Bosch. These actors did not see themselves as links in a value chain coordinated by Volvo Cars, but rather as external entrepreneurs engaging with the automaker to develop their own businesses (*internal versus external collaboration*). Therefore, as noted by the group's founder, economic transactions made a poor instrument for managing collaboration concerns:

> *We make in-car applications together, but normally we're not exchanging any money. Volvo isn't a customer. We're not providing revenue for those companies. Spotify sells to someone else, like the end user. TuneIn makes money on commercials, meaning they have another customer.*

Traditional contracts allowed Volvo Cars to regulate supplier implementation of requirements, but without direct economic transactions, these contracts became useless. Rather than

purchasing predefined applications, the automaker now had to develop an alternative approach that could motivate external stakeholders to share their intellectual property (*existing versus requisite capabilities*). The Hub director commented:

> *Traditional contracts are designed to secure deliveries of the right thing, with the right quality, on time, at the right price, and over long periods of time, even after we have stopped producing the car. They're highly focused on getting all physical stuff together for production. Delivering a digital service, such as Internet radio, delivered through an HTML application, running in a browser, isn't easy in an automotive setting. Translating this into a commercial contract between our Purchasing Department and the content provider's sales organization is a challenge for our conservative industry.*

Volvo Cars understood that traditional cost control and requirement validation had to be balanced against incentives for stimulating value co-creation of digital functions and services (*control versus flexible governance*). By analyzing the TuneIn case and the related contract, the App Development Group's founder invented a new, generic contractual template. Not surprisingly, the Purchasing Department strongly opposed the proposed new contract logic to regulate collaboration with external developers. As the group founder noted, the Purchasing Department was particularly concerned about liability issues:

> *We're telling them there won't be anything physical delivered in boxes and it doesn't cost anything…. Generally, purchasing doesn't have this competence—they don't negotiate [relational] contracts, they negotiate price.*

To move forward, the founder wanted the Legal and the Purchasing departments to start talking to each other. When this proved difficult, he hired a lawyer with experience in similar cases in other industries to reshape the contract template. In spring 2013, Volvo Cars presented an official version of a template contract for cocreating digital functions and services with external partners. Addressing the tension between control and flexibility, it assumed symmetrical reciprocity and stipulated Volvo Cars and its external partners as equals. Hence, it regulated liabilities of content and service providers, as well as the automaker's obligations to its partners. The contract was cost-neutral in that it did not rely on monetary transactions to regulate partnerships, even though it covered cases in which Volvo Cars both charged and paid its partners. The group founder explained:

> *There is text regulating the responsibilities for the quality of their deliveries—the actual services—but there is also text on Volvo's responsibility for the quality of what we produce in the car and that we fulfill legal requirements. We have tried to write it as balanced as possible. Our traditional contracts definitely do not look like this.*

The Hub director was satisfied with the outcome and saw the new contract template as the result of changes in Volvo Cars' approach to innovation:

> *I've been here for seven years and a lot of things have changed during this period. Before, we could just purchase physical products that you can literally drop on your toes. We then learned how to purchase licenses for fonts or maps and those kinds of things. Now we're learning how to purchase partnerships.*

Discussion

As Table 3 summarizes, the Volvo Cars case offers important empirical insights into digital innovation in incumbent firms. We now relate these insights to extant literature to discuss why competing concerns emerge and how incumbent firms can manage them.

Innovation Capability

To embrace digital innovation, incumbent firms must develop new capabilities to identify novel ideas within existing institutional contexts (Henfridsson and Yoo 2014) and to engage external audiences (Henfridsson and Lindgren 2010). Volvo Cars recognized that this required creating networked arrangements (Boland et al. 2007) and engaging with external ecosystems (Selander et al. 2013). The executive team expected the transformation to be burdensome because it involved shifts in firm identity (Tripsas 2009) and organizational culture (Lucas and Goh 2009). Further, these shifts would likely uncover complex tensions between existing hierarchical structures (Baldwin and Clark 1997) and requisite new structures (Henfridsson et al. 2014). Table 3 outlines the tensions Volvo Cars faced, and how it learned to balance existing and requisite innovation capabilities.

Volvo Cars' executive team was convinced that the success of its connected car vision depended on an appropriate combination of existing and requisite capabilities; it thus launched the Connectivity Hub to kick-start internal change,

Table 3. Managing Competing Concerns in Volvo Cars' Connected Car Initiative

Episode	Competing Concerns				Management Initiatives
	Innovation Capability	Innovation Focus	Innovation Collaboration	Innovation Governance	
Establishing the Innovation Hub	Develop capability for cross-fertilization while firm is organized for division of labor and specialization	Reinforce continuous product evolution while current practices center on new product attributes	—	—	• Establish the Connectivity Hub • Make the Connectivity Hub a transient initiative
Engaging Internal Stakeholders	Develop capability to delay decision-making while firm is organized for market forecasting and early commitments	Reinforce new processes for generation of product functionality while current practices center on integrating specific functions into products	Engage in external collaboration with new partners while preserving cost-efficient coordination of internal resources	—	• Set up workshops • Engage in scenario planning
Building a Platform Portfolio	Develop capability to empower independent developers while firm is organized for up-front specification of end-user functionality	Reinforce digital platforms for guided emergence of novel services while current practices center on product platforms for cost-efficient implementation of predefined products	—	Balance flexible access to in-car resources for stimulation of external innovation and encapsulation to control for unauthorized access.	• Implement the Volvo Cars Challenge • Establish Volvo Idea Hub • Launch Sensus Connected Touch • Develop Sensus Connect • Experiment with Roam Delivery Services
Implementing Volvo Cloud	Develop capability to keep design spaces open across product lifecycles while firm is organized to freeze designs before production starts	Reinforce continuous supply of new services while current practices center development on product cycle plans	Engage in external collaboration to build a dynamic aftermarket while preserving internal collaboration for competitive advantage in original sales	Balance flexible access to back-end systems for stimulation of external innovation and firewalls to control for unauthorized access	• Establish partnership with Ericsson • Develop a cloud-centric product architecture • Launch the Volvo Cloud
Reassigning Product Responsibility	Develop capability to continuously release new services while firm is organized to manage uncertainty in development processes	Reinforce rapid generation of novel, unknown services while current practices center on concerted implementation of predefined products	—	—	• Reassess the App Development group • Assign product responsibility to the IT department
Introducing a Partnership Model	Develop capability to motivate external actors while the firm is organized to regulate supplier commitments	—	Engage in external collaboration to access new revenue streams while preserving internal coordination of existing value chains	Balance incentives for stimulating value cocreation and formal contracts for requirement validation and cost control.	• Craft the TuneIn contract • Develop a generic contract template based on: – Symmetrical reciprocity – Cost neutrality

break up the silo mentality, and cross-fertilize the organization. In this vein, the automaker used the Hub to "help nurture projects by reducing uncertainty without increasing bureaucracy" (Leifer et al. 2001, p. 105) and to "serve as a repository for cumulative learning about managing radical innovation" (Leifer et al. 2001, p. 104). The sought-after institutional entrepreneurship (Henfridsson and Yoo 2014) would establish new organizational routines by leveraging "the organization's ability to effectuate discovery, cocreation, and change" (Teece 2014, p. 339). The Hub was seen as an innovation champion, and it was set up as a transient initiative rather than a competing unit, allowing it to engage in strategic actions that Volvo Cars would not necessarily have to replicate in the future (Teece 2012, p. 1397). The Hub turned out to be the key catalyzer of the connected car initiative.

Innovation Focus

Digital innovation is largely about recombining existing resources and knowledge to spur new ideas (Avital and Te'eni 2009; Tilson et al. 2010; Yoo et al. 2012). It is rarely guided by a long-term vision, because products and services are inherently unbounded (Yoo 2013) and incomplete (Garud et al. 2008). Instead, digital innovation is powered by a self-contained system's generative capacity to produce something new without input from the system's originator (Tilson et al. 2010). As evidenced by Volvo Cars' competing concerns regarding innovation focus (Table 3), incumbent firms must therefore learn to focus on the process of innovation—separate it from its outcome—to embrace digital innovation.

Volvo Cars had considerable experience with software development and knew platforms were important to coordinate its work forces. IT was also an enabler for the firm in that digital platforms served as operand resources to support particular tasks (Nambisan 2013). By engaging in thematic workshops, Hub members gradually developed a complementary perspective as they learned about layered architectures (Yoo et al. 2010), APIs and software patterns (Alexander 1999), and the network effects of digital platforms (Gawer 2014). They came to appreciate platforms as operant resources triggering innovations without a clear picture of the end result (Nambisan 2013). Hence, rather than focusing on specific end-user problems, Volvo Cars learned to develop generic design patterns and subsequently specialize them in different contexts (Alexander 1999; Henfridsson et al. 2014).

Not surprisingly, it became clear that such a shift would take its toll. The prevailing model stipulated that new products materialize in an era of ferment with a distinct product innovation focus, followed by the emergence of a dominant design and, concurrently, an increased focus on process innovation (Anderson and Tushman 1990). In this context, process innovations are directed toward efficiency and cost reduction for a specific design solution (Utterback and Abernathy 1975). Thus, detailed specification of end-user functionality enabled Volvo Cars to design product families (Sanderson and Uzumeri 1995) based on modular product platforms (Robertson and Ulrich 1998) and to direct suppliers' attention to incremental improvements and cost reduction. Against this backdrop, generic digital platforms appeared to be highly risky.

This presented a complex dilemma for the connected car champions at Volvo Cars. Somehow, they had to gain support from the organization they were about to change and disrupt (Ansari et al. 2016). Given the tension between specific and generic functionality (Henfridsson et al. 2014), they could not simply introduce digital platforms to replace existing practices. Instead, Volvo Cars built a portfolio of different platforms, each with limited scope and distinct focus. These platforms could then be further developed to cover a broader range of applications. Put differently, this stock of platforms constituted design capital that was gradually enriched through a series of design moves (Woodard et al. 2013) to grow the firm's generative capability.

Innovation Collaboration

As incumbent firms embrace digital innovation, they must reach out to external ecosystems. In doing so, they provide generative products to stimulate development of "new configurations and possibilities" through an ongoing transformative process (Avital and Te'eni 2009, p. 349). To foment network effects, they seek to bring numerous developers on board (Boudreau 2012); to increase variation, they strive to mobilize differentiated and uncoordinated audiences (Zittrain 2006, p. 1980). Table 3 summarizes Volvo Cars' lessons learned about the importance of engaging such external stakeholders as cocreators of value (Jonsson et al. 2008) for the connected car aftermarket. At the same time, it realized that such developments would require relatively open design spaces (Dougherty and Dunne 2012), which would undermine its ability to control the use of shared resources. Hence, Volvo Cars' management was skeptical about relying on trustful relationships (Westergren and Holmström 2012) without complementary formal contractual arrangements. The investments made in modular product design (Baldwin and Clark 2000) offered scale advantages through specialization and effective division of labor (Von Hippel 1990), but required effective internal collaboration based on well-defined tasks. Thus, product architecture and organizational design were frozen well before production time (Baldwin and Clark

2000). Given this legacy, the move toward open design spaces was challenging.

Volvo Cars needed to reconcile the tensions between the requisite capability to pursue open design solutions and the routine practice of freezing designs before production. The concept of layered modular architectures suggests that systems architected as loosely coupled layers allow innovations to emerge independently at any layer without cascading effects on other layers (Yoo et al. 2010, p. 728). Volvo Cars tried to implement such architectural thinking, but software-based functions were still treated as physical components—that is, they were assigned part numbers, scheduled for release in relation to other parts, and frozen based on cycle plans. In response, the Volvo Cloud was launched to host in-car functions based on software in back-end servers. Because software was never inscribed into car parts, Volvo Cars could now manage collaboration concerns and shortcut existing organizational practices.

Innovation Governance

To embrace digital innovation, incumbent firms must "establish governance mechanisms that appropriately bound participant behavior without excessively constraining the desired level of generativity" (Wareham et al. 2014, p. 1195). While seeking this flexibility to align internal product development with the external world (Boudreau and Lakhani 2009), firms must also maintain acceptable control over value appropriation (Boudreau 2010). Table 3 summarizes innovation governance concerns at Volvo Cars.

Based on its understanding of the consumer electronics industry and deep knowledge about the internal organization, the App Development Group crafted a range of boundary resources that could "serve as the interface for the arm's-length relationship" between Volvo Cars and external application developers (Ghazawneh and Henfridsson 2013, p. 174). Initially, this spurred a series of co-creation initiatives, but they lost momentum during transition from demonstration to commercialization, when the Purchasing Department got involved. Purchasing applied its standard practices for controlling transaction costs through formal market contracts. This had a detrimental effect on the App Development Group and its co-creation initiatives, forcing Volvo Cars to rethink its transaction-cost-centric governance approach.

To move the co-creation initiatives beyond technology demonstration, the automaker crafted a new contract emphasizing mutual liability and cost neutrality. Recognizing mutual liability reduced the risk for external actors by regulating Volvo Cars' commitments in supplying and maintaining boundary resources. The cost-neutrality principle directed attention away from economic transactions as the basis for control, as it recognized that companies such as TuneIn and Skype did not derive revenue through Volvo Cars. Although such companies were keen to expand their existing markets into the automotive context, they were not willing to pay for it and believed Volvo Cars was reluctant to pay for access to their customer bases. The new governance approach thus released the generativity of the App Development Group's boundary resources.

Managing Competing Concerns

Volvo Cars' connected car initiative involved each of the competing concerns identified by prior research (Table 1), but we were unable to trace particular concerns to particular episodes. Several concerns emerged during each episode (Table 3) and the interrelations among them often spilled over into other episodes. This systemic interrelating, in which the manifestation of competing concerns was widespread and intertwined across all episodes, is best illustrated by the "Connected Vehicle Cloud" episode, which involved all four competing concerns and extended into the "Reassigning Product Responsibility" episode.

Consistent with a salient characteristic of complex digital ecodynamics (El Sawy et al. 2010), we observed patterns in how managers paid attention to competing concerns and how their attention shifted across concerns and over time. Capability concerns materialized during each episode, and managers' attention to them interacted closely with all other competing concerns throughout the connected car initiative. As such, capability concerns played a fundamental role in how other concerns emerged and how managers pushed the initiative forward. Regarding shifts across concerns, managerial attention was initially directed toward product–process concerns; it then gradually shifted to include collaboration concerns and finally zoomed in on the clash between existing control mechanisms and the urgent need for flexible governance practices.

These shifts in attention reflect how managers accommodated new opportunities and specific needs related to car connectivity. Equally important, however, the shifts show how managers responded to resistance across the organization. The application of digital innovation logic to the connected car initiative continuously challenged institutionalized innovation practices which, in turn, fueled resistance. This was particularly visible as new practices challenged the established waterfall model for product development. This model instigates new product development on the basis of an overall technology assessment that includes specification of

customer needs and identification of development and production risks. As the "Engaging Internal Stakeholders" episode illustrates, middle managers instinctively rejected open-ended design practices because they wanted to grasp both the specific functions connectivity would enable and when those functions would be integrated into cars.

In the next phase of the waterfall model, Volvo Cars' projects move to a concept-readiness phase to develop detailed use cases and implementation plans, often in collaboration with potential suppliers. As illustrated by the "Implementing Volvo Cloud" episode, increasing attention to these collaboration issues triggered resistance toward engaging distributed and largely uncoordinated external partners to develop a rich connectivity aftermarket. At Volvo Cars, competitive advantage was traditionally anchored in coordinated initiatives to improve car sales, rather than in exploratory efforts to boost aftermarket opportunities. Finally, in the last phase of the established development model, projects are reviewed for application readiness through systematic demonstrations of technical solutions to ensure that they comply with business and performance objectives. This phase involves the Purchasing Department and includes contracting with suppliers. The "Introducing Partnership Model" episode reveals that this routine created resistance toward giving away resources for free to stimulate external innovation. Such a strategy contradicted Volvo Cars' established control practices based on monetary transactions and formal contracts.

These findings show how Volvo Cars managed competing concerns through an emergent tuning process of accommodation and resistance (Barrett et al. 2012; Eaton et al. 2015). On the one hand, connectivity afforded a wide range of newfound opportunities that managers embraced in a rather experimental manner**.** On the other hand, accommodating digital options triggered organizational resistance as a reflection of shifts in both identity (Tripsas 2009) and organizational culture (Lucas and Goh 2009). As such, managing concerns during the connected car initiative evolved as a dancing landscape of competing forces (Tanriverdi et al. 2010), requiring cohesive management through the continuous negotiation of new digital innovation opportunities and resistance grounded in established innovation practices.

Conclusion

With a focus on incumbent firms, we have identified four competing concerns in digital innovation and indicated the conceptual origins of these concerns in digital innovation research. We also showed empirically how and why they differentiate and interrelate, and demonstrated their relations to the more general literature in the field. Finally, we argued that managers must deliberately manage these concerns cohesively to embrace digital innovation. Our main contribution to the extant literature, which recognizes these four concerns separately, is an awareness of their individual trajectories, joint emergence, and multifaceted integration. Our findings suggest that, given such awareness, incumbent firms can manage the systemic interrelating of competing concerns and the ongoing tradeoffs between them to perform well in relation to all four concerns.

Our analyses identified the contours of the systemic interrelating and cohesive management that corroborate and go beyond insights from available intellectual tools. While Gregory et al. (2015) identify concerns managers must resolve in IT transformation programs, they primarily address intraorganizational situations rather than those interorganizational arrangements that characterize digital innovation. Adopting an ecosystem perspective, Eaton et al. (2015) conceptualize distributed tuning as the innovation process through which heterogeneous actors shape and reshape digital technologies into organizational resources, but they stay silent on relationships between competing concerns and associated management initiatives. Wareham et al. (2014) offer a dialectic analysis of such relationships and discuss their potential relevance to the emergence of different types of generativity in digital innovation. We complement their work by explicating the linkage between systemic interrelating and the building of generative capability. We suggest that a sustainable design vision is at the heart of managerial intervention, whereas prior research depicts digital innovation as an emergent process wherein deliberate managerial intervention cannot help avoid unpredictable outcomes (Barrett et al. 2012).

Our research paves the way for further research to uncover empirical patterns and intellectual tools for understanding and managing the competing concerns incumbent firms face as they embrace digital innovation. Such research could build on our study of car connectivity at Volvo Cars and draw on alternative theoretical framings to further explore the manifestation and management of competing concerns. As illustrated here, such framings might include dialectical inquiry (Robey and Boudreau 1999), the related notion of paradoxical management (Lewis 2000), and organizational ambidexterity theory (O'Reilly Iii and Tushman 2013).

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About the Authors

Fredrik Svahn is an assistant professor at the Department of Applied Information Technology, Gothenburg University, and a researcher at the Swedish Center for Digital Innovation. He received his Ph.D. in Informatics at Umeå University in 2012 and conducted postdoctoral studies at Chalmers University of Technology. Fredrik's work is broadly focused on digital innovation in incumbent firms, including research on organizational capability, platform design, and innovation strategy. Prior to his Ph.D. he worked as an engineer and applied researcher, and he has more than 15 years of experience in the defense, telecom, and automotive industries.

Lars Mathiassen is Georgia Research Alliance Eminent Scholar, Professor at the Computer Information Systems Department, and cofounder of The Center for Process Innovation at Georgia State University. His research focuses on development of software and information services, on IT-enabled innovation of business processes, and on management and facilitation of organizational change processes. He approaches innovation and improvement initiatives with a strong focus on people skills and collaborative processes while at the same time emphasizing adoption of state-of-the-art technologies and methods. Lars has published extensively in major information systems and software engineering journals and has coauthored several books on the subject including *Professional Systems Development*, *Computers in Context: The Philosophy and Practice of Systems Design*, *Object Oriented Analysis & Design*, and *Improving Software Organizations: From Principles to Practice*. He has served as senior editor for *MIS Quarterly* and is currently serving in that capacity for *Journal of Information Technology* and *Information & Organization*.

Rikard Lindgren is a professor of Informatics at the University of Gothenburg, Sweden, and the University of Borås, Sweden. Rikard is also research director and cofounder of the Swedish Center for Digital Innovation. His research has been published in *European Journal of Information Systems*, *Information and Organization*, *Information Systems Journal*, *Journal of Information Technology*, *Journal of Strategic Information Systems*, *MIS Quarterly*, and other outlets. In 2003, he was awarded the OR Society's Stafford Beer

Medal for the best paper published in *European Journal of Information Systems and Knowledge Management Research and Practice*. Rikard currently serves on the editorial board of *Journal of Strategic Information Systems* and the advisory board of *Scandinavian Journal of Information Systems*. Previously, he has served as an associate editor of *Information Systems Research* and *MIS Quarterly*, associate/senior editor of *Information Systems Journal*, and editor-in-chief of *Scandinavian Journal of Information Systems*. In 2011, he was awarded the Best Associate Editor of Information Systems Research.

Appendix

Research Design

Our case study (Yin 2009) of the connected car initiative at Volvo Car Corporation (Volvo Cars) provides longitudinal insight into a comprehensive innovation effort; it focuses on information technology (IT) as an operant resource triggering changes in its approach to car design and business partnerships (Nambisan 2013); and, it involves radical innovation that challenged the company's established design and management practices. As such, it is well suited to shed new light on how competing concerns are implicated during digital innovation in incumbent firms.

Based on an established collaborative practice research initiative (Mathiassen 2002) at Volvo Cars, the first author engaged with managers (Table 2) in a facilitative role, analyzed challenges and provided advice on digital innovation (Van de Ven 2007). The collaboration process was iterative and fluid, with loosely defined activities and sequences. This approach let us shape our engagement with Volvo managers based on the unfolding of the connected car initiative, and it afforded rich opportunity to collect and analyze data based on 11 workshops between May 2010 and February 2012. The first author took detailed notes in each workshop; seven of the workshops were also recorded and transcribed. Each workshop lasted two to three hours and produced additional documentation, such as industry analyses, scenario descriptions, collective problem formulations, and digital innovation options. During fall 2013—18 months after the final workshop—we interviewed six of the managers, who were handpicked to represent complementary perspectives across the organization. We also had access to reports and analyses from the connected car initiative and to Volvo Cars' press releases about the initiative's effects.

We followed Miles and Huberman's (1994, p. 12) iterative approach to data reduction, data display, and conclusion drawing. This helped us identify gaps in evidence, which we then addressed through additional data collection. In a first step, we reduced data using ATLAS.ti to repeatedly read and code all data and identify key themes in how Volvo Cars embraced digital innovation. This process included 59 primary documents, from which we coded 543 unique quotes. In a second step, we used ATLAS.ti's network view to create data displays of the empirical material, with particular focus on identification of key activities and decisions. Based on these displays, we developed an overview of how the innovation process had unfolded over time and across the organization by focusing on evidence of competing concerns and how the automaker had managed them. During these analyses, we observed that Volvo Cars' attention shifted across concerns and over time and that people's engagement with a competing concern in one context often spilled over into another context. Hence, to explain why different concerns emerged, how they manifested, and how the firm managed them we had to better understand those contexts and the different concerns fueling them. In the final step—conclusion drawing—we therefore used the data displays to develop detailed accounts of distinct and coherent episodes during Volvo's connected car initiative. Each episode focuses on a key activity during digital innovation in which managerial interventions were closely linked to specific competing concerns.

We recognize limitations in our research design. First, we focused on well recognized competing concerns in previous studies of incumbent firms embracing digital innovation. Instead, we could have zoomed in on one (or more) of these concerns for in-depth investigation vis-à-vis other potentially relevant sociotechnical concerns. Second, as a single case study of one particular digitalization project, it is important to be aware of the specific characteristics of the context at Volvo Cars before transferring our findings to other incumbent firms. Third, while we were deeply engaged with Volvo during the period 2010–2012 through workshops and scenario planning activities, our reporting of the later period is based solely on retrospective interviews and press releases. Therefore, we recognize the risk of biased interpretations in retrospective interviews. To address this, we purposefully interviewed people who were still involved in digitalization efforts at Volvo Cars and we took care to triangulate findings between multiple data sources.