A Mixed-Methods Research Approach to Investigate the Transition from on-Premise to on-Demand Software Delivery

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Abstract. Verdicts on the advisability for software vendors to adopt on-demand delivery models are widespread in the business and technology press. Incumbent software vendors, in particular, are prompted to transition to on-demand and cannibalize their on-premise customer-base, in order to supposedly enjoy market expansion, economies of scale and revenue predictability. Yet, academic research addressing this strategic move is scarce. Relying on a mixed-methods research approach, I examined the transition of two software companies which originally entered the market as on-premise vendors and turned into pure on-demand players over time. Specifically, I performed a qualitative analysis of financial reports and transcripts to identify possible milestones in the course of the transition, followed by an econometric analysis of quarterly financial results to shed some light on the impact such milestones may have had on the vendors' performances.

Keywords: on-demand, software-as-a-service, cannibalization, mixed-methods research, intervention analysis.

1 Introduction

The appearance of a technological or organizational innovation should always be scrutinized closely by market leaders, for overlooking disruptive changes may seed their demise [1]. The rise of the on-demand delivery model in the enterprise software market is increasingly regarded as a case in point and has indeed exhibited some of the defining attributes of disruptive technologies. The first generation of on-demand solutions (so-called Application Service Providers) was underperforming in comparison with on-premise counterparts, both in responding to customers' needs and in generating the high-margins software vendors were used to. Moreover, it targeted the fringe price-sensitive market segments (medium-size companies). The following generation of on-demand software solutions – now commonly called Software-as-a-Service (SaaS) – has been bridging the performance gap, increasingly appealing to the mainstream business software customers (viz., to large enterprises), yet remaining less profitable than packaged software.

K. Vanmechelen, J. Altmann, and O.F. Rana (Eds.): GECON 2012, LNCS 7714, pp. 212–222, 2012.

The above-mentioned interpretation is a basic tenet of the plethora of verdicts from the business and technology press prompting incumbents to transition to on-demand and cannibalize their customer-base on the premise of certain advantages: market expansion, economies of scale, and revenue predictability. Yet, academic research which would rigorously verify these claims and examine the nature and the consequences of such a strategic move is scarce. A vendor's transition from an on-premise to an on-demand delivery model is, therefore, a topical theme for academics and practioners alike. Relying on a mixed-methods research strategy, I conducted an explorative study focusing on two of the very few software companies which already turned into pure on-demand players after an on-premise market debut. Specifically, I used qualitative analysis to identify the milestones within such a transition and the most salient organizational issues they raise, and time-series econometric analysis to assess the statistical significance of their impact on the vendors' financial performances.

After revewing the relevant literature (section 2), and detailing my research approach and data (sections 3 and 4), I describe the transition as it emerges from the qualitative analysis (section 5). The econometric analysis and its findings are then illustrated (section 6) and put in perspective with the outcome of the qualitative data analysis, and the limitations and possible extentions of this work (section 7), before concluding.

2 Related Work

During the late 90s and early 2000s, three concurrent phenomena paved the way to on-demand. First, enabling technologies such as server-based computing and the Internet became widely accepted [2]. Second, on the demand side, large enterprises manifested the intention to reconsider their IT-sourcing strategies in order to reduce overheads and focus on core competences [2]. Third, on the supply side, software vendors grew conscious of the middle-market's hunger for affordable enterprise software [3].

As a response to such demands, the Application Service Providing model (ASP) was introduced: renting and remotely accessing a software solution hosted and managed by a third party (outside of the customer's premises). Over time, the Software-as-a-Service (SaaS) moniker displaced ASP, but whether something substantially differentiates SaaS from ASP is a source of debate. I will adopt today's seemingly more common view that the distinguishing characteristic of SaaS from ASP be multi-tenancy – i.e., the one-to-many cardinality between software instances and software customers [4]. Multi-tenancy supposedly yields economies of scale while increasing the development cost [5].

The economics of on-demand software have attracted the scholars' interest from both a theoretical and an empirical point of view. From a microeconomic perspective, on-demand software shares the characteristics and complexity of both services and information goods. Therefore, analytical approaches must rely on simplifying assumptions and abstract the differences between on-demand and on-premise.

In a duopolistic model where the SaaS provider can guarantee customers lower implementation/installation costs than its on-premise rival but must bear the expenses for the needed IT capacity, quality is showed to have a more decisive role in the long run than the lower costs [6]. With different modeling choices (abstracting all but the licensing terms), it has been shown that, in a monopoly setting, in the presence of network externalities, renting is more profitable than selling [7]. Besides, a SaaS monopolist has an incentive to invest more in software quality than an on-premise one and, whenever its cost of quality is not much greater than the latter's, will earn a higher profit [8].

The economics of on-demand have also been investigated empirically. An analysis of the quarterly financial results of a sample of software companies (with 158 firm-quarter observations of SaaS companies between 1994 and 2006) revealed that on-demand providers had significantly higher costs of goods sold and higher levels of sales, general and administrative costs (i.e., lower gross and operating margins) than their on-premise peers [9]. The estimation of Cobb-Douglas production functions from the annual financial results of another sample (with 284 firm-year observations of SaaS vendors between 2002 and 2007) has revealed significant *diseconomies* of scale in the on-demand model as opposed to the on-premise or hybrid one [10].

A second relevant stream of research is that around the marketing phenomenon of cannibalization. In a narrow sense, sales cannibalization is the diversion of sales from existing products toward a newly introduced-one [12]. It is traditionally presented as the consequence of erroneously marketing a new product too closely with old ones and their established markets [13]. However, cannibalization may be tolerated or even deliberately pursued to reduce the dependence on a single market segment, to preempt or retaliate a competitor's entry, to attack the competitor, to take advantage of new distribution channels, or to replace a product while retaining its market share [14].

To my knowledge, the *transition* from on-premise to on-demand has barely been touched upon by scholars, and only from a software engineering perspective: traditional software engineering practices devised in the on-premise paradigm cannot support the service-oriented business model and need to be re-aligned with it [11]. Moreover, the "willingness to cannibalize" established products and related assets has been found to be an organizational trait which distinguishes enduring market leaders [15], but strategies of deliberate cannibalization are a rather underinvestigated topic. As a unifying note for the two research themes: higher-than-average cannibalization rates and the ability to successfully introduce a new product already during the growth phase of the previous one have been found a distinctive feature of successful software vendors [16].

3 Research Methodology

To comprehensively investigate the transition from on-premise to on-demand, I relied on a mixed-methods research approach combining qualitative and quantitative data analysis. The qualitative component consisted in the interpretation and analysis of publicly available written accounts on the way the transition was conceived and

conducted by the two organizations. This encompassed coding and systematic comparisons of codes and quotations. An initial series of codes was derived from the literature and iteratively revised while coding the texts. Relevant paragraphs in the SEC filings were preliminarily identified through computer-aided lexical search. The coding techniques employed were Descriptive, Simultaneous, Hypothesis, and, to a lesser extent, In-Vivo coding [17]. Codes, coded passages, and thematically-related sets thereof were systematically compared across vendors, speakers, and publication dates to identify the transition milestones and to extract the qualitative input for the quantitative phase.

The econometric part of the study was structured into an *exploratory* and a *confirmatory* data analysis stage as suggested in [18]. The exploratory analysis consists in detective work to reveal the main statistical characteristics of the time series and, in the context of my mixed-methods research, bridges the qualitative and quantitative research phases. It does not assume a formal model fitted to the data, but instead relies on instruments such as time-plots, smoothers, and autocorrelograms. In the confirmatory data analysis, clues from the qualitative data analysis and the exploratory procedures are rigorously verified by estimating appropriate econometric models. In particular, intervention models allow for a formal test of a change in the mean of a time series [18]. In its most general form (see [19] for a more detailed account), an intervention model has the following structure:

$$y_t = a_0 + A(L)y_{t-1} + c_0 z_t + B(L)\varepsilon_t \quad (1)$$

where the response variable y_t is the product of an auto-regressive moving-average process (whose two components are respectively $A(L)y_{t-1}$ and $B(L)\varepsilon_t$) plus an intervention term $c_0 z_t$. The intervention series z_t is a dummy variable, of the same length of y_t, modeling the occurrence of the intervention. It assumes a value of 1 if the intervention is taking place (or is in effect), and a value of 0 otherwise (i.e., intervention not yet started or stopped). The coefficient c_0 is the intervention's impact effect.

It should be now clearer why the qualitative component is an important preliminary step to the subsequent quantitative analysis: it enables to devise circumstantiated hypothesis around candidate interventions produced by the transition, which might have impacted the vendors' cost and revenue generating stochastic processes. In other words, it suggests possible shapes and anchor-dates for the indicator series to be used in the intervention models. Besides, it provides an historical perspective on the organizational and technological context in which decisions and events took place.

4 Data

All documents and numerical observations are from secondary data collection. The software vendors considered for this study are the US public companies Ariba (provider of solutions for enterprise spend management and sourcing) and Concur Technologies (provider of employee spend management solutions). The documents are SEC filings (available from the vendors' own corporate websites) or transcripts of

interviews and earnings calls with the participation of senior managers from the two vendors (published on specialized websites). A detailed description of the data can be found in Table 1.

Table 1. Data employed in the study

	Data	Ariba	Concur Technologies
Qualitative	SEC filings (10Q / 10K / others)	47 / 22 / 122	41 / 14 / 1
	Earnings call transcripts	11	21
	Interview transcripts	22	7
Quantitative	Observations (per time series)	53	56
	Time span	Q2 1999 – Q2 2012	Q3 1998 – Q2 2012

Four time-series for each vendor were constructed from the collected quarterly observations: sales revenue (SR), gross profit margin (GM, gross profit over sales revenue), operating profit margin (OM, operating profit over sales revenue), and asset turn (AT, sales revenue over total assets). Sales revenue is an absolute measure of business scale; the profit margins summarize a vendor's ability to make a profit from its operations; the asset turn testifies of the vendor's efficiency in employing its assets. Revenue figures were converted to constant dollars using the Producer Price Index for Software Application Publishing of the US Bureau of Labor Statistics.

5 Qualitative Analysis

Analyzing the transcripts and financial reports, it is possible to elicit some generic phases and milestones which may characterize the transition from on-premise vendor to pure on-demand service provider (cf. Figure 1 and Table 2 throughout the following paragraphs). An initial phase poses the basis for the decision to transform the business and is therefore called *gestation*. Senior managers from both vendors declare that the strategy was mainly elaborated as a response to the way organizations were expected to buy enterprise software in the future, especially the middle market, seen as an untapped source of growth. Both firms had *ante-litteram* on-demand offerings in the market already (i.e., web-based, hosted, or ASP) which, though amounting to a minority of revenues, exposed the vendors early on to distinctive on-demand characteristics and challenges: scalability, subscription-pricing, potential cannibalization of license revenues and reduction of cash flows, integration requirements, and continuous enhancement.

The formalization and internal dissemination of the decision to embrace on-demand as the main delivery model for the company's future represents the beginning of the *transformation* phase. This phase affects all of the company's assets: the developed IT artifacts as well as the organizational capabilities needed to market, deploy and service them. Apparently, the vendors realized early the need for a multi-tenant architecture underlying the new on-demand business, and built it mostly organically, re-engineering pre-existent technology and establishing new hosting organizations.

Acquisitions and merges with ASP/SaaS pioneers, however, also played a role in making the needed technological assets and organizational capabilities available (the 2004 merge of Ariba with FreeMarket and the 2002 acquisition of Captura by Concur in particular). The underlying multi-tenant platform is not the only technological novelty. Since subscriptions move the revenue barycenter farther away in time compared with traditional licensing, on-demand products must be built to simplify and thus speed up deployments, so as to accelerate revenue recognition.

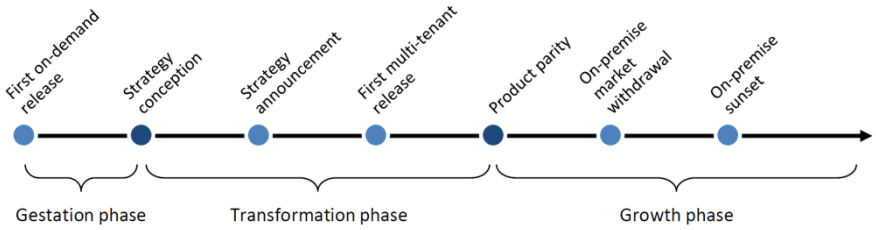

Fig. 1. Generalized timeline of a vendor's transition from on-premise to on-demand

The primacy of platform and product development efforts lasts approximately until the first multi-tenant on-demand application or module is launched, shortly following or coinciding with the public announcement of the strategy shift to all external stakeholders (customers, analysts, investors, etc.). The most prominent goal then becomes adapting the organization. This is judged an even greater challenge than the technologic transformation, and it namely impacts the company's leadership as well (e.g., all but two executives were replaced at Concur over 9 months after the decision to transition was taken). In particular, services and sales must bear the most radical changes.

In the transition to on-demand both the service mix and the nature of individual services change. Consulting services must be optimized for the deployments' higher volume and lower average complexity and length. Specialized services and expertise must be added to complement a solution which grows commoditized in its technological component. As a case in point, Ariba's system integration services, mainly linked to on-premise installations, have declined as professional services around sourcing and spending have increased. A customer management department must be established, which focuses on customers' satisfaction to drive usage – a recurrent theme, probably owing to the transaction-based pricing employed by both providers. With regard to sales, under the on-demand paradigm these tend to be more transactional, with shorter cycles and lower upfront commitment than on-premise. Therefore, salesmen should quickly close many small opportunities and build from there in a so-called "land and expand" model instead of aiming at only few large deals as they used to with on-premise products.

As the transition progresses, a fundamental turning point is reached when the on-demand solutions equal the on-premise counterparts' performances: product parity. As Ariba's senior management put it: "*This is the milestone that marks our successful* transformation *to an on-demand company. […] we are entering the* growth phase *for subscription and on-demand software*" (notice the In-Vivo coding in the excerpt).

Starting from product parity, the on-premise business is overtaken. The on-demand organization rides the learning curve and builds capacity to sustain growth. Amongst the vendor's challenges at this stage, organizational aspects are once more predominant: a bottleneck may namely arise whenever the balance between the capacities of the sales, deployment, and research and development organizations is lost.

The way legacy on-premise applications and their customers are managed in the growth phase deserves closer examination. Ariba and Concur have ceased offering on-premise solutions to new customers, and revenues from perpetual-licenses have accordingly grown smaller until the corresponding GAAP financial measure stopped being reported altogether. Nevertheless, this now finite universe of on-premise customers appears resilient – caught in the lock-in effect of sunk costs and customizations – and spontaneous conversions to on-demand are qualified as the exception rather than the norm ("*we do see a handful of customers go to on-demand […] but it is not strategic and it is not significant*"). Nonetheless, self-cannibalization is expected to increase with the growing acceptance of SaaS and the aging of past IT investments.

Ariba devotes on-premise customers a business unit and last delivered a new on-premise software release in the third quarter of 2008. Concur stated in 2010 being in the process of "sunsetting" some legacy systems and migrating their customers to the on-demand platform. However, this is a delicate move from a competitive point of view, and, therefore, the disclosed information is merely sufficient to sketch the transition's end. Interestingly, Ariba managers declare that they refrain from any such self-cannibalization plan, although it would supposedly be attractive to both the customer (through total cost of ownership reduction) and Ariba (the subscription fee being higher than the maintenance one).

Table 2. Historical timeline of the examined vendors' transition

Milestone	Concur Technologies	Ariba
First on-demand release (i.e., web-based or ASP)	October 1999 (Concur eWorkplace.com; ASP)	April 1999 (Ariba Supplier Network; web-based)
Strategy conception	March 2000	May 2004
Strategy announcement	June 2000	November 2005
First multi-tenant release	not disclosed; est. 2000 – 2003	October 2005
Product parity	not disclosed; est. 2003 – 2007	April 2008
On-premise market withdrawal	2010*	Q1 2008*
On-premise sunset	Q1 2011, ongoing*	not disclosed

* Approximations based on the publicly disclosed information.

Theoretically, any of the above-mentioned transition milestones may represent a candidate intervention which could alter the stochastic processes underlying the vendors' performances. In particular, the specific dates in Table 2 could anchor indicator series with a variety of patterns: a step function with a sudden level change coincident with the identified date, a gradually increasing or decaying level change, a temporary level change, a trend change. A perusal of the time series is thus required.

6 Econometric Analysis

In the *exploratory* stage of the econometric analysis, the collected observations were visually inspected to determine the stochastic processes' main characteristics and detect apparent interventions. Given space constraints, only few illustrative examples of the undertaken procedures are given, summarizing the main findings.

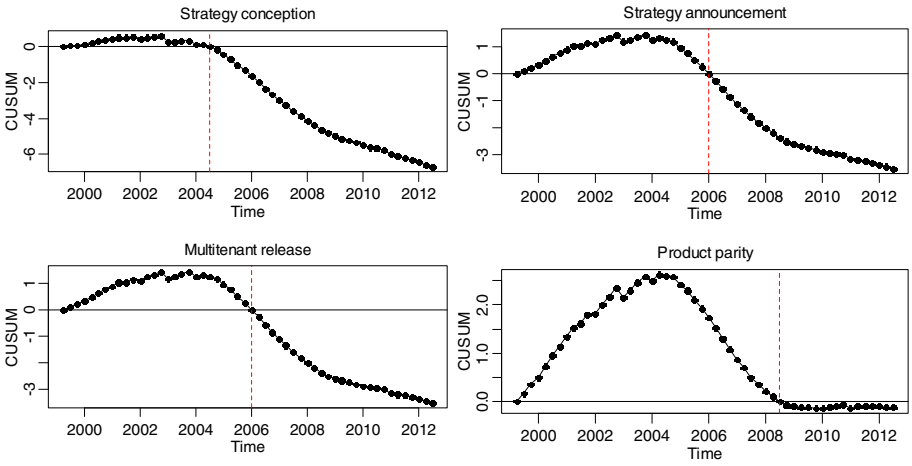

Fig. 2. Cusum charts for candidate interventions in Ariba's GM series

Level changes unambiguously relating to a transition milestone are not easy to identify on time-plots alone, for other complex nonstationary components (seasonality, deterministic and stochastic trends) may confound their effects. An exploratory investigation tool specifically suited for intervention analysis is the "cusum chart": a plot of the cumulative sum over time calculated for a tentative intervention date (see [18] for a formal account). The cusum follows an upward (downward) slope whenever the mean increases (decreases), and a sudden change in direction or steepness may signal the occurrence of an intervention.

Consider the cusum charts in Figure 2, used to investigate the effect of four transition milestones on Ariba's GM series. While strategy announcement and release of a fully-multitenant software version do not seem to produce any effect (there is no apparent change in the cusum in correspondence with the intervention date), strategy conception and product parity *might* be turning points in the profit-generating process (a change in the cusum may be spotted). Transition milestones identified as interventions by such exploratory procedures are gathered in Table 3.

In the *confirmatory* stage of data analysis, econometric models are fitted to the time series, and the interventions' significance could thus be statistically assessed. For every time-series/milestone pair, I estimated intervention models with an array of alternative ARIMA configurations (in particular: AR1, AR2, MA1, MA2, ARMA11, and constrained AR2 and MA2 – with and without first-differencing). For each

intervention, three possible effects were simultaneously estimated, that is, three shapes of z_t were used in the response equations (cf. Eq. 1): pulse, step, and trend. Formally:

$$y_t = a_0 + A(L)y_{t-1} + c_0 z_{0t} + c_1 z_{1t} + c_2 z_{1t}(t - T + 1) + B(L)\varepsilon_t \qquad (2)$$

where the c's are the intervention terms' coefficients, whose significance would corroborate the transition milestones' impact in the vendors' performances. z_{0t} is a pulse indicator series entirely made up of 0's, except for a 1 at time T (the intervention date). z_{1t} is a step indicator series made up of 0's until T, and then 1's thereafter.

This main round of estimations served the two purposes of selecting the significant effects among the three considered for each intervention/time-series pair, and of screening the best fitting ARIMA configurations. Subsequently, the insignificant terms were removed from the equations before re-estimating the more parsimonious models. The first round of estimations resulted in discarding most candidate interventions (not producing any statistically significant impact), and keeping a few which produce multiple concurrent (significant) effects. Results of the second round of estimations are showed in Table 4.

Table 3. Detected interventions from the exploratory data analysis

	Series	Ariba				Concur Technologies			
		SR	GM	OM	AT	SR	GM	OM	AT
Milestones	First on-demand release				✓		✓		
	Strategy conception	✓	✓		✓		✓		
	Strategy announcement			✓			✓	✓	
	First multi-tenant release			✓		✓			
	Product parity	✓	✓						✓
	On-prem. market withdrawal								
	On-premise sunset	N/A	N/A	N/A	N/A				

Table 4. Detected interventions from the confirmatory data analysis

Series		Significant intervention	Pulse effect* $\hat{c}_0$	Step effect* $\hat{c}_1$	Trend effect* $\hat{c}_2$	ARIMA best fitting conf.
Ariba	SR	None				AR1
	GM	Strategy conception	- 0.37124	0.05527	- 0.00275	ARIMA(0,1,1)
	OM	None				ARIMA(0,2,1)
	AT	First on-demand release	3.03762	- 4.69899	0.03697	ARMA11
Concur Tech.	SR	First on-demand release	- 0.37914	- 0.16106	- 0.1263	MA2
	GM	Strategy announcement	- 3.75797	- 0.39184	0.00723	ARMA11
	OM	Strategy announcement	- 6.14422	0.16008		MA2
	AT	First on-demand release	0.50136	0.23668	- 0.00654	ARIMA(0,2,1); constrained

* significant at 5% level at least.

7 Discussion of the Findings

The processes underlying the on-demand transformation are complex and difficult to manage for a vendor, both from a technological and from an organizational point of view. The latter is an often overlooked aspect shaded by the attention on technological topics, such as multi-tenancy. Yet, the deep changes affecting sales and consulting organizations are amongst the most relevant issues emerging from the qualitative analysis.

Some of the identified transition milestones do appear to produce changes in the vendors' cost and revenue generating processes – changes which can be visually spotted in the time series and confirmed as statistically significant by appropriate econometric procedures. Interestingly, some milestones act on multiple levels and impact in contrasting ways the short-term performances (pulse effect), the long-term ones (step effect), and the rate of change (trend effect) – a further testimony of the high complexity involved in the transformation. Surprisingly, despite the attention that on-demand attracts on the premise of expanding the market, no significant stimulation of total revenues could be detected in correspondence with any milestone. Moreover, early on-demand experiences (ASP, web-based solutions, etc.) seem to play an unexpected important role: this first milestone has triple significant impacts on the efficiency of assets utilization of both vendors and on the sales revenue of one. Profitability is negatively impacted in the short-term, as hypothesized in the literature (and intuitively reasonable considering the bearing of incremental responsibilities by the vendor). On the long-term the verdict is less clear.

A number of limitations must be acknowledged. First of all, the low number of companies in the sample may hamper generalizability. Moreover, the causal relationship between milestones and financial performances should be examined further, for there may be other phenomena acting in the background, either confounding or amplifying the effects ascribed to the milestones. With regard to the identified interventions, interactions and simultaneity were not investigated, and pattern of gradual or lagged change could be introduced.

8 Conclusion

Incumbent software vendors are often prompted to transition without ado to on-demand, but academic research around this transformation and its consequences is scarce. I employed a mixed-methods research approach to exploratively study the transition of two of the very few software companies which already turned into pure on-demand players from on-premise. Specifically, based on a qualitative analysis of reports and transcripts documenting the transition, I sketched the main phases composing such a transition and elicited the most salient organizational issues they raise. Relying on an econometric analysis of their quarterly performances, I then assessed the impact statistically ascribable to these milestones.

Acknowledgments. This work was partially financed by the European Commission under grant agreement 285248 (project FI-WARE).

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