Assessing Cloud Readiness at Continental AG^{1,2}

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Executive Summary

Despite the growing attention being given to cloud computing by researchers and practitioners, the deployment of cloud computing is still in its infancy. For this to change, client companies need to know which of their IT services are appropriate for cloud computing. They often lack a sufficiently specific, yet applicable method to determine their cloud readiness and to identify and assess which IT services are candidates for moving to the cloud. This article describes a field-tested method for assessing the cloud readiness of an organization's IT services. The Cloud Readiness Method, developed by Continental AG, a multinational leading automotive supplier, consists of three phases and uses simple assessment measures. Applying the method led Continental initially to determine 29 IT services that were potential candidates for cloud computing, subsequently reduced to 15 assessed as "likely cloud ready." Continental also determined that compliance is the greatest barrier to moving IT services to the cloud.

THE NEED TO ASSESS CLOUD READINESS OF IT SERVICES

Cloud computing is booming and the forecasts are impressive. For instance, Gartner Group placed cloud computing as the top technical priority for global CIOs in 2011; Forrester Research expects almost all business computing categories to move to the cloud; and in the 2011 SIM member survey, cloud computing was the second-most important IT application and technology investment issue facing IT executives.³ Research and Markets (a leading source for international market research and market data) expects the global cloud computing market to grow from \$37.8 billion in 2010 to more than \$120 billion in 2015.⁴

Moving IT services to cloud computing reshapes a company's IT landscape and can heavily impact its IT strategy and performance. Selecting the wrong IT services for the cloud can therefore be operationally costly and potentially could harm a business strategy. Client companies thus need a sufficiently specific, yet applicable method to assess the cloud readiness of their IT services. That method should take account of the IT services that can most easily be moved to various types of cloud computing, and should be capable of being applied in parallel with ongoing business activities. For a large multinational, improving the knowledge of the organization's decision makers about the opportunities and risks of cloud computing via a participative process is also likely to be viewed as a valuable risk-reduction strategy—even if there is no clear dollar figure assigned during the initial assessment.

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¹ Carol Brown is the accepting senior editor for this article.

² An earlier version of this article was the first-place winner of the 2011 SIM Paper Awards competition. A portion of the article was also presented at an IFIP Working Group 8.6 conference; see Loebbecke, C., Thomas, B. and Ullrich, T. "Assessing Cloud Readiness: Introducing the 'Magic Quadrants' Method Used by Continental AG," 2011, IFIP TC8 / WG 8.6 Conference, Hamburg.

³ McDonald, M. and Aron, D. *Reimagining IT: The 2011 CIO Agenda,* 2011, Gartner; Ried, S. and Kisker, H. *Sizing The Cloud, Understanding And Quantifying The Future Of Cloud Computing,* 2011, Forrester Research; Luftman, J. and Ben-Zvi, T. "Key Issues for IT Executives 2011: Cautious Optimism in Uncertain Economic Times," *MIS Quarterly Executive* (10:4), 2011, pp. 203-212.

⁴ Global Cloud Computing Market (2010-2015), 2011, Research and Markets (www.researchandmarkets.com).

This article describes a three-phase Cloud Readiness Method for assessing the cloud readiness of a client company's IT services that was developed by Continental AG. Applying the method enabled Continental to select 15 IT services (from an initial list of 29 possible services) that were "likely cloud ready" and to identify the conditions (criteria) that had to be met for different types of services. After successfully using this method, Continental found that it could quickly pursue the next investigative and negotiating steps, and thus maintain the positive cloud-computing momentum in the company.

Categorizing some IT services as "likely cloud ready" of course requires a common understanding of cloud computing. For this initiative, Continental initially defined cloud computing in a similar way to a recent Wikipedia entry:

"The delivery of computing as a service rather than a product, whereby shared resources, software and information are provided to computers and other devices as a utility (like the electricity grid) over a network (typically the Internet)."

First, we provide an introduction to Continental AG and the three dimensions of cloud computing it identified for engaging multiple internal and external participants. Then we describe the multi-phase Cloud Readiness Method and present Continental's specific results of categorizing IT services as "likely cloud ready."

CONTINENTAL AG

Continental AG, founded in 1871 in Hanover, Germany, is a global leading automotive supplier with approximately 149,000 employees at nearly 190 locations. In 2010, the company achieved sales of about €25.5 billion (\$32.3 billion) with adjusted margin of earnings before interest and taxes (EBIT) of about 9.5%. With its six divisions-Chassis and Safety, Powertrain, Interior, Passenger and Light Truck Tires, Commercial Vehicle Tires and ContiTech—Continental is a driving force for future mobility concepts in the automotive industry and beyond. Most of its business units are leaders in their respective fields. With the acquisition of Motorola's automotive-electronics unit in 2006, Continental added telematics to its portfolio and strengthened its position. In 2007, the acquisition of Siemens VDO Automotive made the company one of the global top five automotive suppliers.

As a large multinational, Continental operates in global, competitive markets where IT services have been the backbone for most distributed business processes. Many of its IT services across business sectors and countries have reached commodity status, suggesting that these services were possibly cloud-ready. For instance, in 2007 Continental had to integrate about 40,000 Siemens VDO IT users into a common e-mail system. These users were familiar with Outlook Exchange whereas Continental had been using Lotus Notes Domino. Would mailbox services "from the cloud" have allowed for a smooth and cost-efficient integration of e-mail systems, as cloud service providers promise? Looking back, this integration problem was a primary catalyst for Continental engaging with cloud computing, and triggered the company's cloud-readiness initiative.

CONTINENTAL'S CLOUD COMPUTING FOCUS

The primary focus of Continental's cloud-readiness project was on what client companies demand from the cloud—that is, IT services that are delivered with a clearly defined and measurable quality, with options for up- and downscaling, and usage-dependent charging from more than one provider.⁵ The ondemand and pay-per-use requirements of cloud computing imply that there is no payment if a service is not used. In more system-oriented terms, client companies require the option to scale down the use of cloud services at short-term notice.

To foster a company-wide, in-depth discussion about cloud services, Continental identified three dimensions of cloud computing: Deployment, Location and Service (see Figure 1). Each of these dimensions is discussed below. With its cloud-readiness project, Continental aimed at identifying those IT services that were ready for shared public delivery.

Deployment Dimension

The deployment dimension shows the degree of openness of cloud computing. A *private cloud* provides a standardized, virtualized and effective manageable environment for IT services for defined user groups, typically within an organization or organizational unit, and under customer control. At the other extreme, a *public cloud* offers highly standardized and scalable services on a pay-per-

⁵ Thomas, B. and Ullrich, T. "Cloud-Readiness: Continental IT Corporate Infrastructure & Security Strategy," eco Workshop, Cologne, 2011 (available at http://sicherheit.eco.de/files/2011/02/1102020_ullrich_Continental.pdf).

Figure 1. The Three Dimensions of Cloud Computing Openess Public Deployment Hybrid Non-Exclusivity Model Shared Dedicated , Location Model Private On-Sit Functionality and Vertical Integration IaaS PaaS SaaS BPaaS ServiceModel IaaS: Information-as-a-Service PaaS: Platform-as-a-Service Saas: Software-as-a-Service BPaaS: Business-Processes-as-a-Service (Source: Thomas, B. and Ullrich, T.)⁶

use model. The same infrastructure—accessed via the Internet—is used in parallel by users from different organizations. A *hybrid cloud* provides interconnections between on-premise IT and private and public clouds. Overall responsibility with a hybrid cloud is with the customer, but the responsibility for operations is typically shared.

Exclusive or dedicated cloud-deployment models are typically organized using logical segmentation methods like multi-tenancy. Owner and operator are external service providers. The more open the deployment model, the greater the economies of scale, whereas adaptation options and levels of control decrease. The Cloud Readiness Method described below is centered on the concept of a public cloud.

Location Dimension

This dimension refers to the location of the cloud. An *on-site cloud* operates on the premises of the client company. A *dedicated cloud* is typically located elsewhere but serves only one client company. A *shared cloud* typically delivers IT services to many client companies and by definition is located off-site (of all or most client companies). The location model binds locations to the deployment model chosen.

Service Dimension

The service dimension indicates the scope of the services to be provided via cloud computing. There are four service models, which integrate an increasing array of services (see Figure 2). First, infrastructureas-a-service refers to on-demand provision of computing power and storage resources, delivered from a highly standardized and mostly virtualized infrastructure with automated systems management. Amazon.com can be categorized as providing this type of service. Second, *platform-as-a-service* provides shared development and runtime platforms, programming, testing and management environments, which are provided as an integrated or optional service. This type of service enables the collaboration of system architects and software developers. Google is an example of a platform-as-a-service provider. Third, software-as-a-service is the provision of shared software services, including all necessary IT resources (infrastructure, systems management, application management and maintenance), accessible via the Internet and network connections, and paid for on a "per unit used" basis. A prominent software-as-aservice provider is salesforce.com. Finally, businessprocesses-as-a-service is the provision of business process operations through a combination of software services and functional services. An example is HR processes. All four types of service were found to

⁶ Ibid.

Figure 2. The Service Model Dimension of Cloud Computing

IaaS	PaaS	SaaS	BPaaS	_ >
CPU &	CPU &	CPU &	CPU &	
Storage	Storage	Storage	Storage	
	Operations	Operations	Operations	
		Applications	Applications	
IaaS: Infrastructure-as-a-Service			Business	
PaaS: Platform-as-a-Service			Processes	
SaaS: Softwa	re-as-a-Service			
BPaaS: Busir	ness-Processes-as-a-Se	rvice		

be applicable for one or more of the IT services that Continental assessed.

THREE-PHASE CLOUD READINESS METHOD

Continental's Cloud Readiness Method is one of the first known approaches developed by a client firm that enables the readiness of a wide portfolio of IT services to be transferred to the cloud to be assessed. The project to develop the method started in December 2010, with the aim of applying a customized method for investigating the cloud readiness of specific IT services. The method was implemented and fully executed for the first time in April 2011. The Cloud Readiness Method is based on two assumptions:

- 1. The cloud computing marketplace will continue to grow.
- 2. Hardly any of a client company's IT landscape will be "completely cloud ready."

The project was led by Continental's Chief Technical Officer and Chief Security Officer, who have corporate-level responsibilities across all divisions for company-wide IT decisions. The project resulted in a sufficiently specific, yet applicable method to assess the cloud readiness of Continental's IT services without using detailed operational criteria and quantitative scales. The next stage after applying the Cloud Readiness Method is to choose the most suitable vendor for "likely cloud ready" IT services. Later in 2011, Continental began the search for a vendor that was "ready for Continental" for each of its "likely cloud ready" IT services.

The Cloud Readiness Method, which resembles some elements of other approaches for evaluating IT providers,⁷ consists of three phases: *Identification*, *Screening* and *Categorization* (see Figure 3). The conceptual novelty of the method lies in the approaches to screening and categorization.

Phase 1: Identification

The identification phase has two formal objectives: (1) identifying IT services to be further investigated regarding their cloud readiness, and (2) identifying the cloud-readiness criteria deemed to be relevant in the Continental context. Another objective is to increase Continental management's and employees' buy-in to cloud computing.

Continental organized 16 workshops with management and other employees, as well as the company's current technology and external service providers. Each workshop had several rounds, with external communication specialists moderating the

⁷ See, for example, Smulders, C. "Magic Quadrants and Market Scopes: How Gartner Evaluates Vendors within a Market," 2011, Gartner; or scientific methods for evaluating IT investments (e.g., Farbey, B., Land, F. and Targett, D. "Evaluating Investments in IT," *Journal of Information Technology*, (7:2), 1992, pp. 109-122). For a discussion of the similarities between Continental's method with the former, see Loebbecke, C., Thomas, B. and Ullrich, T., op. cit., 2011.

Figure 3. Three Phases of the Cloud Readiness Method



Table 1. IT Services Identified for Cloud Readiness Assessment					
1 Intranet	11 Messaging	21 Managed User Workstation			
2 Internet	12 Mobile Device Management	22 Patch Management			
3 Finite Elements	13 2nd WAN & WAN Accelerator	23 Virus Protection Management			
4 ERP Services (SAP)	14 Office & File Viewer	24 Vulnerability Management			
5 Redundant Infrastructure	15 Project Management Suite	25 Realtime Collaboration			
6 Continental Application Framework	16 Internet Access Gateway	26 IT Asset Management			
7 Supply Chain Management	17 DMZ* Operations	27 Service Desk			
8 Storage	18 Internet Mail Gateway	28 IT Service Manager Tool			
9 Data Compression for Storage	19 Managed Server	29 Meta Directory Services			
10 Information Life Cycle Management	20 Archiving Service				

* DMZ (demilitarized zone): a physical or logical subnetwork that exposes Continental's external services to the Internet. It adds an additional security layer to Continental's internal network.

sessions, using a common metaplan technique.⁸ Workshop participants first named IT services they thought should be further considered for cloud computing. They quickly found they agreed on mainly commodity-like IT services. Eventually, they ended up with 29 IT services that they investigated further for cloud readiness (see Table 1).

Workshop participants were also asked to suggest criteria for assessing the cloud readiness of Continental's IT services. In identifying the criteria, they drew on their experiences and well-informed guesses, rather than on any scientifically based criteria list.⁹ They generated unweighted criteria lists at different workshops and aggregated them into one list, relevant to Continental's context. This aggregated list was iteratively reviewed and assessed with the goal of identifying a "good" list. In the end, Continental's IT managers considered the criteria to be operationalizable and currently applicable, and thus

⁸ A metaplan technique involves collecting ideas when a group of people are working together, including capturing initial ideas from individuals without group judgment (brainstorming), grouping the ideas according to categories, and then reflecting on ideas that an individual participant may not have been aware of.

⁹ For examples of a similar approach to identifying client criteria for outsourcing and offshoring, see Hirschheim, R., Heinzl, A. and Dibbern, J. (eds.) *Information Systems Outsourcing: Enduring Themes, New Perspectives and Global Challenges,* "Springer, 2006.

Table 2. Cloud Readiness Assessment Criteria				
Criterion	Parameter	"Cloud-Ready" Value		
Core Business/ Competitive Position	 <i>Relevance for the core business (high/low):</i> high if the service (significantly) contributes to turnover and profit. <i>Contribution to the competitive position (differentiation/ commodity):</i> high if an IT service helps differentiation in terms of innovations, business process speed and agility. 	 Low relevance for the core business Low contribution to the competitive position (differentiation) 		
Importance/ Availability	 <i>Importance (non-critical/critical):</i> critical if core processes cannot run if the IT service is not available. <i>Availability (low/high):</i> high if the IT service can be contracted from cloud provider 365/24 without interruptions. 	 Critical for core business processes High availability 		
Standardization	 <i>Lifecycle (complex/simple):</i> complex if strong integration of IT service into other systems and many dependencies to other processes and its actualization requires intense planning and coordination. <i>Standardization (high alignment/standard):</i> standardized if not adapted to company needs. 	Simple lifecycleStandardized IT service		
Degree of Distribution Within Continental	 <i>Management (local/global):</i> local if management tasks related to an IT service have no central administrative structures, and roles and rights differ among locations. Replication (technical) administration (decentralized support service/globally centralized). 	 Global management Globally centralized replication 		
Network Connectivity	 Bandwidth (high/low). Latency/Sensitivity (high/low). 	 Low bandwidth requirements Low latency/sensitivity		
Identity Management	 Integration (strong/weak): weak if an IT service has its own identity management and is independent of the identity directory of the company/enterprise. Administration (locally integrated/centralized): centralized if provisioning and de-provisioning of users follows central guidelines, including conventions for naming and security. 	Weakly integratedCentrally administered		
Compliance	 <i>Realization Effort (high/low):</i> high if strong organizational and technical efforts are needed. <i>Requirements (high/low):</i> high if requirements for processed data need to match strict legal and regulatory standards, or company-specific compliance standards. 	 Low realization efforts Low compliance requirements		

sufficiently meaningful for assessing cloud readiness. The seven criteria identified were:

- Core business/competitive position
- Importance/availability
- Standardization
- Degree of distribution within Continental
- Network connectivity

- Identity management
- Compliance

Each criterion was defined by two parameters with two simple values (see Table 2).

Phase 2: Screening

The Screening Phase has two goals: 1) to evaluate all identified IT services against all determined criteria





using a *Cloud Readiness Framework* for each IT service, and 2) to determine which criteria are likely stumbling blocks for IT services to be ready for cloud computing—both individually and overall.

Continental screened the 29 IT services by qualitatively assessing each according to the seven criteria, based on best informed guesses. These assessments produced 29 Cloud Readiness Frameworks showing the cloud potential of the services. Figure 4 shows two examples of such frameworks, the one for No. 23 (Virus Protection Management) and the one for No. 4 (ERP Services) Figure 5 illustrates how Continental identified the criteria that were critical hurdles for cloud readiness across the IT services being assessed. In this figure, 10 selected IT services are positioned in the Standardization criterion square (the numbers correspond with those in Table 1). The square shows that the Standardization criterion for cloud

Figure 6. Position of the Soft Threshold Line in the Cloud Readiness Framework

 Better
 Better

 Parameter 1
 Worse

 Worse
 Parameter 2

readiness was pretty much met for most of the 10 IT services, and essentially met for the five services clustered in the upper right: No. 6 (Continental Application Framework), No. 8 (Storage), No. 11 (Messaging), No. 14 (Office & File Viewer) and No. 15 (Project Management Suite). This suggests that the Standardization criterion can be met for many IT services.

Repeating this exercise for each cloud readiness criterion, Continental learned how critical the different criteria were for each IT service to be cloud ready (see Table 3).

Table 3. Compliance and Degree ofDistribution within Continental as BiggestBarriers to Cloud Readiness			
Criterion	Barrier to:		
Compliance	9 Services		
Degree of Distribution Within Continental	8 Services		
Standardization	6 Services		
Network Connectivity	5 Services		
Importance/Availability	4 Services		
Identity Management	4 Services		
Core Business/Competitive Position	3 Services		

Continental then carried these insights forward to the third and last phase of the Cloud Readiness Method.

Phase 3: Categorization

The objective of the Categorization Phase is to designate the IT services under consideration as "likely cloud ready" or "not (yet) cloud ready."¹⁰ Based on the Cloud Readiness Framework for each IT service generated in the previous phase, the final categorization relies on a two-step assessment of where the criteria are positioned in relation to a "soft threshold." This threshold is a dotted curve in each of the Cloud Readiness Frameworks (see Figure 6). The position of this curve is based on best-informed guesses and is consistent across all IT services.

- First, a service with all or most criteria above the threshold (upper right area) is considered to be likely cloud ready.
- Second, special consideration is given to the Compliance and Degree of Distribution Within Continental criteria because these criteria emerged as the most critical ones during the screening phase. If those two criteria are above the threshold line, an IT service may be assessed as likely cloud ready, even if some other criteria are below the line.

¹⁰ During the pilot application of the Cloud Readiness Method, Continental only distinguished between "likely cloud ready" and "not (yet) cloud ready." However, in the future, it anticipates categorizing the IT services in three ways—likely cloud ready, not yet cloud ready and unlikely to be assessed as cloud ready in the next few years.

Figure 7. Examples of Cloud Readiness Categorizations



Table 4. IT Services Assessed as "Likely Cloud Ready"					
1 Intranet	Messaging	21 Managed User Workstation			
2 Internet	Mobile Device Management	22 Patch Management			
3 Finite Elements	2nd WAN & WAN Accelerator	23 Virus Protection Management			
ERP Services (SAP)	14 Office & File Viewer	24 Vulnerability Management			
Redundant Infrastructure	Project Management Suite	25 Realtime Collaboration			
Continental Application Framework	Internet Access Gateway	26 IT Asset Management			
7 Supply Chain Management	17 DMZ Operations	27 Service Desk			
Storage	Internet Mail Gateway	28 IT Service Manager Tool			
Data Compression for Storage	19 Managed Server	Meta Directory Services			
Information Life Cycle Management	Archiving Service				

*The 15 IT services, and their numbers, assessed as being cloud ready are shown in bold.

Examples of applying this two-step assessment are shown in Figure 7. IT Service No. 23 (Virus Protection Management) was categorized as "likely cloud ready." However, No. 4 (ERP Services) was categorized as "not (yet) cloud ready": criterion G was a clear barrier, with unacceptable ratings on both parameters.

Applying this two-step assessment, Continental categorized 15 of the 29 IT services as "likely cloud ready," as shown in bold type in Table 4. (The Appendix shows all 29 Cloud Readiness Frameworks

with the 15 "likely cloud ready" services highlighted.) Continental subsequently started selecting and negotiating with vendors for these 15 IT services, with greater insights about specific criteria that could be significant impediments or facilitators of moving these services to the cloud.

LESSONS LEARNED

Based on Continental's experience of using its Cloud Readiness Method, we provide five guidelines for Loebbecke et al. / Assessing Cloud Readiness at Continental AG

organizations preparing to move IT services to the cloud.

1. Identify IT Services That Are "Likely Cloud Ready" Ahead of Vendor Sales Pitches

A rapidly growing market for cloud-computing services allows an organization to procure a cloud service for any type of IT service that it identifies as being "cloud ready." By proactively determining which of its IT services are "cloud ready," an organization stays in control and is not driven by those trying to sell cloud services. Continental did exactly this: it saw the business potential of cloud computing, and stayed in the driver's seat by initiating its Cloud Readiness Project.

2. Involve Management and Other Employees, as well as Technology and Service Providers

Organizations should involve management and other employees, and technology and service providers, in joint workshops to gain buy-in to a targeted list of IT services and key criteria to assess cloud readiness. Continental chose to include its current service providers in these workshops. The rationale was to gain insights from both key internal employees and current providers of the services.

3. Identify Assessment Criteria and Assign Values to a Pair of Parameters for Each One

Having identified the criteria that will be used to assess the cloud readiness of current IT services, involve management and employees, as well as the technology and service providers responsible for providing the services today, in jointly assigning values to the parameters that will be used to assess the criteria. Using two simple values and simple assessments enabled Continental to identify cloudready IT services without disrupting ongoing global business operations. It also ensured the company did not get bogged down with more precise criteria assessments and complex quantitative comparisons.

4. Weight Criteria Assessed as "Show-Stoppers" More Heavily

Continental found the Compliance criterion (defined as also including security issues) to be the highest hurdle for moving to the cloud for most of the 29 IT services investigated. Based on its belief that cloud computing can and will be beneficial, and that an external cloud provider is not necessarily worse in handling compliance and security issues than some less-specialized internal unit, Continental categorized 15 IT services as "likely cloud ready."

5. Apply a "Soft Threshold" to Finally Determine Those IT Services That Are "Likely Cloud Ready"

Continental found that applying a "soft threshold" enabled it to discard some of the IT services initially identified as potentially being "likely cloud ready." This reduced the risk of postponing the pursuit of advantages to be gained from the cloud.

CONCLUDING COMMENTS

Being easy to understand and to apply, Continental's Cloud Readiness Method has served the company well. The method involved key participants from various internal units as well as external providers, and was an effective eye-opener and motivator for pursuing possible cloud initiatives for an initial list of 29 IT services. We believe that this method can be applied in almost every industry segment by businesses that wish to determine which IT services to consider for moving to the cloud. The method also helped reveal the most significant barriers to moving to the cloud: compliance and security issues. However, as cloud computing gains momentum and matures, laws and regulations, vendor service offerings and a client company's perception of compliance requirements may change. Perhaps sooner rather than later, procuring IT services from the cloud will be the norm, as it already is for procuring energy and communication services from utilities. We believe that the case study of Continental's approach to assessing cloud readiness will foster a well-balanced initial deployment by other client companies.

APPENDIX: CLOUD READINESS FRAMEWORKS FOR CONTINENTAL'S 29 IT SERVICES

Colored backgrounds indicate the 15 IT services assessed as "likely cloud ready."

Cloud Readiness Frameworks for Continental's 29 IT Services

Key:

• Compliance

O Degree of Distribution Within Continental



Cloud Readiness Frameworks for Continental's 29 IT Services (cont.)

Key:

Compliance

O Degree of Distribution Within Continental



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