Development in the Cloud:

A Framework for PaaS and ISV Flexibility

A research report prepared by:

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About This Report

This report was developed and written by the senior staff of Saugatuck Technology Inc. This report is based on independent research developed and conducted by Saugatuck Technology Inc., which is solely responsible for the analysis, conclusions, and recommendations presented in this report. The publication of this report was funded by Progress Software Inc.

About Saugatuck Technology

Saugatuck Technology Inc. provides subscription research and management consulting services focused on the key market trends and disruptive technologies driving change in enterprise IT, including SaaS, Cloud Infrastructure, Open Source and Enterprise Social Computing.

Founded in 1999, Saugatuck is headquartered in Westport, Connecticut, with offices in Boston, Santa Clara, CA and Frankfurt, Germany. For more information, please visit www.saugatech.com, or call +1.203.454.3900.

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Introduction: Toward Structured Cloud Development

Rampant and accelerating use of Cloud-based IT is enabling developers within ISVs, Cloud providers, and user enterprises to consider using Cloud-based development capabilities for on-premise and Cloud-based needs.

When properly deployed and used, Cloud-based development can significantly reduce the costs of software development by improving ease of access to tools and libraries, enabling and encouraging secure community-based development, and reducing time to market/time to deployment. Long-term benefits include improved quality, improved distribution of software, and reduced costs of maintenance and upgrading.

This paper uses the latest research by Saugatuck Technology to examine the need for Cloud-based development, and develop a structure for the "ideal" development platform. In this paper, we:

- Describe the current state of cloud development platforms, including what needs are being addressing today; and
- Present an "ideal" cloud development platform to address these development requirements

Cloud Development Today

The hottest topic of interest and conversation among developers, ISVs and other key players in software and solution development today is that of Cloud Computing, or, more specifically, ***Cloud development.***

There is no doubt that the IT and user worlds are both vigorously embracing Cloud in general. Entire ecosystems and markets have developed and grown around Cloud-based applications and platforms, from native Cloud players (e.g., Amazon, Google, Salesforce.com) to traditional, established IT vendors making moves toward Cloud IT in many forms (e.g., HP, IBM, Microsoft, Oracle, Progress Software, SAP).

And it's only going to get bigger, quickly. Saugatuck Technology's latest survey research indicates that more than half of all user firms worldwide plan on utilizing Cloud-based applications for even their most core business operations within the next two to three years. And all our research points toward more powerful Cloud-based applications, systems and platforms, standing on their own as well as integration with a wide range of traditional on-premise IT.

This Cloud-driven future of business software requires more, and better, Cloud-based development. Solutions can and will be developed on-premise and deployed in one or more Clouds. But speed and cost issues will eventually shift most common development, and most development for Cloud-based solutions, to the Cloud itself.

So it is no surprise when our research also indicates that most ISVs see their future growth in the Cloud, and between Cloud and on-premise IT. Our most recent interview programs with ISVs and with partners in large vendor ecosystems indicate that between 40 and 45 percent of ISVs are already looking for and experimenting with ways to incorporate Cloud offerings and associated development into their business and technology strategies.

What they learn quickly is that developing for and in the Cloud is a significant and potentially costly step for their individual firms. Cloud development requires more new knowledge, more technologies, more resources, and a broader ecosystem of partners than most ISVs and developers are prepared to invest in. Thus, more and more are looking to Platform-as-a-Service (PaaS) providers to help them step up to the Cloud. PaaS is changing the course of software development, by encouraging and enabling powerful, affordable software development without heavy investment in resources.

With the world obviously and aggressively moving toward Cloud solutions, the choice of Cloud development platform becomes a critical decision for developers and ISVs. Choices need to be made based on every developer's or ISV's combination of need and capability; but in every case, *capability* includes *flexibility*, and *flexibility* includes the:

- Ability to develop for multiple Cloud types and multiple Cloud deployments;
- Ability to utilize existing/legacy databases, tools, and languages; and
- Ability to adapt to emerging development technologies and procedures over time.

DEFINING CLOUD DEVELOPMENT

One key trend enabling the ISV transition from on-premise to the Cloud is Cloud development. Cloud development offerings enable building a Cloud business solution, deploying a solution to the Cloud and running it there, and integrating a Cloud business solution with other solutions either in the Cloud or on-premise, behind the firewall. Perhaps the best known of these Cloud development offerings is Force.com, but Amazon Web Services (AWS) now plays host to Cloud development offerings from IBM, Microsoft and Oracle, as well as its own, and recently Microsoft released its Cloud development solution offering, Windows Azure Platform. Cloud development offerings such as those from Progress Software not only enable development, testing and deployment of Cloud business solutions, but may also include the middleware necessary to operate them, charging on a usage basis for data base, storage and other services. Alternatively, Cloud development solution providers may partner with one or more Infrastructure as a Service (IaaS) providers to enable the efficient operation of Cloud solutions through middleware and services offerings.

Each Cloud development solution offering brings its own formula for value. Force.com is a proprietary development environment that emphasizes high productivity and ease of use. Azure is a platform that leverages both the familiarity and the investment of .NET developers in on-premise Microsoft developer tools and APIs. The ideal Cloud development offering would provide these advantages: high productivity, ease of use, familiar developer tools and the ability to leverage existing software assets. *However, none of the current Cloud development providers yet offer a complete, fully-fleshed out set of Cloud development tools. Most rely on existing on-premise toolsets and SDKs with API hooks in the Cloud to provide underlying middleware capabilities.* And while Force.com is increasing its toolset and platform capabilities with a joint-venture Java offering with VMware, it nevertheless lacks significant tools support.

SEEKING THE PERFECT CLOUD DEVELOPMENT PLATFORM

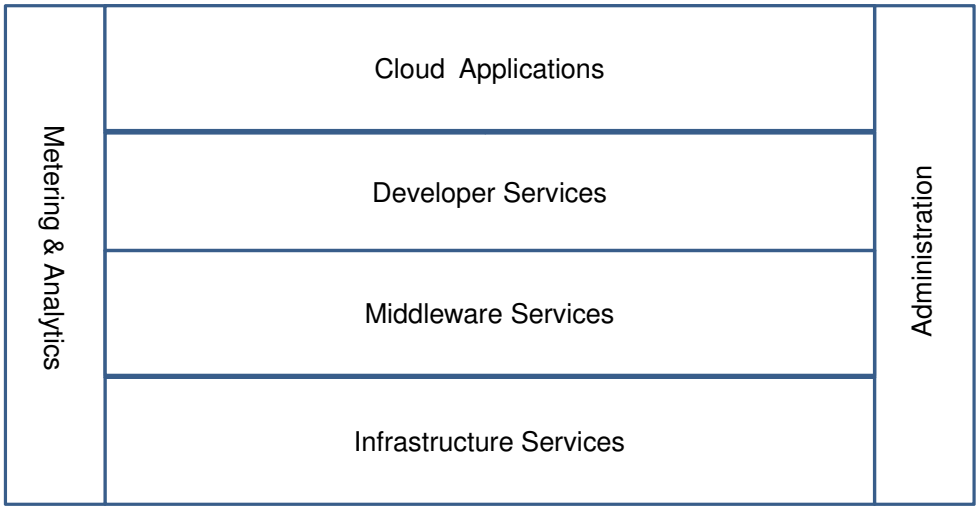
Given such a nascent, changing environment, what do ISVs and developers need to know when it comes to understanding, evaluating and choosing the best PaaS platform and provider? Saugatuck has worked with several hundred ISVs and user development organizations (from enterprise IT groups to open source communities) since 2005 to develop a simple stack model that both illustrates and explains what should be found in the "perfect" PaaS environment.

Obviously nothing technological is, or will be, perfect in every way. We are unlikely to ever see development platforms that solve all requirements perfectly. What's more important is the right set of broad-based and deep capabilities that enable cost-effective development in the Cloud, and which in turn enable the keys to developing and delivering efficient and effective Cloud solutions, as follows:

- A scalable, reliable, and highly-available operational platform deployable to multiple Clouds or between Clouds and on-premise systems;
- Flexibility in deployment, user interface(s), and user experience as desired by customers and developers/ISVs;
- A highly productive environment using industry-standard and widely-available tools, technologies, methodologies, and best practices;
- Data and applications security to enable managed access and control;
- Integration capabilities for apps within a provider Cloud, between Clouds, across Cloud and on-premise applications, and throughout developer/ISV ecosystems; and
- Tenancy migration as required, enabling transition from single-tenant to multi-tenant solutions with all required integration, security, and flexibility per the points above.

Our Cloud Development Stack model is the result of this research, and provides a solid, objective framework for what needs to be included. Figure 1 summarizes the model and its core components.

Figure 1: Saugatuck's Cloud Development Stack Model



Source: Saugatuck Technology Inc.

A brief look at each layer helps us understand the role of each and why its various components are important.

The Infrastructure Services Layer

This layer includes the most basic of PaaS capabilities: The supporting hardware, software and associated infrastructure upon which development is executed, and within which the development is to take place. It must be at least as powerful, secure, robust, reliable and available as any physical infrastructure within a development or ISV organization. In fact, the PaaS Infrastructure layer should be ***more*** capable than almost any of these, as it must enable significant cost benefits (typically based on scale).

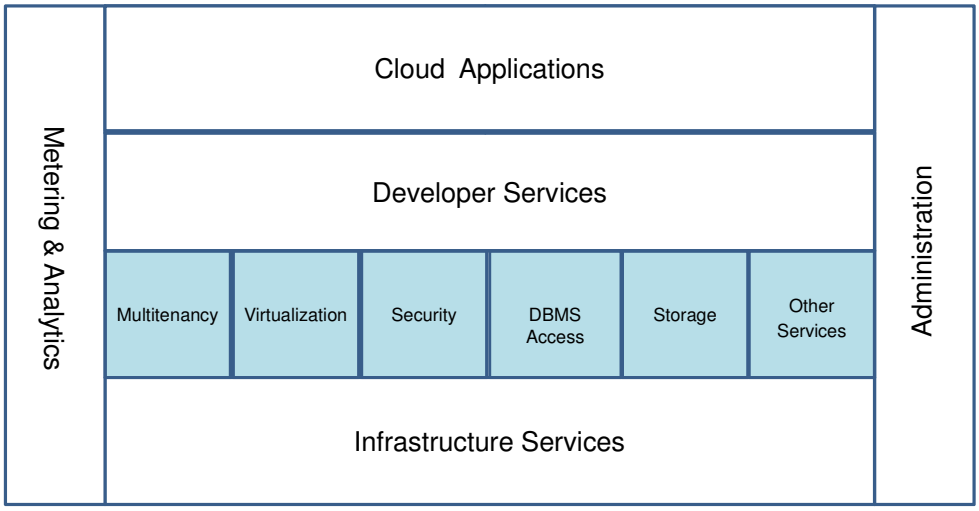
Several existing, Cloud-native PaaS providers (e.g., Amazon, Google) have physical infrastructures of almost legendary size and capabilities. Many others, including key traditional, Master Brand IT providers (e.g., HP, IBM) are working to add to and/or migrate their own extensive infrastructure capabilities and services into PaaS environments and offerings.

The Middleware Layer

The Middleware layer is the "glue" that cements the development work to be done with the desired application(s), data types and sources, environment, and technologies. We can also think of this as the "enablement" layer for Cloud development, as the capabilities offered by the PaaS at this layer will enable and determine many critical capabilities of the code or offering that results from the development effort. Several existing PaaS Clouds offer many key aspects of this layer, often based on Cloud-enabled versions of traditional middleware offerings by mainstream software Master Brands (e.g., Amazon EC2 using IBM WebSphere middleware instances). Other vendors, such as Progress Software, offer platforms with powerful middleware capabilities to be used by PaaS providers and developers.

The components that should be included in a PaaS Middleware Layer are summarized in Figure 2, and briefly defined below.

Figure 2: The Middleware Layer



Source: Saugatuck Technology Inc.

Multi-tenancy (i.e., Database and Application Multi-tenancy Services). For those solutions that are native to the Cloud, or that were originally architected to take advantage of multi-tenancy.

Virtualization. Many ISVs seeks effective means of migrating their existing, single-tenant, on-premise solutions to the Cloud. Virtualization enables the development of single tenant / multiple instance solutions that simulate multi-tenancy without the need for re-architecting. Advantages of this include more rapid deployment of solutions without complete re-architecting, as well as the customization of distinct implementations.

Security. In Saugatuck's annual SaaS user and buyer surveys, the concern ranked highest by IT and business executives is almost always data privacy and security. ISVs and developers need a PaaS provider that can help them build solutions that assuage such concerns. Identity management and encryption are the most important components, because Cloud use frequently enables very broad and widespread user categories with varying access rights. Identity management enables distinct access rights for defined classes of users as needed, while encryption services protect the data in transit or in storage.

DBMS Access. Changes in how data is structured, used, stored and accessed is helping to shape important changes in Cloud IT overall. In general, the more database types supported and enabled, the better, but of course every ISV or developer is going to have preferences based on which db engine is at the core of its ecosystem(s).

Storage. The Cloud reality is, and will be, multiple types of content being used, stored, accessed, and transmitted. Capabilities to look for include BLOB storage for unstructured content, data storage for straight dbms solutions, and baseline document storage for text-based content solutions. Most PaaS may not include all such storage capabilities.

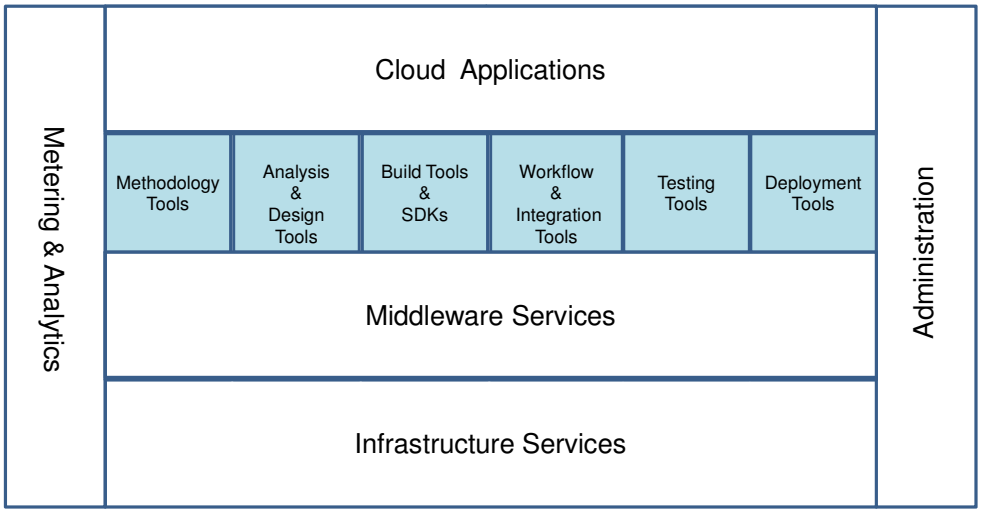
Other Services. The "Other Services" block in this layer should include any and all middleware capabilities required to make the ISV solution work in the Cloud. This can include BPMS and other Workflow engines, Content Management Systems, Runtimes, and Data Services (e.g., Data Transfer In and Out).

The Development Layer

If the Middleware Layer is the "glue," or the enabling and foundational technologies on which Cloud development is executed, the Development Layer is where the "real" work is done. The Development Layer is a critical gap-filler that creates tremendous value in the marketplace for developers, ISVs and PaaS providers.

This is by far the most complex layer within the model, as it must include all the critical components/tools/languages/libraries required by ISVs and developers to develop, test, refine, and link their offerings. Figure 3 summarizes the components that should be included in a PaaS Development Layer; these components are briefly defined following Figure 3.

Figure 3: The Development Layer



Source: Saugatuck Technology Inc.

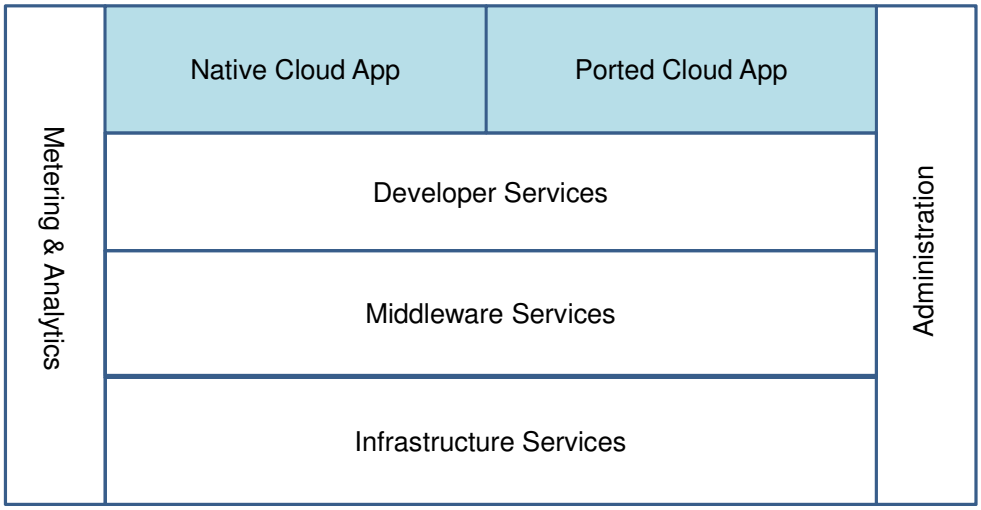
- **Methodology Tools**: Most PaaS will support key development methodologies, but few if any will support all. Agile development (e.g., dynamic systems) is the primary method of software development today, with data modeling and data design a close second. Both must be supported by any PaaS. Examples of what to look for include the following: Dynamic Systems Development Method (DSDM), Business Modeling, Cleanroom (Box Structure Method), Data Modeling / Data Design (Top Down, Bottom Up), Iterative Development, Lean (an outgrowth of Lean Manufacturing), Jazz, Prototyping (especially for user interfaces), Rapid Application Development (RAD), Rational Unified Process (RUP), Scrum, Spiral Development, Test-driven development (TDD), and V-Model (an extension of the Waterfall Method).
- **Analysis & Design Tools**. Key tools that should be included and provided by the PaaS here include the following: Business Process Modeling Notation (BPMN) tools, Modeling and Analysis of Real-Time and Embedded systems (MARTE), Unified Modeling Language (UML) tools (a no-brainer), and 3D Modeling Tools.
- **Build Tools and SDKs**. Here, code libraries and platform SDKs are a must, along with HTML/Web Development Tools, Integrated Development Environments (IDEs, e.g. Eclipse), Compilers, DBMS Tools, Debuggers, Emulators, Graphic Development Tools, Mobile Development Tools, Multi-Tenancy Development Tools, Runtimes, Scripting Tools, Visual Development Tools (Drag and Drop), and finally 4/5GL tools.
- **Workflow & Integration Tools**. If, as an ISV or development group, you're going to have and use a PaaS, then you are also likely to have solutions that users and internal developers will need to bring together. You will want to enable your users or customers to link to other systems or even entire portfolios, whether on-premise, or in other Clouds. Thus you will require, and your PaaS should provide, APIs, data cleansing tools, data mapping tools and widgets, Data Migration Tools, Extract/Transform/Load (ETL Tools), Orchestration Tools, and XML Tools.

- **Simulation & Testing Tools.** The growth of hybrid, on-premise+Cloud business IT environments will require a broad and deep portfolio of PaaS tools optimized to develop and test for, and within, such environments. This portfolio includes, but is not limited to, the following: Black box/white box testing tools, database testing tools, GUI testing tools, hybrid systems simulation tools (really useful/critical for hybrid environments), Integration testing tools (ditto – how does the whole environment work together), load testing tools, mobile device testing tools, network simulation tools, QA and optimization tools, stress test tools, test automation frameworks, and Web testing tools.
- **Deployment Tools**. Finally, the developed software must be deployed in a manageable fashion, usually within multiple types of user business environments, including straight Cloud, multiple Clouds, hybrid Cloud+on-premise, mobile, and all manners of environments combining these. Thus we see a need for Cloud deployment tools, mobile solution deployment tools, and Multi-Cloud deployment tools.

The Application Layer

At the top of our model lies the Application Layer, which consists of two types of applications developed and deployed in the Cloud: Native Cloud Apps, and Ported Cloud Apps, as noted in Figure 4.

Figure 4: The Application Layer



Source: Saugatuck Technology Inc.

- **Native Cloud Applications are those** Cloud Solutions developed for the Cloud, in the Cloud, using one or more PaaS environments.
- **Ported Cloud Applications** are traditional-style, on-premise application solutions re-engineered to run in the Cloud. These are usually migrated, single-tenant, virtualized applications re-architected to some degree in order to call to the middleware.

SIDE ORDERS: ADMINISTRATION, METERING AND ANALYTICS

Across the layers of the stack, developers And ISVs will want and need critical management abilities. We summarize these on the left and right of our stack model as **Metering and Analysis**, and **Administration**, as follows:

- **Metering & Analysis**. These are the "dashboards" and analysis tools for PaaS usage and pricing. They provide baseline management capabilities for developers and ISVs to meter and match their PaaS usage to their PaaS SLAs and performance guarantees. They also provide an ability to see and track development cost models, but they are not just about pricing and SLAs. These tools are also about app efficiency, i.e., How well or poorly is it working? How are database calls working? Why are database charges so high? Why is it getting hung up in places?
- **Administration**. These are the tools that enable the discipline and governance so critical to making things work efficiently in Cloud development. With low-cost access to top-notch tools and technologies on demand, version control can become a challenge very quickly, as can management of multiple projects in various phases and stages. Key capabilities offered by the PaaS should include at least the following: configuration management/version control system, data dictionary services, and directory services (e.g., LDAP).

A CLOUDY FUTURE IS CLEARLY EMERGING

The world user population is not necessarily moving everything to the Cloud, but all research clearly indicates that users (and IT buyers) are willingly and rapidly expanding their software portfolios to include multiple Cloud applications and solutions. Given current rates of SaaS and Cloud adoption overall, by YE 2014 an average of 50% of new software deployments worldwide will be made in the Cloud. And an increasing percentage of those solutions that are deployed on-premise (whether in-house or in outsourced data centers) will need to be linked to, and optimized for, Cloud-based solutions, data sources, and infrastructure.

With the world so obviously and aggressively moving toward Cloud solutions, the choice of Cloud development platform becomes a critical decision for developers and ISVs. Cloud-based development is thus not a long-term need; it's a short-term reality for almost all internal development groups and ISVs.

At the bottom line, developers and ISVs will want to do two things when it comes to Cloud-based development:

1. Maintain at least the standards and capabilities that they currently have; and
2. Extend, enhance, and improve those standards and capabilities to fully enable and embrace development with, and within, the Cloud.

The model that we have provided above can and should be used as a guide for understanding Cloud development needs, and for thinking about, evaluating, and comparing Cloud development/PaaS providers.

The model is not an exhaustive list of everything that can be made available; nor is it an exhaustive list of everything that every developer or ISV will require.

But the model ***is*** a framework for grouping and visualizing key Cloud development needs and resources that will satisfy the two requirements above, while enabling the core ***flexibility*** that will be so important to establishing developer and ISV credibility and competitive positioning in the emerging Cloud marketplace.

SPONSOR PERSPECTIVE:

Progress Software and Seven Keys to Cloud Development Success

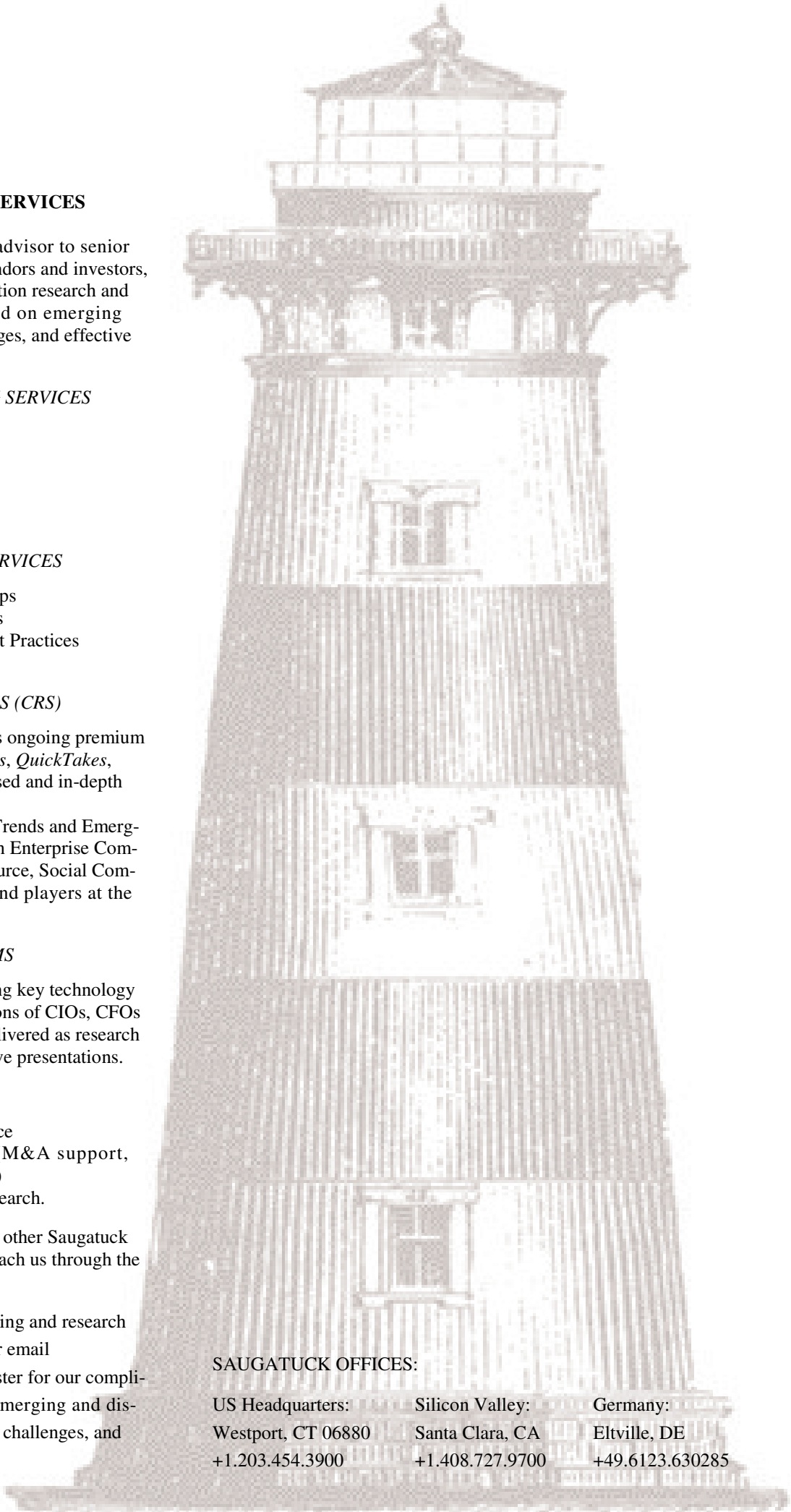
Cloud Computing is driving ISVs to seek ways to develop new solutions and services, but at lower costs and with less management complexity. IT vendors are eager to add new customers and develop applications more quickly, while still providing the stability and robustness that customers demand. Our vision at Progress Software for many years has been about simplifying creation of the world's best business applications.

Progress® OpenEdge® is an integrated platform for the development, deployment, integration and management of SaaS/Cloud-based business applications. OpenEdge's unified environment is comprised of development tools, application servers, application management tools, a relational database, and the capability to easily connect and integrate with other applications and data sources. The OpenEdge development environment has tools that help accelerate every aspect of the cloud development process, including the Industry's first multi-tenant database.

Progress has hundreds of Application Partners that we have worked closely with to not only get their application deployed in the Cloud, but also on the best way to architect an application for the cloud. Based on working with these partners, and lots of discussions we have developed "***The 7 Keys to Success***" - the key areas that developers should consider as primary focus areas from functional, architectural, and operational perspectives for their SaaS/Cloud-based applications.

1. **User Interface Flexibility/Mobility:** The ability to easily use UI technologies that meet the needs of the customer. UIs are as much about flash and sizzle as they are about usability and function—and there are a huge number of UI technologies in the market today, and more coming out all the time. How do you decide which ones to use? Does your application need to support more than one type of UI to meet the needs of different types of users? How do you architect your application to support multiple UIs including the ones that you don't even know about yet?
2. **Productivity:** A tool set and language that is highly productive and is focused and purposed for the type of business application that you are building. Agility and time to market are critical in the cloud computing paradigm, so your tool decision should be more about speed, capability and reputation for flexibility.
3. **Operational Excellence:** Scalability, reliability, availability, business continuity, disaster recovery, hosting choices, etc. When deploying in the cloud it is critical to make sure that the application will RUN and PERFORM. The development/deployment platform must have monitoring tools, business visibility, and service level management.
4. **Security & Compliance:** Security and compliance is all about ensuring that data and applications are accessed only by those with authorized needs and access. Regulatory and other compliance requirements are putting pressure on developers to incorporate more security capabilities. SaaS/Cloud deployment not only presents technical challenges from a security perspective, but introduces a certain amount FUD from customers who need to be assured that their data can't accidently fall into the hands of others.
5. **Multi-tenancy:** Multi-tenancy is all about improving scalability and reducing costs by running multiple customers or tenants on a single application instance in such a way that they each believe that they are executing in isolation. When you consider the infrastructure layer, developer/database layer, and application layer of any application environment, there are many ways of doing multi-tenancy. You may provide more sharing at one level and less sharing at another, so there are degrees of multi-tenancy depending on sharing at each level. What are some of different approaches to multi-tenancy? What benefits does each approach provide? What are some of the ways of implementing each approach?
6. **Integration/Workflow:** The ability to easily integrate to any other application by supporting all relevant standards. As more applications move to the Cloud , a way to extend the value and reach of your application is by ensuring that it integrates with all applications and services. What are the most relevant standards and approaches to doing standards-based integration in the cloud? What are the tradeoffs with each approach?
7. **Personalization and Customization:** Making sure the application looks and behaves as the tenant and the end-user want. Personalization focuses on doing that based on the user experience and past behavior whereas customization is performed by explicit settings. It may involve limiting or directing the information that a user views based on past requests, it may involve setting the skin of a screen for all users of a tenant based on company standards and regulations, etc. What are the types of information that may need to be personalized or customized, and what approaches can be used to manage this information?

The Progress Partner program offers comprehensive empowerment for ISVs, including a SaaS/Cloud Enablement program that assists ISVs as they transition from traditional development and deployment toward a cloud-based services delivery model. For more information visit www.progress.com/partners.



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