

THE SOFTWARE COMPONENT MARKET ON THE INTERNET CURRENT STATUS AND CONDITIONS FOR GROWTH

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Introduction

Component Based Development (CBD) promises a large step forward in the quest for maximizing reuse in software development. Although a variety of definitions of CBD exists, key to CBD is the process of building systems by way of combination and integration of pre-engineered and pre-tested software components. For CBD to be the long awaited breakthrough in software development, the efficient reuse of software components has to be organized by a market system; "*Components develop their full potential only in a component market*" [5]. Organizations may benefit from organizing an internal component market. Software components can then be reused over multiple projects saving valuable resources. However, the most appropriate marketplace to buy and sell components would be the Internet: an international, freely accessible network, which is perfectly suited for offering, promoting and distributing components. A flourishing component market on the Internet would really allow organizations to buy and reuse against low-costs. Developers would only need to focus on functionality specific to the project, and on locating and integrating available components.

Industry watchers have predicted huge growth figures for the software component market. Gartner predicts the component market will grow to \$7 billion in 2001, of which \$2 billion directly comes from component sales [1]. Giga information group predicts an *off-the-shelf* component market of \$3,3 billion in 2001 [6]. Ovum goes further by estimating the size of the software component market to be \$64 billion in 2002 [3].

But does a component market on the Internet already exist, and if so, what is its status? Also, if a component market is so important for CBD to fulfil its promises, what are the conditions for growth towards maturity? Apart from rough estimations of the future size of the market, little research has been done to investigate the current component market and its growth. It is the objective of the research reported on in this paper to gain insight into these questions.

The research described in this article contained two phases: First, an overview of the current status of the component market on the Internet was created. Next, based on this overview and a literature study, conditions for growth of the market were developed. An email-survey was held in which experts were asked to rate these conditions by importance and comment on them. Section two and three describe the results of these research phases respectively.

Overview of the Internet component market

To assess the status of the software component market on the Internet today, an overview of the market was made. The over-

view aimed at including all websites where software components can be found and/or bought. To locate the website a selection of well-known search engines was used, including Yahoo, AltaVista, Lycos, Infoseek, Metacrawler, Excite and Hotbot. The following terms were used as keywords to locate the websites: software component, component, CBD, componentware, ActiveX, JavaBeans and CORBA. The website addresses that resulted from the search queries were visited and the relevant websites were classified into one of the following categories:

- *Producer*: a website of an organization that sells its self-constructed components,
- *Catalogue*: a website of an organization that compiles a list of hyperlinks to components, based at producers' sites; catalogues do not actually sell components,
- *Intermediary*: a website of an organization that sells components built by third parties.

Next, the components found at the websites were described based on their total number, standard, type and documentation. These characteristics will be explained now.

The *total number* is simply the amount of different components sold or referenced to at the website.

The *standard* of a component refers to the technical environment in which a component will function. Since it is expected that open (as opposed to proprietary) standards will be responsible for most of the sales of software components on the Internet, the overview focused on the three major open component standards that exist today: ActiveX, JavaBeans and CORBA [2].

Components can also be classified by their *type*; a taxonomy of six different types (based on [4]) was used here. Controls (1) and containers (2) are both visual components, however a container can supply context (e.g. HTML browser) while a control cannot (e.g. simple editor). There are four non-visual components. A command package (3) interacts with visual objects (e.g. spelling checker), a library (4) is a collection of independent functions or classes, a framework (5) is expandable by plug-ins and, finally, a business component (6) implements domain specific program logic.

Not only standard and type of component are important for making the decision to buy the component; *documentation* can be just as essential. To classify the documentation supplied with the component five different documentation methods are discerned: a simple description (1), technical details (2), demos (3), test reports (4), and component source code (5).

Using the search method and classification schemes described an overview of the component market was compiled. The located

websites were investigated between November 1998 and March 1999. Table 1 shows the results. It is safe to assume that the 38 listed websites represent the vast majority of suppliers on the Internet component market as of spring 1999. It seems unlikely that any of the major online component suppliers did not register their website at any of the search engines used.

From Table 1, the following conclusions can be drawn:

- There are relatively few suppliers on the Internet component market today. Most suppliers offer a limited amount of components, which indicates small-scale production. Furthermore, the few intermediaries on the market supply the vast majority of components available today. The total amount of components offered is limited, the overall size of the market relatively small.
- None of the suppliers offered CORBA components. It can be concluded that the CORBA standard did not yet lead to the development of CORBA compliant components that are suitable for trade on an Internet market.
- Most components can be characterized as controls, containers or command packages in the taxonomy of components. Frameworks and business components are only sporadically offered. The emphasis on the first three types of components can probably be explained by their versatility. Visual and less complex non-visual components can be used by a great variety of users, as opposed to for instance domain specific business components. Moreover these first three types may be easier to develop than more complex components.
- A final observation concerns the documentation of components. Mostly only a limited description and a demo of the component is offered. Test reports are rare and in most cases based on user comments, lacking any 'independent' opinions. Not surprisingly, source code is even harder to come by. Only a few small producers offer this.

3. Conditions for growth of the market

Phase one of the research concluded that the Internet component market is still in its infancy. As mentioned in the introduction, CBD and component markets are expected to grow dramatically. However, as is known in economic theory, the growth of an innovative market is dependent on several conditions. The second phase of our research is concerned with identifying these conditions for growth. Based on the results of the overview in the previous section and on literature thirteen conditions for growth were developed. The conditions were then rated on their importance for growth by an email-survey among international experts. The conditions are now briefly explained after which the results of the survey are presented.

1) The market has to focus on fine-grained components
Fine-grained components can be expected to be cheaper and easier to understand than large-grained components. This removes potential fear with buyers to do large financial transactions on the Internet. Also, the Internet is less suitable for complex negotiations that are normally needed in large transactions. Finally, limited documentation may be necessary for these types of

components.

- 2) Suppliers have to make it easy for their customers to assess the value of a component, by offering extensive information (for example demos, documentation)

This lowers the risk for potential buyers. Using a demo, or even a limited trial version, potential buyers can make sure the component delivers benefits and works properly.

- 3) Components have to be offered against known/published prices (price lists)

In a true market comparable products are offered through different suppliers. The consumer should be able to compare prices and to shop for the best deal.

- 4) Specifications of components have to follow a standard documentation method

As the number of components in a market grows, it becomes increasingly complex to locate the right component, understand its working, and integrate it into a software system. When insufficient documentation is provided, search costs become a serious barrier. Also, when a huge variety of documentation methods is used, searching components and assessing their use remains problematic. Therefore, interfaces and working of components on the market need to be documented using a standard method.

- 5) The market has to focus on black-box reuse

The intellectual property rights of component suppliers are better protected when source code is not delivered with the component. Also, black box reuse assures that the true principles of CBD are followed, as adapting the internals of the component is prohibited.

- 6) There has to be a generally usable solution for the protection of intellectual property

Effective means are needed to protect producers of components against illegal copying and reselling. Also, reselling after slight adaptation should be prevented. Without such protection, producers are not likely to sell valuable components over the Internet.

- 7) There has to be a (supplier) independent Internet search engine for components

In our effort to localize component shops on the Internet, and to classify existing components within these shops, we learned that finding components on the web is still a cumbersome effort. It would benefit potential buyers if a specialized component search-engine existed. Such a search engine should be independent of component suppliers, and locate and compare components using the various websites of producers, intermediaries and catalogues. Other electronic markets have seen similar developments, e.g. the market for compact discs.

- 8) Components have to be offered mainly by intermediaries

A few large intermediaries would simplify the search for components. Also, potential buyers would more easily buy a component at a large and trusted intermediary than at a small producer website. Producers will benefit as well from such large intermediaries. They can more effectively reach their consumers and offer advertising and promotional activities through a limited number of channels.

Website	Market P= Producer I=Intermediary C=Catalog	Standard A=ActiveX B=JavaBean C=CORBA	Component Type						Nr.	Documentation				
			1.controls 2.containers 3.command package 4.library 5.framework 6.business component							1.simple description 2.technical details 3.demos 4. test reports 5. source code				
			1	2	3	4	5	6		1	2	3	4	5
www.active-x.com	C	A	x	x	x	x		180						x
beans.cuesta.com	C	B	x	x	x	x	x	308						
browserwatch.internet.com	C	A	x	x	x			150						
www.findcomponents.com	C	A,B	x	x	x	x		329	x					
www.iversonsoftware.com	C	A	x	x				40						
Www.javashareware.com	C	B	x	x	x			30						
Java.wiwi.uni-frankfurt.de	C,I	B	x	x	x	x	x	1326	x	x			x	
www.beyond.com	I	B		x	x			<10	x					
www.buydirect.com	I	A,B	x	x	x	x		60	x					
www.componentsource.com	I	A,B	x	x	x	x	x	1200	x	x	x	x		
www.flashline.com	I	A,B	x	x	x	x		101	x		x	x		
www.apexsc.com	P	A		x	x			<25	x		x			
www.artisoft.com	P	A	x	x	x			<10	x		x			
www.baysidecomputing.com	P	B	x	x				<10	x		x			
www.brattberg.se	P	A,B			x	x		<25	x	x	x			x
www.cereus7.com	P	B	x	x	x			<10	x	x	x			
crescent.progress.com	P	A		x	x	x		<25	x	x	x			
www.dameware.com	P	A	x	x	x	x		<10	x		x			
www.data-tech.com	P	A		x	x	x		<10	x	x			x	
www.dbi-tech.com	P	A		x	x			<10	x		x			
www.dharbor.com	P	B		x				<10	x		x			
www.dolphinsys.com	P	A	x	x	x		x	<10	x		x			x
www.fpoint.com	P	A	x	x	x			<10	x	x	x			
www.framework-dcl.com	P	A					x	<10	x	x	x			
www.green-tree.com	P	A	x	x				<25	x	x	x			x
idealeng.com	P	A	x	x	x	x		<10	x		x			
www.intervista.com	P	A		x				<10	x	x	x			
Www.jcomsoft.com	P	A	x	x				<25						
www.klg.com	P	A,B	x	x				<10	x	x	x			x
www.ncompasslabs.com	P	A					x	<10	x	x	x			
www.neurondata.com	P	B		x	x	x	x	<10	x		x			
www.protoview.com	P	A,B	x	x				<10	x	x	x		x	
www.roguewave.com	P	B	x					<25	x	x	x			
www.softoholic.bc.ca	P	A	x	x				<10	x	x	x			x
www.stingray.com	P	A	x	x				<25	x					
www.tidestone.com	P	A,B	x	x				<10	x		x			
www.vocaro.com	P	B	x	x				<10	x		x			
www.wintertree- software.com	P	B			x			<10	x	x	x			x

Table 1: Results of the overview of the Internet component market, March 1999

9) Intermediaries have to add a quality rating to each component they offer

Intermediaries can add value through testing and rating the components they offer. When large intermediaries emerge that provide trusted quality ratings, independent of the producers, the buyer's search for high quality components will be simplified.

10) Intermediaries have to supply technical support
When consumers are using components of multiple suppliers,

obtaining technical support can become a hassle. The intermediary can add value by providing a helpdesk and technical support for all components its sells. It so becomes the main contact point for a customer.

11) Intermediaries have to set up standard criteria for the comparison of components
Comparable to a general quality rating, intermediaries can provide assistance to potential buyers by objectively specifying the

Conditions	Rating	SD
1 Suppliers have to make it easy for their customers to assess the value of a component, by offering extensive information (for example demos, documentation)	8,8	1,3
2 Specifications of components have to follow a standard documentation method	7,6	2,3
3 The market has to focus on black-box reuse	7,4	2,6
4 There has to be a generally usable solution for the protection of intellectual property	6,8	2,6
5 Suppliers have to focus on specialization, advertising, brand name and image	6,0	2,7
6 Components have to be offered against known/published prices (price lists)	5,9	2,2
7 There has to be a (supplier) independent Internet search engine for components	5,6	2,8
8 Intermediaries have to set up standard criteria for the comparison of components	5,4	3,1
9 Intermediaries have to add a quality rating to each component they offer	5,3	3,2
10 Intermediaries have to supply technical support	5,1	3,3
11 Components have to be offered mainly by intermediaries	4,6	3,1
12 The market has to focus on fine-grained components	4,6	2,6
13 The standardization battle needs to be decided soon in favor of one object model	3,6	3,0

Table 2. Average rating of conditions for market growth (n=36)

various properties of components (performance, platform, etc.).

12) Suppliers have to focus on specialization, advertising, brand name and image

As the component market grows, many small suppliers will enter the market, offering components of varying usability and quality. Customers may be scared away from such a chaotic market. By establishing a strong brand name and image, and possibly by specializing on a niche market within the component arena, strong providers can continue to attract customers.

13) The standardization battle needs to be decided soon in favor of one object model

Suppliers need to choose in favor of one object model or invest additional effort to build multiple versions of their components. Also customers can be uncertain which component standard to invest in. This uncertainty delays the growth of the market.

During May 1999, an email survey was held among international experts in the field of CBD to rate each of these thirteen conditions on a 0-10 scale ('very unimportant for market growth' to 'very important for market growth'). They were also asked to motivate their rating. The experts were selected based on their involvement with the component market, either in a practical or scientific way. Naturally, all suppliers from the market overview of the previous section were included in the survey. In addition, practitioners and scientists were selected based on their publications in various conferences concerning CBD, like the WCOP (Workshop on Component Oriented Programming), ICSR (International Conference on Software Reuse) and WISR (Workshop on Institutionalizing Software Reuse). The survey was sent to hundred-three experts. Thirty-five experts responded to the questionnaire, resulting in a response rate of 35%. The response consisted of 25% component suppliers, 44% scientists and 31% practitioners. The respondents came from various regions: North America (39%), Europe (56%) and Asia and Australia (5%). The results of the survey are depicted in Table 2, where the conditions are ranked by their average rating.

There is more consensus on the importance of the top seven conditions (standard deviation <3) than on the conditions ranked lower. The results show an interesting overall conclusion: it is considered to be more important *how* components are offered, than *who* offers them. The top three conditions are concerned with documentation and information on the component for sale. The role off intermediaries is viewed of limited importance only (ranked eleven). The respondents strongly disagree with the often heard comments that only fine

grained components and a market with a single standard will succeed. Respondents feel that specialization and strong brand names are of high importance. It was commented that specialization by suppliers into domains is needed to provide non-visual components such as business components for specific domains.

Conclusion

The Internet component market is still in its infancy. The number of producers that sell the currently leading component standards (ActiveX and JavaBeans) over the Internet should be counted in dozens rather than hundreds. This research found that experts worldwide agree that the shape in which components are offered on the internet is an important condition for market growth. Components should be more than an independent piece of software. Extensive documentation following standard methods, demos, and a clear focus on black-box reuse are all regarded very important. The software component market needs valuable and easy to integrate components to grow as dramatically as often predicted. In addition, a number of both technical and market conditions need to be met before the market reaches maturity.

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