Above All : The Cloud
Knowledge Management Beyond Desktops!
By Ben Thum ben@siacad.com

Synopsis : This paper chronicles part of the journey taken by an IT company formed by the Singapore Institute of Architects in providing and supporting its members with cutting edge technologies. There have been hits and some misses but what is really crucial is the thinking / decision making processes involved and the courage to jump straight into new technologies, reinvent, repackage them and collaborate with the profession in the discovery, experimentation and exploration of new frontiers. In line with the theme of this conference, the focus will be on “Future”, “BIM” and “Cloud”.

1. Prologue
In late 2000, the Singapore Institute Of Architects decided to form a commercial company to assist their members with their IT needs. The reasons for this were obvious. IT tools, skills and knowledge are crucial for productivity and effectiveness. It forms a major cost of running any firm. Back then we were just recovering from the Asian Financial and one of the goals is for “cost-effective” IT solutions. To do so, we have to develop our own solutions or seek out alternative solutions... away from the tried, tested, and tired mainstream solutions.

We called the company “SIACAD” as back then CAD was still (perhaps still is now) the most sought after tool for architects. To remind us of our mission, goals and directions, we coined the slogan “Reinventing The Profession!”. Actually, this was based on the book “Reinventing Work” by Tom Peters.

We were also heavily influenced by Tom's 1994 book “The Pursuit Of Wow”. Both these slogans have been the guiding light for all our software development, training and support activities.

Almost immediately after the formation of the company, we developed and released a CAD add-on called “SIACAD” for AutoCAD, FastCAD, IntelliCAD, VectorWorks and MicroStation. This add-on enables CAD users to easily produce drawings that were CP83 compliant – critical for e-Submission in Singapore. Most of the projects done by practitioners in Singapore made use of our SIACAD add-on. In fact, it's still being used by many firms today.

2. Welcome To The Future
Our SIACAD add-on “added” some extra intelligence into the normal 2D CAD drawing. It automatically organised “layers” and “symbols”. In fact, it made the 2D CAD drawing so well-organised that in 2004, when BCA made “Buildability Score Assessment” mandatory, we simply wrote an extension called “eBDAS” and it was able to do all the complex buildability score computations. In fact, we took that to the limit and even included a bill of quantities feature.
We realised back in 2001 that 2D CAD has its limitations. We began to explore BIM. At that time, ArchiCAD from Graphisoft was practically the main solution. Until we chanced upon a small Massachusetts-based company which was developing a “parametric building modeler” specifically designed for the AEC industry. It was called "Revit".

Perhaps the most unique feature of Revit (at that time) was “parametric / links”. You make a change somewhere in your model, it automatically checks the “collisions / validity” and makes the necessary updates. We downloaded the evaluation and communicated with the developers. I am not sure if the term “BIM” (Building Information Model) has been used prior to that but it was certainly a term that was introduced to us by Revit.

In late 2001, a team from Revit Technologies visited us and offered to be a distributor.. perhaps the first in Asia. Besides “parametric linkages”, Revit was not a software that you “bought”. There is no upfront investments. You pay as you use. It was like USD100 per user per month. We knew that this was the “future” that we were looking for.

We got a group of architects excited about “BIM” and developed a hands-on training program to get them up and going within 2 days. Surprisingly, most of the early adopters were bosses / principals of their own firms. Perhaps back then BIM wasn't as sophisticated (complex?) as it is now. To add more “WOW” to the program, we developed our own object libraries and even wrote an add-on that enabled such object libraries to be easily searched and automatically inserted into the BIM model. It was a big deal then. Revit didn't have “API's” (Application Programming Interface). In other words, it couldn't be controlled outside of Revit. But we did it. It created a lot of buzz around.

Just when we thought we had the future sorted out, AutoDesk bought up Revit Technologies for USD133 million. It was a shock to the industry. At first, we thought it was just a joke as the announcement was made on 1st April 2002. AutoDesk had different ideas on how Revit should be distributed. The first thing they did was to remove the “pay-as-you-use” business model. We didn’t want to be part of that and we reckoned that it will take a few years for the dust to settle. We said back then that we will wait it out.. for Revit to come back to us.

To replace the loss of Revit, we brought in “SketchUp”. It's not BIM but it's 3D and is very easy to use for Design and Communication. People laughed at us and said that it was a “toy”. Today, SketchUp is the most commonly-used 3D solution and we are one of the biggest distributor / training centre in ASIA. Now, it also has parametric features and an excellent API.

Jumping into the “future” prematurely with Revit was a painful lesson. But there are some lessons that we picked up that enabled us to embark on our next / biggest software development project.

### 3. Knowledge Management

In 2001, Architects 61 came to us and wanted us to write a “Time-Sheet” reporting program. The reasons were obvious. They wanted a better / faster way to record time-sheets and generate reports. Back then this process was almost certainly a manual process or with a bit of Excel thrown in. Another medium-sized firm Liu & Wo followed by AWP wanted the same solution.
We did extensive research on Time-Sheet solutions and basically, they just do one thing: time-sheets. It's purely collecting of information and crunching of information. We see this as being something boring and time-consuming. Besides, nobody we know liked to fill in time-sheets. We wanted to add the “WOW” into this boring process called “Time-Sheets”.

Time-Sheets and most of what a design practice does is shuffling of bits and pieces of “information”. That’s a lot of information. We sat down and jotted down the kinds of information that an average “knowledge worker” is bombarded with daily.

A lot of these bits of information although seemingly unique are indeed inter-related.

Next, we looked at the relationships between different bits of information and tried to find the common links. We reckoned that if we could linked information together instead of repeating them, we will generate less redundant information and hence arrive at a more efficient database.

Instead of filling up time-sheets, what if the user fills in an Event in the Calendar. This event is linked to the Project involved and automatically fills up the time-sheet. What if 3 other guys go with this user for the same event? It will fill up the time-sheets for all 4 and also automatically send them a message regarding this event. In addition, there will be Auto-reminders, pre-filling of transportation claims etc.

In short, the information is “parametrically linked”.

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We actually toyed with the notion of “parametrically linked” information way before we dabbled with Revit. But the brief encounter with Revit reinforced this approach. In fact, we generate so much (redundant) information daily that we are always overwhelmed. In fact, it’s not even useful information but bits of unrelated data. It's only when Information (or data?) is linked together that we can arrive at what is known as knowledge.

Based on this “parametrically-linked” approach, we developed the other relevant modules like Leave, Projects, Claims, Email, File Exchange, Contacts, Project Reports etc. For the first time, there is now a one-point solution to keeping you on top of all these otherwise unrelated bits of information.

We call this solution APEX and the slogan is “Keeping You On Top”!

APEX is a web-based client-server solution. The entire program runs on a web server and users connect and use APEX via an web browser on their desktop. Nothing else needs to be installed on the desktop. Back in 2001-2002, internet access was slow and expensive. Hence APEX was run in-house on an “intranet” web-server. There is indeed a cost involved in setting up and maintaining an in-house server. Basically only medium-sized and large firms can afford to have such a setup.

In 2003, the SARS epidemic swept through most of ASIA. Singapore was badly hit. It was not just locally but many firms have already gone regional and they were barred from getting in/out of the country. We had to relook at the internet and run APEX fully on-line. By 2004, the internet speeds were fast enough with the availability of 128KB Broadband. That was a far cry from today’s commonly available 25MB Broadband. Nevertheless, we decided to take the plunge.

We started re-developing APEX to run completely on the Internet in 2004 but it was only in 2007, with APEX 6.0, that we managed to migrate most of our users entirely to the Internet. What is even more important is that with the Internet version, we changed our business model to a pay-as-you-use monthly subscription system. This is flexible and enabled firms to manage their costs more effectively.

APEX 6.0 took us 2 years to develop. We had to develop technologies that enables the interface from the browser to the server seamlessly and fast. More important still was the availability of mobile devices, in particular the iPhone. Earlier versions of APEX already supported mobile devices like Windows CE, Symbian and even Palm. But iPhone with it's new interface made it imperative for us to relook at interfaces on small graphical screens.
It took us another 2 years with the release of APEX 8.0 before we succeeded in developing all the technologies to have almost real-time experience on your browser although APEX is internet-based. As usual, we coined a slogan to best describe this experience “It’s Alive!”

Because APEX 8.0 “is alive!” it prepared our users for the quantum leap into the next level of progress - “The Cloud!”.

4. The Cloud

The “Cloud” is a fancy name for the internet. The name comes from the use of a cloud-shaped symbol as an abstraction for the complex infrastructure it contains in system diagrams. Cloud computing entrusts remote services with a user's data, software and computation.

APEX has been on the “Cloud” since we moved to the Internet. The only difference is that we supplied and maintained all the web servers. We had to pay a local data centre for “rack-space” and hosting. While it was relatively stable, there were some instances of downtime.

We already knew about the “Cloud Service Providers” like Amazon, Microsoft etc. But ironically, it was during the AutoDesk Developer Days 2010 that we realised how important the cloud will be. Why on earth was AutoDesk stressing so much on the cloud when their CAD / BIM applications are generally desktop-based? More on this in the next 2 chapters...

It took us most of 2011 to evaluate, test and use different cloud service providers. We finally narrowed down to Amazon Web Services. The reasons were obvious. They are the pioneers in this field and have their Asian HQ and data centres right in Singapore. They are more pricey than others but they guarantee uptime of supposedly 99.999999999999999% (that's 15 decimal places!)

To fully exploit the “real” cloud, we decided to rewrite the “core-engine” of APEX. We also decided to rewrite most of our browser-end to make use of HTML5. A quick search on google will return lots of matches why HTML 5 is not ready for prime time. What the heck? Let's give HTML5 a go! It's not that we have not failed before. But what if we succeed?

We released APEX 10.0 on 10/10/2011 10:10 and retired all our 22 web-servers from the data centre within 2 months. As usual we needed a slogan to best depict this drastic move - “All Systems Go!”
It costs us almost 4x more to run APEX on the Amazon cloud but we are confident that we will benefit in the future, i.e. we don't have to worry about hardware upgrades anymore. Also, we can easily “scale” up or down the amount of disk space or cpu speed as required. Our users also experience at least 4x improvement in speed. More important of all, it freed us from having to worry about hardware and networks. And we have more time to devote to software development.

APEX II.O was launched on 11/11/2012 11:11. Because we have more time to focus on software development, we added many new functionalities and improved many of the existing. It is indeed the version with the most improvements and practically covers everything that has been wished by the users. Hence, the slogan for this version is “Everything Under The Sun!”

Embarking on the cloud isn't just for APEX development. We also made use of this for our BIM development.

5. Back To The Future

After we left Revit, AutoDesk promoted it aggressively. The Building Construction Authority of Singapore also gave incentives for firms to migrate to BIM. The emphasis was on e-Submission and the first stage of this submission is for Buildability Scores. There was no automated solution for this in BIM. Users actually exported their BIM model into 2D DWG and used our 2D eBDAS solution to do the computation. Not only was it slow but prone to inaccuracies.

On 10/8/2010, AutoDesk signed an MOU with SIA to promote better Revit usage amongst SIA members. One of the additional requirements of that MOU is that SIACAD should join as an AutoDesk Developer Network member. They wanted us to develop add-ons for BIM. What a sense of Deja-Vu!

We joined ADN and attended our first Developer Days 2010 on 9/11/2010 and were briefed on the future development of BIM. What was really amazing was the emphasis on the “Cloud” for AutoCAD and BIM!

We started working on the development of a BIM version of Buildability Scores on 19/04/2011. Surprisingly, we completed the core programming on 25/04/2011 - a mere 6 days later. Why was this even possible? The short answer to that is BIM itself – it contains all the information regarding the building in the right places. All we needed to do is to write a way to extract and organise the information. It is simply not possible that easily using 2D CAD.

The solution eBDAS BIM was beta-tested by BCA, RDCA, HDB and several other firms. Since its release in 25th July 2011, eBDAS BIM is perhaps the most sought after add-on for BIM. As usual, we also needed a slogan to best describe what it does. Since it literally counts the walls, doors, windows, floors and columns, it's simply “You Can Count On It!”

We were in the midst of redeveloping
APEX to be fully cloud-based and it was natural for us to explore some cloud-based features for this BIM Buildability Score project. Since we were not sure what the user reaction may be towards the cloud, we played it safe by using cloud-technologies for licensing, help and support.

The cloud-based licensing control for eBDAS BIM is indeed refreshing. Companies with, say, 100 users all over the region can install our eBDAS BIM solution in all their computers. They do not need to purchase licenses for all 100 machines. Instead, they can purchase only 3 licenses and our cloud-based licensing system will manage it such that at any one moment in time only 3 concurrent users can use the software regardless of where they may be geographically.

With the success gained by developing a full-featured add-on for BIM/Revit, we have received requests to develop other solutions like “Constructibility”, “Green Mark”, “Optimise Concrete Design”. All these requests centre around some act of “counting” and suddenly, after a hiatus of 10 years, we are again the new kids on the block whom they can “count on”.

6. The Near Future

The really cool part of being an ADN member, besides having access to all the beta software, documentation and developer support, is the annual ‘AutoDesk Developer Days’. This is where and when developers from the region get together for a day to learn new technologies and basically exchange ideas. This year, it was held on 14th November in Singapore. This is indeed a big deal as we get the inside scoop of what’s in store for the near, very near future. After Melbourne, Singapore is the 2nd city for this roadshow, way ahead of USA, Europe and the rest of Asia.

I had expected a big turnout as in the past 2 years but this time, there were only 5 of us there – 2 from Thailand, 2 from Malaysia. Perhaps it was due to the Deepavali Holidays the day before but boy, what an awesome insider’s only conference they all missed out on! OK, there seemed to be only one singular message but it was loud and clear – everything will go to the cloud very soon whether it’s AutoCAD, GIS or BIM.
Autodesk® BIM 360, the next generation of Building Information Modeling (BIM), is for anyone, anywhere, at any time. Building, infrastructure, design, and construction professionals can access intelligent, model-based workflows through a broad range of cloud-based services within the Autodesk® 360 cloud-based platform that provide mobility, accessibility, and virtually infinite computing power.

This isn't even news. BIM 360 was released 6 months ago. Now, Autodesk is releasing the APIs, Development Toolkit to any developer who wants to join in the excitement. Supporting up to 50 design file formats and also desktop, android and IOS platforms, it will revolutionise the way we use BIM.

Graphisoft is also moving parts of their BIM to the cloud. With the recent release of ArchiCAD 16, they have cloud-enabled the BIM Components search and usage functionalities. There is also an upgraded BIM Server, Cloud-integrated model sharing service for BIMx users. The direction is clear. BIM will be cloud-based very soon.

Besides BIM, your sundry list type applications like Word, Excel, PowerPoint etc are already cloud-based. You can now subscribe with Microsoft 365 and work on the cloud.
For those who want to venture into cloud-based solutions but do not want to commit with any investments or subscriptions, just check out the granddaddy of cloud-based solutions – **Google Apps**. In fact, you are probably already using some of these cloud-based apps individually. For a firm and an enterprise, it's best to use the entire suite in a collaborative setup with all your staff members. Depending how to set this up, you either pay very little or nothing to move to the cloud. But do be forewarned that these are generic applications and are not in anyway project-centric like **APEX**. But it's a great start, if you still haven't yet.

7. The Battles Ahead

I may have inadvertently painted an overly glossy picture of BIM, Knowledge Management and the Cloud. Implementing any of these isn't just a walk in the park. There is indeed a “scary movie” version. In fact, very often we hear of “uphill battles”. There are basically 2 battles that will be fought, not physically but in the minds.

The first battle is internal. Many staff members especially CAD users and “knowledge managers” are too accustomed to the comfort zone provided by existing solutions or workflows. Few people like any kind of change and BIM, especially, is a drastic change. Even those who succeeded in moving completely to BIM had to deal with this battle. What we have realised is that top management must be fully involved with this change. They cannot sit back and leave it to their “IT Manager”. Whether you like it or not, the typical IT Manager has little or no knowledge or experience in BIM. Or the Cloud. He will simply see it from the IT angle. But BIM is a process, it’s a new workflow which only top management can have a helicopter view of the direction and intended results. Top management, aka the generals, have to make vital decisions. I can still remember vividly how SIA immediate past president Ashvin telling me how **Architects 61** migrated from drafting to CAD. Top management gave a presentation to all the staff highlighting the advantages of CAD and why that is the direction they are heading for. At the end of the presentation, the big boss simply said something to this effect “.. anyone who feels this is not the direction we should go, please come to my office after this and I will accept your resignations.”. Sounds like another urban legend but there must a reason why Architects 61 is always ahead in IT adoption for BIM and also **APEX**.

The same battle will be fought when you try to implement a new cloud-based knowledge management system. You will encounter staff, especially older ones, who will insist that the “tried-and-tested-good-old-ways” are better. Many cannot understand why there is a need for change and that “change is the only constant” especially in today’s context.

The second battle will be fought outside your office. BIM, in particular, is a paradigm shift in technology, workflow and processes. In any such paradigm shifts, there will be winners and losers. The traditional “pecking order” in the Construction Industry is that the Architect is the “leader”, followed by the engineers, consultants then the contractors. With BIM, some of the current processes will be made redundant. Some processes may be completely automated as part of the BIM workflow. For instance, bills of quantities and specifications. These can already be done either in BIM directly or using add-ons. So what is the position of the Quantity Surveyor when this gets even more efficient?

Not all consultants, including Architects, are fast in adapting to new technologies. They have valid reasons for this. Architects have probably invested heavily in CAD while Engineers in expensive structural analysis programs. Many cannot stand the pain of dropping what they have now for something new / integrated like BIM. Contractors, on the other hand, invested very little in CAD or
other IT productivity tools. It’s not surprising that they are now bypassing the evolutionary step into CAD and hyper-jumping straight into BIM. They can see immediate benefits of using BIM for “collision detection” or taking quantities or cost estimation. With the 4D add-ons, they can use BIM for on-site project management. The take up of BIM by contractors in Singapore is anything short of phenomenal. Dollar for dollar, Contractors in Singapore are spending more on BIM than Architects or Engineers. They are also paying top dollar to employ experienced BIM operators.

The realignment of “pecking order” has already taken place in many countries which have adopted BIM. The “uphill battle” has started whether you are aware or not. Perhaps the only recourse is learn how to fight such a battle. The classic management approach is to seek wisdom from “Sun Tzu’s Art Of War”. Personally, I prefer “Marketing Warfare” by Ries and Trout. Actually, the premise behind “Marketing Warfare” isn’t exactly “warfare” but “positioning”. Logically, if you can “position” your company effectively in this current “constant-change-massive-paradigm-shifts” environment, you will be able to best make use of the situation at hand.

There is another way around this situation – collaborate, join forces. This is particularly effective if you are a group of smaller firms. This has already happened in several firms in Singapore. Different consultants, sometimes even with the contractors, form join-ventures or consortiums to implement BIM. It makes perfect sense as everyone in this setup will be using the same BIM model, sharing costs.

There is a third battle that will be fought. But consultants / users will not be “fighting”. It’s between BIM software / cloud service providers. They all know that with any paradigm shift, there will be winners and losers. Remember Lotus 123? That was the spreadsheet solution on DOS. With the technological shift to Windows, Excel has taken over. And basically there will be only one game in town. These sw corporations will want to have technological superiority over their competitor and be the only game in town. Well, as a software user you can expect to get better products, services and pricing when this battle is raged. But you must also be wise to bet on the winning horse. Imagine if you betted on Lotus 123 when Windows was taking over from DOS. But of course, after the dust settles, there will be other players e.g. OpenOffice. The same happened with Browser Wars. Internet Explorer fought with Netscape. Netscape is gone, IE is there but there is now FireFox, Chrome, Safari.. all of them free of charge.

8. Hope
Of course, it’s not all doom and gloom. Governments are fully aware of the benefits of BIM and the Cloud. They are also aware of the amount of money the construction industry contributes to the annual GDP. Many governments starting with USA, South Korea, Singapore and now PRC are all taking proactive steps to move the industry into the right direction. Some are just making it compulsory for all Government projects to be done in BIM. Some are giving cash incentives outright. Some do both – like in Singapore. But of course, there are fine prints and footnotes of what is expected of those who receive these incentives.
BCA Singapore has rolled out a series of cash incentives called the BIM Fund. Originally, the take up rate was slow. Now that the fund is running low, firms are rushing to get the last bites of the cake. On the whole, those who have taken advantage of this BIM Fund acknowledge that it has helped them make strategic decisions and reduce the direct cost of implementation. More important still is that they are required to do at least one project in BIM in collaboration with another consultant. The collaboration project has indeed elevated even some of the smallest firms into BIM readiness.

Besides incentives for BIM, the Infocomm Development Authority of Singapore is actively promoting Cloud adoption:

“IDA’s cloud vision is to sharpen the overall economic competitiveness of Singapore through catalysing demand and adoption in key industry verticals, as well as driving the creation of new products to address business needs, and developing manpower capabilities....”

Some of our APEX users have indeed benefited from tax breaks and other cash incentives for using our cloud-based services. Unfortunately, SIACAD Pte Ltd is not eligible for any of these development grants as we completed and commercialised our cloud-based implementation in 2011 and this grant is for projects starting in mid-2012. So much for being forward looking and pro-active.

Besides the government, the professional bodies have a big role to play. The Singapore Institute Of Architects have played a very active role in technology adoption. The Institute Of Engineers Singapore now is also very active.

But the most active institution is perhaps the Royal Institute Of British Architects. Just check out their “National BIM Library”. We have been in contact with them and they have stressed that they want to collaborate with institutions in different countries. In fact, they claim institutions from 4 different countries are already in talks with them on collaboration. Perhaps this is a direction that the RISM and other institutions can consider to leap frog ahead in BIM implementation.
9. RoadMaps

We all love roadmaps to guide us along, especially when it comes to BIM. BCA Singapore together with all the various professional bodies have spent a lot of time producing the “Singapore BIM Guide”\(^{36}\). I am also a member of that team and also the “BIM Steering Committee”\(^{37}\) headed by BCA.

This Singapore BIM Guide is perhaps the most comprehensive guide in this region. It covers everything from “BIM Execution Plan” to “BIM Modeling Guidelines”. I Besides Singapore, USA\(^{39}\) and Australia\(^{40}\) have their BIM guides, roadmaps available on-line:

As with any guides, even if done locally, you have to adapt it to your firm and way of practice. In fact, roadmaps and guides may become irrelevant because of the changes in technologies. For instance, I did a search for “cloud” in the Singapore BIM Guide and it returned no matches. The reason for this is obvious. When the draft was started in March 2012, BIM + Cloud is not commonly uttered together in a sentence. Eventually, you have to rely on your gut instincts and ability to understand trends to decide on which direction or “roadmap” to take.

10. Epilogue

I hope this has given some valuable insights into BIM, Knowledge Management and Cloud Implementation. I believe I have given you some real-life accounts of the journey, the failures, the successes and the exciting dreams that will soon be reality in the very near future. Speaking of the near future, at the recent “Developer Days 2012”, many new concepts and plans were presented. Many will come to fruition, some may never will. More “solid” information will be available within the “next 2 weeks”.. or the near future. Everything is still in constant flux. What an exciting future we have just ahead!

Besides BIM, Amazon has organised the “..first global customer and partner conference”.. on 28-29 November. Aptly themed “Invent”\(^{41}\), there will indeed be exciting new technologies and directions. Even more exciting is that you don’t have to be physically in Las Vegas to acquire this knowledge. You can sign up for the “Live Stream Keynotes” or access the presentations from the cloud.

I wrote this entire paper on the morning of 19\(^{th}\) November 2012. By the time I actually present on the 26\(^{th}\), there will be would have been new knowledge, directions and concepts. I hope to be able to share such “up-to-minute” knowledge with you. Actually, there can be no simple conclusion to this. Like the “Energizer Bunny”, this will keep going, going and going... even after this conference.

Thank you for giving me the opportunity to share my thoughts with you. I am confident we have an exciting future. And the future is NOW!
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“National BIM Library” : http://www.nationalbimlibrary.com/

The Singapore BIM Guide is no longer available for download. However if you do a google searcb, you may find a cached version floating around somewhere for download.

“BIM Steering Committee” : http://bimsg.wordpress.com/2012/02/01/about-singapore-bim-steering-committee/


“Amazon - Invent” : https://reinvent.awsevents.com/livestream.html