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VIRTUAL CONSTRUCTION MARKET

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Abstract

Currently use of information technology (IT) in construction industry is limited to the micro level; many construction companies have developed their own enterprise resource planning (ERP) systems and have built additional features on their websites to facilitate their intra-organizational communications. But, a tool which connects network of various contributors in the construction market is still missing. For example, although most construction companies own large number of equipment items, new construction projects and methods might necessitate new types of equipment and make some others redundant. Equipment items could be left untouched on some construction sites while some construction companies in the same region are in need for them; a tool which can connect the two is missing. Similar matters caused by a disrupted information flow within construction market can be seen in other aspects such as introduction of new projects, holding training courses and hosting professional events. In this research we introduce virtual construction market (VCM) to address the issue. VCM is a web based portal which assists communications among different contributors in the construction market. It facilitates direct owner to end-user communications in different aspects of the construction market and eliminates need of middle-men in many cases. Reduced cost and increased efficiency are the expected outcomes.

Keywords: information technology, construction industry, Virtual Consept, VCM features

Introduction:

During recent decade many construction companies have invested in their information technology (IT) infrastructure to be competitive and improve their intra-organizational management systems. Currently IT departments are well established departments within many construction companies, developing and/ or maintaining companies' IT infrastructure. Popular commercial project planning and control programs such as M.S. Project or Primavera P6 are offering their client - server based or web-based packages which

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their installation and operation require properly developed and maintained IT infrastructure. Many construction companies have their own email servers to manage their organizational correspondence more properly. Companywide ERP systems, which facilitate intra- organizational communications between different departments (e.g., engineering, procurement, construction, accounting, etc.) working within main office and construction sites, are now inseparable part of construction companies. Undoubtedly use of IT in construction companies has had its positive impact on construction projects and construction company's performance.(Zhai et al. 2009).Construction companies are now destined either to adapt themselves to the new business rules or to be kicked out of the business. But, this is just the beginning of the road when it comes to the IT potentials for the construction industry!

At a macro level view, construction industry constitutes of a complex network of main and subconstructors working for construction project owners. There are also other contributors to the construction industry whose main proficiencies are not necessarily construction, but they provide services to or receive services from the construction industry. Government, manufacturing companies, transportation companies, training institutes, real estates, and health industry are some examples. These contributors form a complex network of communications toward completion of construction projects within the construction market! Here again IT has potentials to play a significant role for improving the construction industry by facilitating the flow of information among different contributors in the market. Past experiences in other industries, such as tourism, book and publishing, and retail, have created tremendous impacts. In these industries many physical and actual locations are vanished and moved to the virtual web locations; new virtual markets have been created!

For example, one of the most affected industries is the tourism industry. Not so long while ago we used to purchase our flight tickets by directly referring to travel agency offices in the cities and book hotels by directly referring to their locations, getting in touch with their agents or making phone calls. Arrangements for visiting attraction areas and leisure activities were also made at the destination. All of these are now available by easily surfing the web! More options, higher qualities, more comprehensive information and reduced prices are some benefits travellers enjoy today; more clients, shorter supply chains and higher revenues are outcomes for tourism service providers! Similar enhancements in other markets are also seen after replacing many physical locations with new virtual places and features on the web. The main question here is whether it is feasible to create a VCM to improve the construction industry? Where are the potential virtual places and features which bring added value to the construction market?

In this practical research we have dug into the mentioned questions and investigated possible solutions. First, main contributors to the construction market and the way they communicate to each other have been explored. Possible virtual places and new features to be offered via the web have been discussed at the next step. Then, as a pilot experience, a web portal which could provide discussed features to different construction contributors has been created. At the current stage of the research the web portal targets construction contributors within the Canada. As per our future plan, we are going to expand the portal services to other countries as well.

CONSTRUCTION MARKET CONTRIBUTORS

Figure 1 presents our main perspective about communications between different construction market contributors. Among different contributors in the construction market, constructors are the ones literally do

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the construction work; most communications during completion of construction projects are made directly with constructors. As a result, we consider constructors as middle men who receive resources required for completion of construction projects from different contributors to be able to complete construction projects. In addition to the constructors, there are 9 other construction market contributors presented in Figure 1. Before bringing a brief explanation on the way that each contributor contributes to the construction market, it should be mentioned that neither the list of contributors presented in Figure 1 nor the way that their communication to each other is presented is not meant to be comprehensive. The figure is presented here to demonstrate the variety of contributors in the construction market and to sketch an approximate structure for the way that contributors communicate within the construction market.

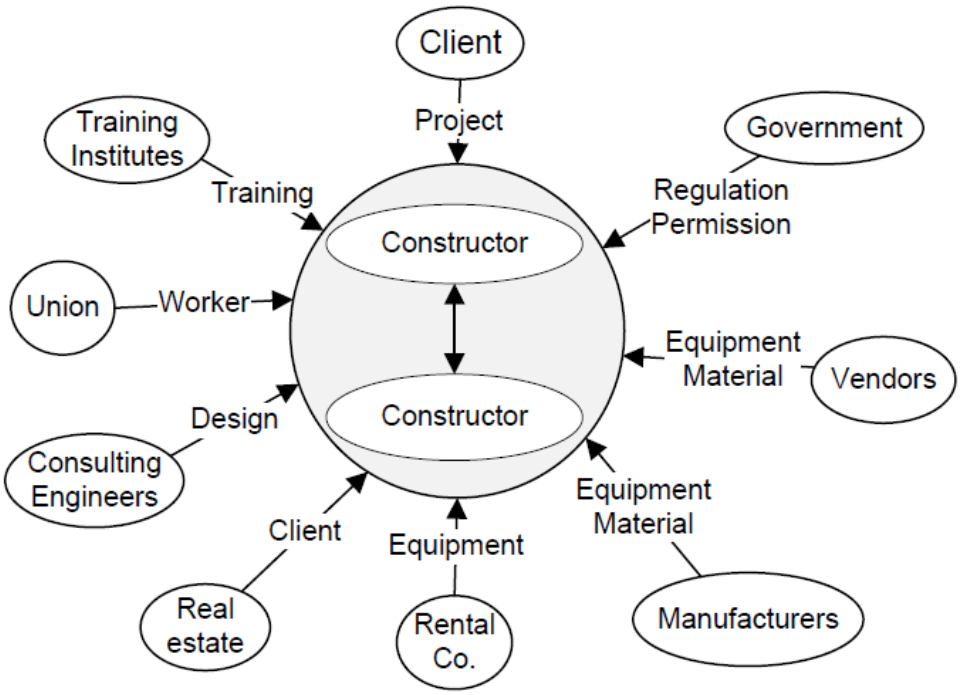

Figure 1: Communication of construction market contributors with constructors

Although constructors are shown as the middle men in the Figure 1, it should be noted that there will be no construction projects without a client(s); this fact puts the client(s)as another major contributor in the construction market. During a construction project, constructors must obey regulations set by the government and acquire permission required; this regulatory role makes the government as another contributor to the construction market. Most equipment and materials used in construction projects are purchased from a variety of vendors; however, for some other equipment items and materials constructors might directly refer to their manufacturers (e.g., mills). Equipment and materials deals bring vendors and manufacturers as effective contributors to the construction market. Renting equipment is a common practice during construction projects; equipment rental companies are another type of contributors in the construction market. When construction companies initiate and invest on their own construction projects, especially in residential and commercial building projects, real estate dealers play a

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major role, as contributors to the construction market, for introducing the projects to the potential buyers (or clients).Consulting engineers are permanent contributors at every construction project for providing project design. Close relation with unions is necessary for every constructor to be able to supply construction workers required for projects. And finally, trainings required by a constructor's workers are provided by training institutes, including universities, colleges and vocational training institutes.

Staying at the middle of communications among a variety of contributors in the construction market increases the chance of missing proper communications required; reduced performance in the construction market is the ultimate result of these miscommunications. The chance of miscommunication is increased when there is more than one contributor in each category to communicate with. For example, there are many new and existing construction project clients introducing their new projects to the construction market over time. It is no wonder if, even in need constructors miss dues form any new projects introduced to the market, since there are a variety of clients and the way that each client introduces its new projects to the market varies from one to another. Increased project price level is the outcome at the client side and a lost benefit for the competent constructor is the result at the constructor side. Similar issue happens for constructors when it comes to vendors, manufacturers and rental companies. As a result of existing variety in these contributors, there is no guarantee that constructors can find the best possible equipment and material source, e.g., cheapest price with acceptable quality. Increased cost and reduced profit in construction projects is a direct result. In our perspective a VCM might be a proper tool.

VIRTUAL CONCEPT

Virtual concept is not a new concept to the construction industry. It has been repeatedly addressed in research efforts done in variety of research areas such as building information modeling (BIM)(e.g., Bilal 2009; Shen et al. 2012), construction simulation (e.g., Rekapalli and Martinez 2010; Sacks et al. 2015), and computer based construction training tools (e.g., Li et al. 2012; Ku and Mahabaleshwarkar 2011). Use of virtual concept in BIM refers to the computer models (e.g., drawings) of building designs with additional information about the construction method, implementation schedule, cost, etc. linked to different parts of the model. Virtual concept in construction simulation again refers to the computer model which simulates the behaviour of a construction operation. Many construction training games, as well, try to create similar situations occur in some aspects of the construction industry by developing computer (or virtual) models where students can see the impacts of their decisions/ behaviours and build up on their skills. However, virtual concept in this research has a different meaning compared to the prior usages. By talking about VCM we mean a location on the web in which different contributors present their on-sale or look for their in-need products/ services. This virtual market allows sellers to easily post their on-sale items and lets buyers to easily find items they are looking for. Type of on-sale and in-need items in VCM

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might not necessarily follow types of goods conventionally exist in physical markets; though, it is customized to the virtual world potentials dealing with the construction market needs.

VCM FEATURES

Similar to other virtual markets, we expect VCM can be used as a replacement to some parts of the current construction market; some features of physical construction market are not replaceable by VCM; however, some new features can be offered by VCM which do not have any analogous features in the physical market. So, even by increasing popularity of VCM, we still expect continual presence of the physical market. However, prevalence of some of physical market features is expected to be diminished; changes in the structure of some other features are also possible. The ultimate result can be a new structure for the construction market. How this new market is going to form is a difficult question to answer and depends on the way that different contributors react to the introduction of VCM. Though, advantages that VCM brings to the market and its disadvantages can point up an approximate direction for the changes.

Accessibility is one the most important advantages of VCM. It is a 24/7 market, accessible from every single office, construction site or even home.IT, as the infrastructure used for VCM development, is the main tool used for increasing data flow efficiency in recent decades. This capability helps VCM clients to easily find their desired products and services by using related keywords; it eliminates needs for middle-agents in the market; it also empowers clients to easily comparing products and services supplied from different sources. Reduced final price is the main outcome. A conceivable disadvantage of VCM, though, is that the representation of quality and specification of products/ services are easily manipulable or misled; clients might find products/ services received considerably different than what was envisioned based on explanation on VCM.
According to the existing features of the other virtual markets, analyzing construction market needs, and advantages and disadvantages of VCM, as for the first stage we have proposed five features to be built-in VCM, including equipment buy/ sell, equipment rental, training, bids/ tenders and events. Figure 2 presents a schematic view of these features. More explanation for each feature follows.

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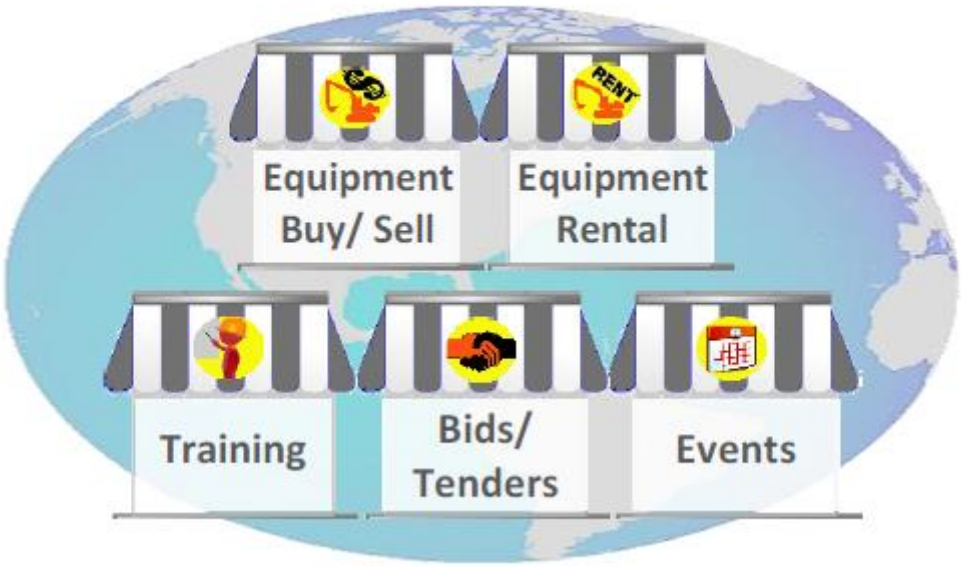

Figure 2: Proposed features of VCM

A) Equipment buy/ sell

As a result of shifts in the type of projects and/ or construction methods, many equipment items used in prior projects might become redundant for construction companies and stay untouched on construction sites or the companies' yards for a long period of time. On the other hand, it is possible that, because of starting new type of projects and/ or using new construction methods, other construction companies in the region are in need for those equipment items. VCM can provide a place where original equipment buyers and seller can refer put their items on sale or search for the items required. This feature provides an opportunity to increase construction companies efficiencies buy getting rid of extra equipment and earning money from it, for one side, and spending less money for buying equipment as well as less time, on the other side.

B) Equipment rental

Use of rental equipment in construction projects is common, but, due to the limitations of the physical market, currently this is just done through equipment rental companies. However, in the construction industry it is quite possible that, because of workload reduction or completion of special type of construction projects, some equipment items become temporary idle. Equipment rental feature in VCM gives the opportunity to the companies with idle equipment to post their idle equipment items for rent; construction companies in the region which are interested in renting construction equipment, then, can use the feature to find available rental items. In this perspective, VCM can bring opportunity incomes for

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the construction companies which own the equipment and can create saving in the rental cost for the companies in need to rent the equipment while through an expected reduction in rental cost.

C) Training

Training is a crucial need for construction companies. Annually many individuals in the construction industry attend training programs hosted by training institutes to either upgrade or maintain their level of skills and related certificates. Currently, a common way for advertising new training programs in a region is to post it on the institute's website or on the related forums. So, an individual who is interested in taking a special training program needs to search different training institutes' websites to find his/ her desired training program; it is very likely that he/ she misses some of the websites and training courses. Training feature of VCM provides a centralized location for training institutes to post their training programs and for construction workers to find their desired programs.

D) Bids/ Tenders

VCM can be used as an effective tool for facilitating the bidding process. Construction project owners can announce their invitations to tender by using bids/ tenders feature. Contractor companies can find new projects by simply searching for their related types of construction work (e.g. steel construction, industrial construction, pipe line construction, and tunnelling and road construction) within the region they are interested to work. As a result more contractors are informed about new projects in their special field of work and they can more easily reach projects that fit their special area of expertise. This is going to increase the competition level among contractors and decrease the final cost of the project for owners.

E) Event

Construction events such as conferences, group gatherings or auctions are common in construction industry. VCM can provide a feature in which construction individuals can post and search upcoming events in a region. It helps professionals in the construction industry to be able to find each other and get in touch more easily.

VCM IMPLEMENTATION

Studied VCM was implemented as a web-based portal page using an open source web development framework including a combination of php as the server side programming tool, Java Script as the client side programming tool and mySQL as the database tool. A domain address, "ConstructionPath.com", was registered to upload the developed web portal. All five features discussed in the section 4 were implemented on the web portal. To make features more applicable for the web portal clients, different sub-categories were built in each feature; the subcategories were defined according to the frequency of related usages found in different websites (e.g., "europe-construction-equipment.com", "constructionsales.com.au", and "kijiji.ca") as well as interviews done with experts in the construction market. Figure 3 depicts a snap shot of the home page of VCM web portal.

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Figure 3: Main page of VCM located at: ConstructionPath.com

Currently, implementation of the VCM is completed and we are at the pilot launching stage of the portal. Canada is selected to be the first country VCM is launched in and our pilot launching is held for Canada. During launching stage possible issues with the VCM is resolved and possible new features are explored, before we expand VCM services to other countries. Direct contact with selected construction industry contributors and use of social networks are the main marketing strategies to introduce services VCM can provide to the construction market.

Supply and demand of many products and services in construction industry are very dependent to their locations. For example it is uncommon that clients from Alberta, Canada, become interested in buying construction equipment items put on sale in Ontario, Canada, because of the equipment size and high transportation cost. In the VCM, users can easily adjust their target location to the entire country, a province or a city. At this stage all provinces and main cities within Canada can be set as the target location. The implemented VCM provides a wide range of services to connect contributors in the construction market including posting, subscribing, searching and responding to the posted advertises. Details on the portal's services and features are referred to the portal address at: ConstructionPath.com.

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CONCLUSION

During recent decades global market has been deeply changed; new technologies have helped the market to grow and its efficiency has been improved. Undoubtedly, emergence of new technologies, and on the top of them IT technology, has revolutionized the way that construction industry is run. However, most changes in the construction industry have happened at the micro level or within construction companies. In this research we introduced VCM as a new tool that can affect construction industry at a macro level, i.e., it can be used for improving the way that different contributors communicate with each other in the construction market. In this research proposed VCM features are implemented as a web portal. Currently design and implementation of the web portal is completed and the research is at its pilot launching stage.

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