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## **Business Models for Selling AEC Knowledge Over the Cloud**

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**Abstract:** The AEC (Architecture, Engineering, and Construction) firms should modify their business models to exploit available opportunities by the increasing role of knowledge management in the global economy. This paper will define the concept of business models, their elements and classifications done by researchers in literature. The paper will propose knowledge based business models targeted to AEC firms with the aim of exploiting new business opportunities and improving performance. The models were developed through benchmarking cases in other industries. These models are designed to sell consulting knowledge online through emerging information technology and cloud-based platforms.

### **1. Introduction:**

A business model is simply a map that defines the value, operations and financials of a business. It identifies the main aspects composing any business such as financial streams, logistical streams, customer segments and the added value proposed to customers. In order for companies to concentrate more on added value services and customer needs, they have to modify their business models to cope with the changing environment. Analysis of business models emerged lately as one of the most powerful tools for an organization to redesign (reinvent) itself. This is mainly due to the increased penetration of information technology in today's business and the spread of trans-national business ventures. A survey done by IBM showed that 70% of CEOs emphasized the importance of integrating technology and business strategies, those CEOs focus 30% of their innovation efforts on developing their business models (IBM, 2006).

The AEC industry should re-consider some of its business models to capitalize on the opportunities presented by the increasing role of knowledge management in today's global economy. It should be noted that this does not mean just selling products online or developing portals for e-bidding or online procurement. This activity is e-business; that is, selling the wisdom of experience, gained over the years, through optimizing designs, coordinating projects, troubleshooting problems, facilitating project communications, and promoting business opportunities. Thanks to the advancements in cloud computing, firms can invite customers, and other firms, to upload relevant data to a cloud-based server and, then, use business intelligence and data analytics tools to discover discrepancies and opportunities then match them to best practices or possible solutions. Here, the main point is not in the development of these applications; rather, it is in creating a reliable business about such concepts and delivering business value to end-users.

This paper propose three business models targeted to AEC firms with the aim of exploiting new business opportunities as well as optimizing current practices. These business models are designed to sell consulting knowledge online through new technological innovations and cloud-based platforms. The paper, first, makes the case for selling knowledge as a commodity. Next, we introduce a synthesis of business models: their definitions, components and types. Finally, through benchmarking cases in other industries, we describe three possible key business models of selling knowledge in AEC. These models were developed using the definition and structure proposed by Osterwalder and Pigneur (2010).

## **2. Literature Review:**

### **2.1 Selling Knowledge:**

Data is a representation of the simplest facts about a system with limited meaningfulness. Information is the composition of various data to establish a meaningful representation of facts. In information systems, information is, normally, exchanged through communication between humans or via electronic means; the exchange of information is the domain of e-business. Knowledge, in contrast, is the wisdom gained from experience and understanding of the inner behaviour of systems that enables better decision making. While data and information tend to be technology-oriented, knowledge is basically human-centered. Knowledge is a “mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information (Davenport and Prusak, 1998)”.

The impact of industrialization has shifted the focus of knowledge from an investigation of philosophical/social concepts about wisdom, values and truths, to becoming an industrial commodity (Lyotard, 1984). Thanks to recent advances in cloud computing, companies can now package some of their knowledge in the form of web-based systems to provide in-depth advice to customers. A variety of cloud-based services will be offered (Marston et al., 2011). These include:

-Infrastructure as a service (IaaS): This service stores and manages all of a project's information. It provides a secured environment for data sharing across all of the project's stakeholders. This streamlines the updates to any of the project's activities thus enhancing decision making and conflict resolution. The idea is not only to offer storage but also offer knowledge management and data mining tools that help provide intelligence.

-Software as a service (SaaS): The idea is to offer customizable, web-based software and apps tailored to the customers' needs in addition to managing the software versions and updates. The web-based applications will offer the project's stakeholders problem solving and communication tools. The applications create reports and generate intelligence to measure the progress of various business activities and generate recommendations to decision makers.

-Platform as a service (PaaS): This service offers web-based platforms that could enhance collaboration and interoperability between different stakeholders. This will optimize interaction during different project activities such as design or procurement. A good example of PaaS is Google docs which offer an online platform where people can work on their documents collaboratively at the same time.

Customers in AEC are in need of web-based services to manage knowledge. This belief was fostered by the following drivers:

- The shift from IT to KM: KM goes beyond software interoperability and e-business transactions to encompass the modeling of human knowledge (both tacit and explicit), developing advanced work processes that encapsulate the wisdom of past mistakes with an emphasis on human interaction over software automation and the consistent harnessing of best practices to support continuous improvements and optimization.
- Globalization: Multinational organizations and projects are, increasingly, becoming a reality in the construction industry and there is a pressing need for establishing a means of communication in the virtual organization that transcends national boundaries.
- The need for intelligence and innovations: Companies need to sustain and grow their business. The value of business analytics could be exploited online using web-based services. Information systems management, as well as data mining tools, could provide the client with added value information and services needed for sustaining and growing business.

### **2.2 Business models**

The research in the business models area is divided into three main topics. Some authors are concerned with the definition of the business model as a concept, while others concentrated on the building elements that should be in the company's business model. Other authors worked on developing stereotypical types of business models and applied them to different industries.

#### **2.2.1 Business model definition:**

The business model was defined differently in the literature. Timmers (1998) defined a business model as the architecture of the physical or intellectual product provided, including the description of different

aspects that form this business and the financial aspects paid or gained from this product or service. He also stated that the level of detail of a business model is not supposed to be high, or concrete, because this will reduce the understanding of the business functions (Timmers,1998). In addition to these elements, Weill and Vitale (2002) added that business model should include the description of the relationships between the firm’s customers and partners. Other authors defined the business model as a tool that exploits additional values proposed by the business and how these values can be integrated within the current firm’s strategy. This exploitation happens through managing the content and structure of the business model (Amit and Zoot, 2001; Linder and Cantrell, 2000; Rappa, 2001). Osterwalder and Pigneur (2002) defined the business model from another perspective; they regarded it as the missing link between a company’s strategy and implementation; thus, they defined the business model as a blueprint of how a company does its business. Mahadevan (2000) proposed that business models are a combination of three main streams: the value stream that defines the proposition offered to customers; the revenue stream that defines the revenue generation scheme; and finally the logistical stream that relates to the design of the supply chain which serves the business.

Bakos (1998) claimed that the increased interest in business models has been fueled by the unprecedented growth of e-business. The ability to communicate with customers and suppliers online has shifted many of the old paradigms of doing business and mandated a change in the layout of business processes. An e-business model is simply implementing different means and tools of technology, into the traditional business model, in order to create more business opportunities and value to the end-users thereby gaining a competitive advantage over competitors and gaining more revenue. E-business presents the first step in building a business model for selling knowledge online; however, the two activities are not the same. Knowledge selling business models are not related to online or electronic transactions. They relate to capturing, packaging, and selling the expertise of one firm to another.

In table 1, different business model definitions in the literature were synthesized. It is obvious that the core of all definitions is to determine the value proposition as well as the financial streams. Some researchers proposed that customer identification is an essential block forming business models, while others introduced the concept of logical streams into their business model by adding activities and resources required for business operations. Most of the authors related the idea of business models to internet business, while Osterwalder & Pigneur (2002) and Lai (2005) proposed business models applicable to any business type, internet based or not.

Table 1: Business Model Definition

Author	Definition	Value Proposition	Financial stream	Customer Related	Logistical Streams	IT related
<b>Timmers (1998)</b>		✓	✓			✓
<b>Weill and Vitale( 2001)</b>		✓	✓	✓		✓
<b>Lai et al. (2006)</b>		✓	✓			
<b>Rappa (2001)</b>		✓	✓			✓
<b>Linder and Cantell (2000)</b>		✓	✓	✓	✓	✓
<b>Amit and Zoot(2001)</b>		✓	✓		✓	✓
<b>Mahandevan (2000)</b>		✓	✓		✓	✓
<b>Tapscott (1998)(2000)</b>		✓	✓	✓	✓	✓
<b>Osterwalder &amp; Pigneur (2002)</b>		✓	✓	✓	✓	

### **2.2.2 Business model elements:**

Researchers defined the elements of a business model in different ways; however, there are a set of shared components that are used by these researchers. As shown in table 2, these elements encompass value proposition, revenue streams and logistical streams. Alt and Zimmerman (2001) built their business model elements on two dimensions, horizontal and vertical. The horizontal dimension is the back bone of the business model and includes the company’s mission and strategic objectives, the targeted market

and its characteristics, the value proposition proposed to the customers and the resources and activities. The vertical dimension includes the components that outline the broader view of the business which include the market trends, governmental regulation and technology (Alt and Zimmerman, 2001).

The business model developed by Alt and Zimmerman (2001) did not include the financial aspects of businesses and did not recognize the importance of cost structure and revenue. Weil and Vitale (2001) stated that the business model should include the major entities interested in the business such as customers, suppliers and allies, in addition to information about products offered and revenue streams. Osterwalder and Pigneur (2002) emphasized that a business model's strength is its way of representation, how it tells a story about the business and integrating all the elements together in one simple model. They proposed that the business model is based on four pillars: products and services; the infrastructure of activities; the relationship capital with the customers and the financial aspects. Later, Osterwalder & Pigneur (2010) re-developed their four pillars model into 9 basic elements that identify the business model. Those elements are: value proposition; customer target; distribution channels; customer relationships; value configuration; core competency; partnerships; cost structure; and revenue model. This model will be used as the basis upon which we will propose three specific models for selling knowledge in AEC. For more information about the elements of the Osterwalder and Pigneur business model and its composition, please check (Osterwalder and Pigneur 2010). In the next table, we synthesize different business model elements proposed in the literature.

Table2: Business model elements

Element	Partnerships	Activities	Resources	Value Proposition	Customer Relations	Customer Segments	Channels	Cost	Revenue
Author									
Alt and Zimmerman, 2001		✓	✓	✓		✓	✓		
Osterwalder and Pigneur, 2002		✓	✓	✓		✓	✓	✓	✓
Weil and Vitale, 2001	✓	✓	✓	✓		✓	✓	✓	✓
Osterwalder and Pigneur, 2010	✓	✓	✓	✓	✓	✓	✓	✓	✓
Timmers, 1998		✓	✓	✓					✓

### 2.2.3 Business models classification:

Business model taxonomies are simply categorizing different business models to fit different business types. Some authors formed generic business models that are suitable for many businesses (Timmers, 1998) (Weil and Vitale, 2001) (Rappa 2001, 2004) (Bambury,1998) (Lai et al., 2006). Some other authors preferred to categorize the business models as an industry based categorization: (Shybar and Lechner, 2004) for wireless networks' business models; (MacInnes et al., 2002) for mobile gaming; and (Rajala and Weterlund, 2007) for the software industry. Bambury, in his categorization of business models, mixed between the real-world business models and internet-based business models. In total, he identified 13 models, 7 of which are not internet-based. Table 3 lists some of the most important model taxonomies developed in literature.

Lai and his team (2006) in the MIT Sloan program categorized the business models from different perspectives. Their aim was to define business models applicable to any type of business. They succeeded in doing this through their research in which they developed 16 different business models and categorized 10,970 publicly traded US companies according to their 16 developed models. It was usual to

find one company that operates with more than one business model (Lai et al., 2006). Their categorization was based on two dimensions. The first dimension determines the type of right sold, whether it is a creator, distributor, landlord or brokerage. The second dimension is dependent on the asset type. The four types of assets are physical, tangible financial and human. For more information about Lai business model classifications, please check (Lai et al. 2006).

Table 3: Business models Classifications

<b>Business model</b>	<b>Definition</b>	<b>Authors</b>
<b>E-Shop/Direct to Customer</b>	The model is an online shop that offers wider choices and better prices to customers. It offers convenience to customers through one to one marketing and 24/7 support.	Timmers Weil and Vitale
<b>E-Procurement</b>	The model offers online tendering, bidding and procurement process. It offers choices, higher quality and costs savings to customers.	Timmers
<b>E-Auction</b>	The model is an online auction house for different services and products. It increases efficiency to customers through time savings and transactional risk reduction.	Timmers Rappa
<b>E-Mall/Virtual Market</b>	The model is an online mall composed of collection of E-shops. It provides choices, accessibility and a better shopping experience.	Timmers Rappa
<b>3<sup>rd</sup> Party Market Place/Full Service Providers/Market Place Exchange</b>	The model outsources marketing to a different company. It involves branding, transactions management and logistics management	Timmers Weil and Vitale Rappa
<b>Virtual Communities</b>	The model Extracts information from people with same interest through open source online platforms. It improves the marketing process and encourages customers engagement	Timmers Weil and Vitale Rappa
<b>Value Chain Service provider</b>	The model integrates and optimizes the supply chain processes to maximize efficiency reduce costs and improve quality.	Timmers
<b>Value Chain integrator</b>	The model Integrates multiple steps of value chain to exploit information flow thus generate more business opportunities.	Timmers Weil and Vitale
<b>Collaboration platform</b>	The model Provides a set of tools and collaborative information environment. It enhances interoperability between a project's stakeholders through virtual teams.	Timmers
<b>Information Brokerage/Intermediary Model/Infomediary Model</b>	The model provides consultancy advice or certification to customer segments. It depends on providing information intelligence to customers.	Timmers Weil and Vitale Rappa
<b>Content Provider</b>	The model Develops and provides intelligence and valuable information to end-user to enable exploiting business opportunities or business enhancement.	Weil and Vitale
<b>Shared Infrastructure</b>	The model shares IT infrastructure between multiple providers to reduce IT cost and increase computing power by offering a computational pool of computers.	Weil and Vitale
<b>Whole of Enterprise</b>	The model Integrates multi-businesses into a single point of contact. This provide wide offering through one purchase point which	Weil and Vitale

	increases convenience to customers.	
<b>Brokerage Model</b>	The model connects buyers and sellers of a certain product or a service. It is mainly depends on the trust factor. It reduces risks to customers and saves business costs.	Rappa
<b>Advertising Model</b>	The model offers an Internet web-based advertising to improve marketing process through exploiting new channels with less cost.	Rappa
<b>Merchant Model</b>	The model is an online mall with the auctioning and bidding capabilities which gives the customer wider choices with lower prices.	Rappa
<b>Utility Model</b>	The model Provides on-demand online services to customers. The services are customized for customer requirements with a pay as you go scheme.	Rappa
<b>Affiliate Model</b>	The model Provides a purchase point on an online website. It provides enhanced sales process with reduced channel costs.	Rappa

### **3. Proposed Business Models:**

The proposed business models aim at selling AEC knowledge online over the cloud. These models not only do business online, but also exploit the embedded value within the knowledge inside AEC firms. The aim is to combine knowledge management practices with e-business practices to provide the client with online wisdom packages that serve their business objectives. E-business is the electronic trading of physical goods or intangible assets such as information; this encompasses all trading activities such as online marketing, ordering, payment, support and delivery (Zhang, 2009). Many people related the success of firms like eBay, amazon and Dell to the successful implementation of e-business backed up with emerging information technologies (Lai et al., 2006). The business models proposed differ from e-business in which the model is targeted towards knowledge management tools such as data mining, analytics and intelligence activities which generate added value out of the dissipated information within the AEC market boundaries and offers it online to clients to support the business operations and generate business opportunities.

### **3.1 Business intelligence**

Organizations in the era of globalization are exposed to many internal and external factors that affect their progress and operations. The increase in the sophistication of competitors, customers, and suppliers, in addition to international competition in different businesses, has led to a new challenge to all organizations. The real challenge is how to analyze and manage all factors surrounding the business environment and take advantage of all available information and opportunities. Business intelligence helps organizations exploit new business opportunities in addition to enhancing decision making and operations. The business intelligence model is composed of market intelligence, procurement analytics, project analytics and virtual communities. This business model can include providing analytics and services on managing and optimizing the following tasks:

#### **Market intelligence:**

Market intelligence offers the analysis of different markets, competitors and customers to provide intelligence through added value information. It exploits business opportunities for the customer segments though providing meaningful information about construction markets locally or internationally. The aim of the model is to provide the client with a full picture of all internal and external factors surrounding their business environment and, accordingly, exploit business opportunities and enhance operations.

#### **Procurement analytics:**

The procurement analytics model deals with managing all activities and strategies through a project's life cycle until the final delivery of the outcomes. It includes providing the client with partnerships, outsourcing means and prequalified stakeholders. The model is responsible for managing the whole bidding and

tendering process through an online platform that involves virtual teams and online communicating tools. The aim of this model is to guarantee better management and interoperability through the procurement process.

#### Project analytics:

It is the application of innovative project management tools to analyze a construction project's progress. The business model deals with analyzing the current situation of a construction project in addition to forecasting the future trend of the project's progress. The analysis will determine any cost or time overruns and recommends different scenarios and plans to improve project performance and optimize construction operations.

#### Virtual Communities:

Virtual communities depend on the public as a source of knowledge. They encourage public participation and engagement in decision making through an online platform where the public can present their ideas and concerns. The model also deals with social analytics to produce information intelligence through the information dissipated in the online crowds and social media. The aim is to enhance decision making through the intelligence produced as well as tailoring the projects to be directed towards the end-user customer needs.

### **3.2 Design Optimization & Innovation**

Innovation in design is the key to successful high quality projects. New design tools are introduced every day, especially with the rise of information technology. The application of innovative design tools to traditional designs will lead to time and costs savings in addition to the production of high quality design that could easily be constructed and managed.

#### BIM Management service

This model deals with traditional design drawings and specifications. The aim is to convert traditional designs into building information models involving 3D parametric modeling, in addition to adding the cost and time dimensions. This will enhance interoperability in project teams and provide better graphical representation and information management. BIM is becoming an essential tool in engineering design; however, its implementation is still a complex process due to IT infrastructure and software requirements, as well as the engineering know-how required. Small and traditional design firms are seeking assistance in converting their projects to being BIM-based and implementing BIM into their design activities.

#### Design Certification

Design certification deals with checking designs done by other parties. It implements standards and specifications to the proposed designs. The certification process guarantees that proposed designs are according to design code in addition to assuring constructability and functionality of the design. The certifier will take full responsibility for the design following the certification process. This model is mainly based on the reputation and trust of the service provider.

#### Value engineering:

This business model involves design optimization. The main aim of this business model is to modify designs to be more efficient. Value engineering includes resource optimization, time optimization as well as cost cutting. Value engineering assures the delivery of the required project with minimum resources and with maximum cost savings.

### **3.3 Software Tailoring:**

Organizations are seeking help from software developers to assist in business optimization and operations. The rise of information technology made software customization possible and essential to run business. The clients' software requirements change from one business to another and even from one company to another in the same industry. The software tailoring business model deals with offering software design applicable to very specific customer requirements and tailored to fit the customer's need exactly.

#### Software customization:

This business model offers customized software services to the customer. Customers have to identify their software requirements and then the software will be tailored to satisfy their needs. Customer engagement in this model is a very important factor to deliver the best fitting software to the requirements. Training and maintenance of the proposed software is a very important factor in this business model.



#### Module customization:

It is developing customized modules for off-the-shelf software to perform a specific objective required by the customer. The service involves developing add-ons and plugins according to the customer's needs. This service involves high customer engagement to identify the customer's needs and tailor the required software accordingly.

#### Software as a service (SaaS):

SaaS offers software systems online over the cloud. The software systems, or modules, developed on the two previously discussed business models will be offered over the cloud in this business model. Cloud software will enhance interoperability and communication between different stakeholders and reduce time and cost losses accordingly.

#### Real time monitoring and control:

Real-time monitoring and control is an addition to the Software as a service business model. In this service the company will provide analysis of the data acquired from the software users. The business model deals with data analytics to provide useful intelligence and trends of the exchanged data over the cloud. The recommendation and information proposed will enhance decision making and will show current progress of projects and future trends.

#### **4.0 Benchmarking proposed business models:**

It is important to benchmark the proposed business models and classify them according to previous classifications of business models in literature. The previously discussed classifications of business models were developed to fit different businesses. In table 4, the relevance of the proposed business models to the previously discussed classifications will be determined. The classification proves the applicability of business models to the industry, especially the relevant cases from other industries that applied these business models

Table4: Proposed business models classification

Proposed business model	Relevant Classifications in literature	Relevant Cases
<b>Market Intellegince</b>	Information brokerage (Timmers, 1998) Informediary model (Rappa, 2001) Content provider (Weil and Vitale, 2002)	<b>McKinsey:</b> A management consulting firm.It provides advice to businesses, governments and institutions.It provides market intelligence reports and analytics. <a href="http://www.mckinsey.com">www.mckinsey.com</a>
<b>Procurement Analytics</b>	E-Procurement (Timmers, 1998) Collaboration platform (Timmers, 1998) Brokerage model (Rappa, 2001) Virtual market (Rappa, 2001)	<b>Ariba:</b> Provides integrative procurement solutions.They exploit networked economy through enhancing collaboration. <a href="http://www.Ariba.com">www.Ariba.com</a>
<b>Project Analytics</b>	Value chain provider (Timmers, 1998) Infromation brokerage (Timmers, 1998) Content provider (Weil and Vitale, 2002)	<b>Acumen:</b> Provides project diagnosis and analytics.It provides innovative project management solutions to improve project's efficiency. <a href="http://www.projectacumen.com">www.projectacumen.com</a>
<b>Virtual Communitis</b>	Virtual Communitis (Timmers, 1998)(Weil and Vitale, 2002)(Rappa, 2001)	<b>Attensity:</b> Provides social media analytics and real time intellegince from online commnuitis to enhance customer's engagement. <a href="http://www.attensity.com">www.attensity.com</a>
<b>BIM Design Services</b>	Infromation brokerage (Timmers,	<b>Rapid BIM:</b> Provides BIM



	1998) Intermediary model (Weial and Vitale, 2002) Infomediary model (Rappa, 2001)	design services and implementation to governments, A/E firms and contractors. It specializes in Marine industry <a href="http://www.rapidbim.com">www.rapidbim.com</a>
<b>Design Certification</b>	Infomation brokerage (Timmers, 1998) Intermediary model (Weial and Vitale, 2002) (Rappa, 2001)	<b>Civil Certification:</b> Provides consultancy services and design certifications <a href="http://www.civilcertification.com">www.civilcertification.com</a>
<b>Value Engineering</b>	Value Chain Provider (Timmers, 1998) Infomation brokerage (Timmers, 1998) Content provider (Weil and Vitale, 2002)	<b>VSE Corporation:</b> Provides engineering and tehcnical support to reduce cost and improve reliability <a href="http://www.vsecorp.com">www.vsecorp.com</a>
<b>Software Development</b>	Software Tailoring (Rajala, 2007) Colloboration platform (Timmers, 1998)	<b>SAP :</b> Provides business management software solutions tailored to the client`s needs. <a href="http://www.sap.com">www.sap.com</a>
<b>Module Customization</b>	Applied formats (Rajala, 2007)	<b>Applied Software:</b> Provide module customization for Autodesk packages <a href="http://www.asti.com">www.asti.com</a>
<b>Software as a Service</b>	Standard offering (Rajala, 2007) Utility model (Rappa, 2001) Colloboration platform (Timmers, 1998)	<b>Sales Force:</b> Cloud-based software and app that enhance sales and marketing for different businesses. <a href="http://www.salesforce.com">www.salesforce.com</a>
<b>Real Time Monitoring and Control</b>	Value chain provider (Timmers, 1998) Utility model (Rappa, 2001) Colloboration platform (Timmers, 1998) Content provider (Weil and Vitale, 2002)	<b>Chainalytics:</b> supports value-driven supply chain decisions through monitoring and control. It provides intelligence, analytics and advisory services. <a href="http://www.chainalytics.com">www.chainalytics.com</a>

## **5.0 Conclusions and future work:**

Business models, if applied to the construction industry, will have a positive potential of exploiting new business opportunities, in addition to optimizing the performance and efficiency of the entire industry. Construction companies should move more downstream toward the customer by modifying their business models to be more customer oriented. The key success factor is to offer the perfect service packages to the relevant customer segment according to the customer attributes and, accordingly, generate business revenues.

The paper proposes three main business models for an engineering consultancy: business intelligence; design optimization and innovation; and software tailoring. Those proposed business models build on developed generic business models by authors in literature. The proposition applies new business concepts into the construction industry to offer more integrative solutions to the construction client in addition to business optimization and better operations.

The next step in this research is to identify the customer segments applicable to each of the proposed business models. The aim is to determine which service's packages are most suitable to different customers' profiles judging by the customers' attributes. It is also essential to determine the revenue streams associated with each business model and the best way to generate money. Business model

elements will be presented in the Osterwalder canvas to provide consultants with a road map of how to conduct business using the proposed business models

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