Article No. 1

BLOCKCHAIN, IOT AND ARTIFICIAL INTELLIGENCE – AN ASSESSMENT OF THEIR FUTURE IMPACT ON BUSINESS EDUCATION IN THE INFORMATION AGE

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Abstract: Blockchain, IoT and Artificial Intelligence are three major technologies that are poised to revolutionize the way we conduct business. Coupled with Big data capabilities and innovations around immersive experiences which are slated to receive further fillip from 5G enabled mobile networks, we expect to see gradual but fundamental shifts in the way business decisions are made. New technologies and their impacts must find their way into the knowledgeability and flexibility that tomorrow's managers will exercise as they make their honed decisions, resulting in new and nested business models, intelligent and deep learning based automation in business processes, and trust-based p2p audit and control mechanisms that are transparent, cost-effective, and efficacious.

We as business educators have the responsibility to help new managers acquire skills and knowledge elements critical for success in the thus altered paradigms of decision making and be relevant to the time. Clearly, business curriculums and educational instructions need to be augmented with such contextual treatments of technology in their understanding, discussion and analysis in order to serve their purpose. Towards such programmatic and educational goals, we propose a roadmap to analyze organizational integration of these emerging technologies and derive insights into the knowledge elements that must be imparted to the managers-in-training and be included in business school curriculum and instructions.

As a theoretical framework, we use the Internet Business model Ontology of Osterdalder et al. (2002) in this paper. We stepwise impose emerging technologies, one at a time, on the above theoretical framework of the chosen model; identify and analyze the disruptive forces that these technologies will likely usher, and then isolate candidate knowledge elements that managers would need to learn in business schools and thus should find their way into the curriculum design processes and finally find their inclusion in the instruction and discussion phases of business education.

This is a nascent research and is a part of a more significant effort to an enhanced and comprehensive institutional curriculum design process that the authors have currently engaged themselves. The fundamental objective of this paper is to propose a viable theoretical framework to analyze the organizational impact of the emerging technologies of the 4th industrial revolution in order to isolate knowledge elements essential for the managers to learn. The current and express goal of this paper is to present and discuss the initial baseline concept with business faculty in a collaborative setting, collect knowledgeable feedback that can help create a comprehensive roadmap to inform business curriculum design and development processes.

Our future plans include proposing a refined and comprehensive model of analyzing organizational integration of emerging technologies that are specifically focused to adequately and appropriately support curriculum design research in business education. Being an information technology context research, the

final artifact of this work is expected to be a journal paper in an upper tier outlet like Communication of the Association of Information Systems (CAIS) or the Journal of Information Systems Education (JAIS).

Keywords: Block chain, IOT, AI, Business education, Osterwalder, Curriculum design process SAM model.

1. Introduction and a Brief Literature Review

One primary need for business managers is to be in the know and be able to scope technology trends in order to assess their impact on business models and make informed decisions (Richarne, 2009). The complexities and dynamic challenges in the business landscape are best navigated when business managers are able to discern upcoming changes and their impacts in business processes (Cornuel, 2009). In other words, when managers are able to learn, assess trends and remain adaptive, they can help organizations achieve success.

Blockchain, IoT and Artificial Intelligence are some significant technologies that will revolutionize business. 5G enabled big data capabilities and innovations around immersive experiences will usher gradual, but fundamental shifts in the way decisions are made in the business. Impacts of these new technologies must be scoped and understood by the managers of tomorrow for them to make effective business decisions. New business models that incorporate automated business processes powered by intelligent and deep learning technologies and trust based p2p accounting control mechanisms must become tools and enablement for the business students whom we teach and train today to be tomorrows' managers. Clearly, our business curriculums should reflect such needs and provide adequate scope and content for the future.

Looking ahead and planning for future is existential. Thus a plan to prepare managers for the future must be dovetailed in the curriculum, especially in the new era where new innovations in information technology is an everyday affair (Deutsch, 2004). However, curriculum updates are infrequent in practice and requires substantial time and effort. Long lead time through the university decision chains further exacerbates the situation. This suggests that interim processes must be cycled in to form an existing curriculum development and update process, especially in those knowledge domains where impacts of information technologies are rapid and profound. Such continuous curriculum improvement cycles are needed at the delivery end, and thus will remain faculty-led. This also ensures that this important stakeholder is innately integrated in the continuous update process.

In such ongoing cycles of continuous improvement and update, it is also important that the following motivations and goals are met and achieved. First, all stakeholders (curriculum developers, instructors, businesses, university administrators etc.) should be represented in the circle of influence, contribution and feedback. Second, students must be an integral part of the update process. This has the potential to help them realize the value of knowledge renewal down the road, as they leave business schools and hope to remain gainfully employed in the economy. Finally, as the course level learning objectives are modified at the delivery end, a deliberate bottom-up approach to update the

program level learning objectives must be in place as well. These together can work as a framework for continuous update for curriculum process.

Although much criticized in the intervening decades since it was published, the conventional curriculum is often developed with the rational linear approach of Tyler (1949) and appear to serve current needs adequately (Wraga, 2017). Although faculty involvement in the curriculum is well appreciated, research has indicated that faculty may not always begin with objectives as they design their planning of delivery (Marsh et al., 2007). Recent research also suggests that the linear approach in selecting learning objectives and learning experiences including evaluation of learning as per the linear rational model of Tyler (1948) is inconsistent for a fundamental process of dynamic, on-going curriculum updates (Flowers, 2007).

While an ongoing, stakeholder inclusive process of technology-focused curriculum update appears quite desirable, the previous literature does not provide us with an appropriate methodology or modern framework of implementation. Towards that capability, we have looked into and paired such motivations with the modern agile paradigm that is implied in the development of modern IT artifacts. The reason why we adopt such a framework is threefold. First, the technological changes that bring about the need for continuous curriculum renewal are themselves often developed using agile paradigms. Second, the speed of change is ushered and triggered by these technologies, and thus the above paradigm suits well in thus reflective updates of the curriculum as well. The desired functionalities of an enhanced curriculum is a shifting goal, which is quite similar to many IT artifacts, especially software, which are known to have moving targets in terms of functionality (Lee et al. 2005). Third, new IT artifacts represent the industry's response to the latent and emerging business needs (Cusumano et al. 1999) and the speed with which they evolve (Iansiti et al. 1997), thus a paradigm that is implied in the development of such technologies and artifacts are also apt to capture the need for new knowledge elements when these technologies and artifact are in turn cycled back in business processes. In this work, we implicitly deploy the agile paradigm to model an effective framework of continuous renewal and update of the business curriculum.

While we have argued the need for continuous updates in the business curriculum and identified a useful collaboration framework (paradigm) in the above paragraphs, we still need an ontology in the form of an appropriate business model in order to assess the impacts of an incoming technology on the dynamics of business processes and decisions in an organizations. This is because a business model implements business strategies of an organization, and essentially captures the web of logic for value creation, which in turn motivates the design and implementation of those business processes in the first place (Petrovic et al. 2001). Further, business models support managers' need to communicate their shared understanding of business dynamics with other stakeholders (Fensel, 2001). Finally, business models help isolation, identification, understanding and ratiocination of domain-specific decision elements and their interdependencies (Morecroft, 1994).

In what follows, in Section 2 we describe the agile methodology, which we incorporate as the implicit paradigm in a continuous update of the business curriculum. Section 3 presents the Osterwalder's e-business model (Osterwalder et al., 2002) as our chosen ontology of business dynamics on which impact of new technologies are assessed. In Section 4, we describe the standard rational process of curriculum development and our proposed continuous update process as a comparison between their basic natures of being top down and bottom up strategies. Having done so, in Section 5 we provide an example of marketing and CRM coursework and how our proposed bottom-up curriculum renewal and update process can identify new learning elements as technologies like Blockchain, IoT and Artificial Intelligence through the involvement of multiple stakeholder groups, viz. faculty, students and Businesses. Finally, section 6 describes our future efforts and concluding thoughts.

2. The agile paradigm

Agile as against traditional structural (waterfall) paradigm was formally drafted and published as a manifesto[1] by seventeen prominent technologists in 2001. It enshrines four important principles which can be summarized as below:

- An original plan must continuously respond to changes
- A promptly developed working artifact is essential and could be more valuable over a comprehensive outcome and documentation that is planned far in future
- Stakeholder interactions must receive precedence and importance over strict adherence of prescribed processes and tools
- Close customer collaboration is desirable over strictly enforced traditional processes of contract negotiation

The paradigm puts priority in satisfying customers (e.g., the students, businesses etc. in our case here) through regular cycles of delivery of artifacts that are results of a collaboration between businesses and the internal stakeholders (e.g., the faculty and students here). Further, the paradigm accepts late changes (e.g., recent technologies in this paper) and modifications by directly involved and motivated stakeholders (e.g., the faculty and the students in the business curriculum). The paradigm proposes simplicity in conceptualization and integration of all changes in requirements and argues that the best designs arise out of the motivated working of self-organized groups of stakeholders. Finally, the methodology urges a concept commonly known as the 'lessons learnt' part of the above collaborative process where stakeholders regularly converge to discuss problem issues and their solutions that happened in the recent past to appropriately reflect and adjust work behavior, architecture and processes of development.

In this work, we will imply close collaboration akin to the above paradigm of agile methodology between businesses and the faculty and students of the business curriculum while impacts of technology-driven changes are assessed to identify learning objectives that will be integrated into the continuously evolving curriculum and its delivery processes.

3. The Impact Assessment Ontology

[1] http://agilemanifesto.org/principles.html

The ontology that we conveniently deploy for the purpose of assessment of technology impact on business dynamics is the business model propounded by Osterwalder (2002). The model proposes that a business virtually stands on four pillars (Figure 1), namely those of 1) Business Innovation, 2) Customer Relationship, 3) Infrastructure Management and 4) Financial Aspects/Dimensions and that the dynamics between these 4 pillars are fundamental to all business decisions and processes that are integral to the organization that runs the business.

Osterwalder argues that through a set of basic and differentiated value proposition a firm expresses its desire to cater to express, implicit and latent customer needs. When customers purchase and enjoy value embedded in the products and services offered by a firm, the firm legitimately earns revenue. In order to propose value, firm need capabilities (Pillar 1). In order to gauge current and future trends in the target segments of customers and to satisfy needs, a firm develops relationship capital. Through the forward channels of the relationship network, products and services reach the customers while the reverse channel maintains continued relationship to ensure repeat sales, and manage return cycle, servicing needs as well as an assessment of emergent demands (Pillar 2).

In order to propose a value, the firm needs the optimized mobilization of resources (activity configuration), which includes owned as well as other resources that are accessed through contracted and negotiated arrangements with vendor networks. This, however, gives rise to the cost of business (Pillar 3). Pillar 4 encapsulates the financial aspects of a business operation, are transversal and in fact, traverses through all the other pillars. This includes both cost and revenue cycles of the business that have been mentioned above in connection with pillars 1 and 3. This pillar also manages the motivation of business profit and fulfils all legal and regulatory reporting requirements and provide fiscal prudence and financial wherewithal.

The model with its pillars, as well as the internals of the pillars is depicted in Figure 1 below.

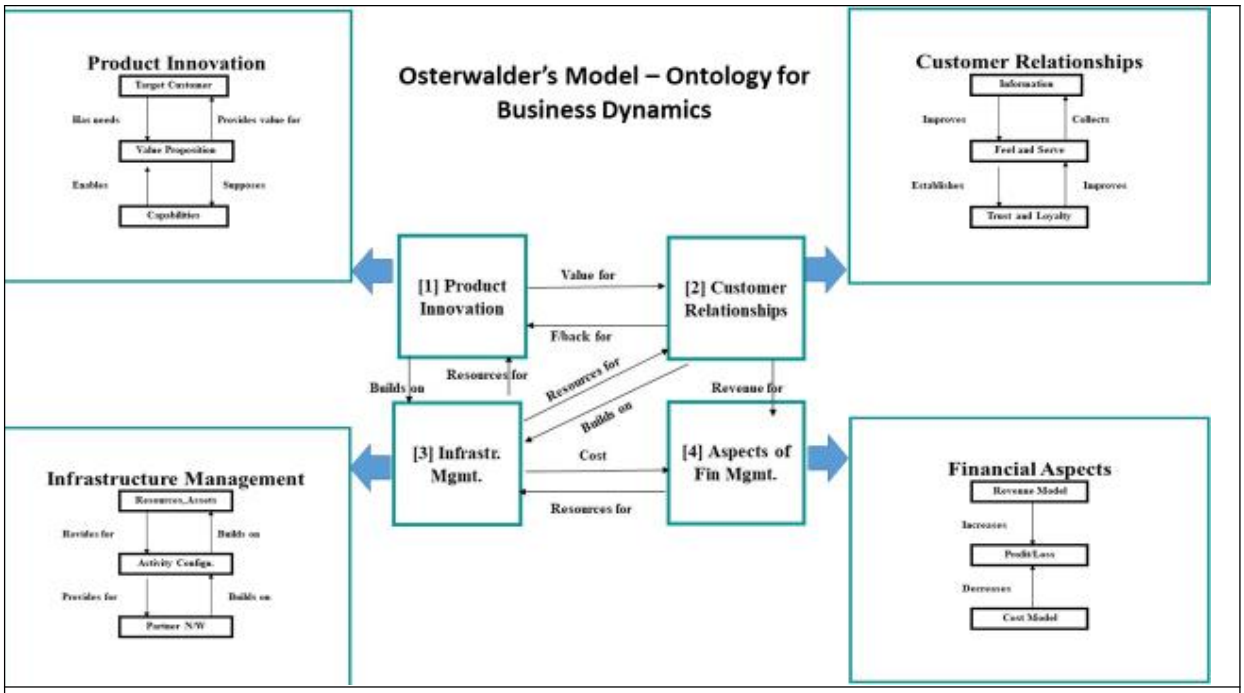

Figure 1. Osterwalder model - the ontological framework to assess technology impact

4. The Curriculum Development Process

In general, a curriculum for an educational program is developed in a strategic top-down approach. At first, the knowledge seekers are identified, and the fundamental goals of the program are articulated. For example, an MS program in Financial Engineering identifies business students with strong mathematical and statistical skills as the knowledge seekers and their gainful employment in the financial markets as its primary goal. At this point, often another program that is envisaged as similar, competitive or aspirational is identified, and its students and program goals are often benchmarked for strategic marketing purposes.

The above process then leads to ideation and identification of the knowledge domains, which must be included in the curriculum for the students to learn and master in order to subscribe and be compatible to achieving the program goals. These domain areas are then subdivided into individual courses where course-level learning objectives are identified, books and assignment resources are identified and validated, and plans for instantiation of the delivery of knowledge elements are delineated. Finally, a review/renewal period and the prescribed processes for curriculum review are laid out, and a manager (e.g., the academic director) is identified who is then charged with the implementation and continuous management of the curriculum for the program.

The renewal is a similar process where the above steps are traversed in quick successions to check out the updates that happened during the intervening time period and then commensurate modifications, and alterations are proposed, which are then approved through established university policy and process guidelines. However, it is worth noting that the process is once again top-down and led by an administrative or faculty leader or

the program manager. This renewal does not ensure motivated participation of the directly involved stakeholders, especially the faculty.

In contrast to the above, we propose that between planned yet infrequent top-down renewals of curriculum, closed-loop continuous updates be done through a bottom-up approach. Among other benefits that we have alluded in earlier sections, a bottom-up approach in the curriculum is expected to bring better alignment with instructors' ideas of knowledge and skill development in the students (McCarthy, 2008).

In our proposed approach, students and faculty collaboratively explore the impact of new technologies on extant business models. The process results in multiple vital outcomes:

- ✓ Plausible usage trajectory of the technology specific to a set of firms can be charted.
- ✓ Investigation of usage trajectories can lead to the identification of likely perturbations in internal and external business dynamics, which can be analyzed for firm strategies.
- ✓ New relationships among internal and external stakeholders can be identified, and the strategic interplay between competing firms can be researched.

The above, when done in a classroom setting with the help of mini cases and role play, will point to knowledge elements that students should learn in order to be successful when these technologies indeed disrupt existing markets and businesses. Once these knowledge elements are identified, they are then taught upstream in the next cycle in order to make the students know before they assess the impact of same/similar new technologies. Over time, a repository of sets of course level learning elements is transferred to the curriculum manager/custodian who then transforms them into course-level learning objectives. These course-level learning objectives have then coalesced across domain-specific outcome objectives in view of their collective alignment to the program objectives. Figure 2 depicts the commonplace top-down approach (left) as against our proposed small cycle close loop collaboratively approached incremental update initiatives (right) at the delivery end of the business curriculum.

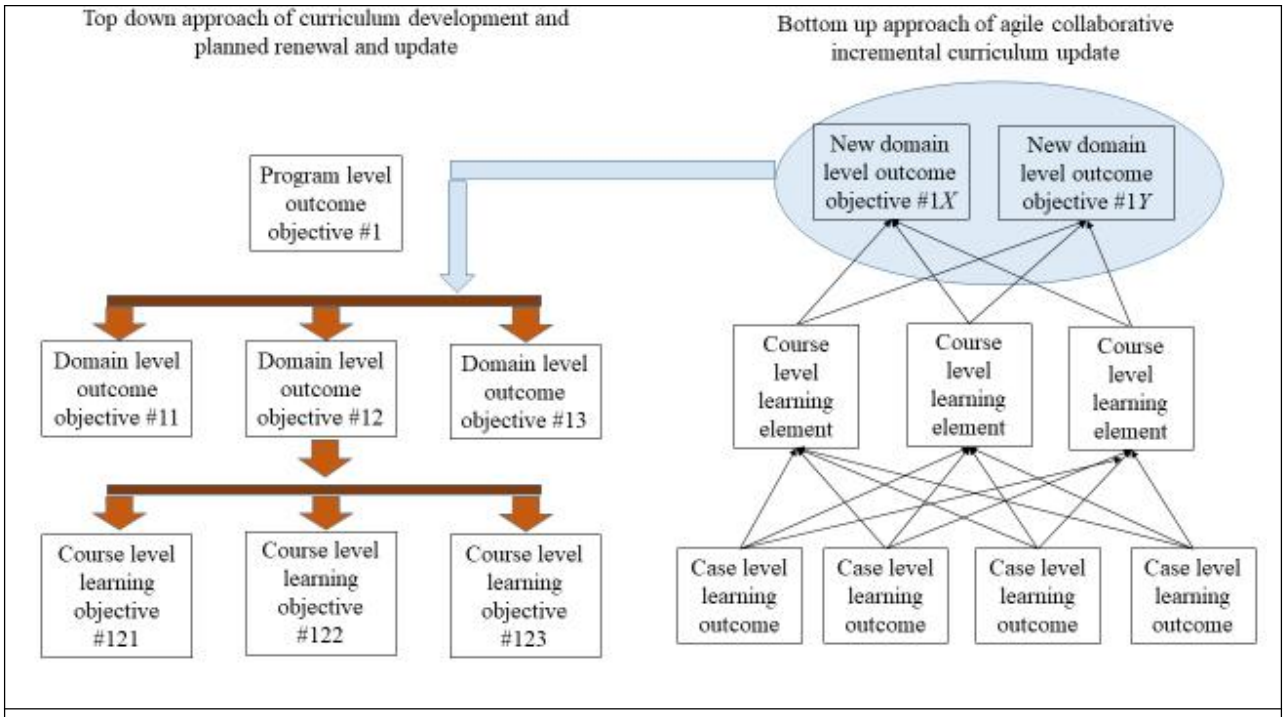

Figure 2. Traditional curriculum development (left) as against Agile, incremental update (right)

5. Chosen Ontology to Identify Emerging Learning Elements

In this section, we use the Osterwalder business model to explore plausible impacts of the emerging technologies of Artificial Intelligence, Block Chain and Internet of Things (henceforth AI, BC and IoT) on business dynamics and then identify the learning elements that should be integrated in the immediate next cycle of curriculum update We will use the hypothetical case of a sports and arena management (***SAM Inc***.) company that has its footprint over multiple clubs and several sports stadia as well as other entertainment venues in mainland USA.

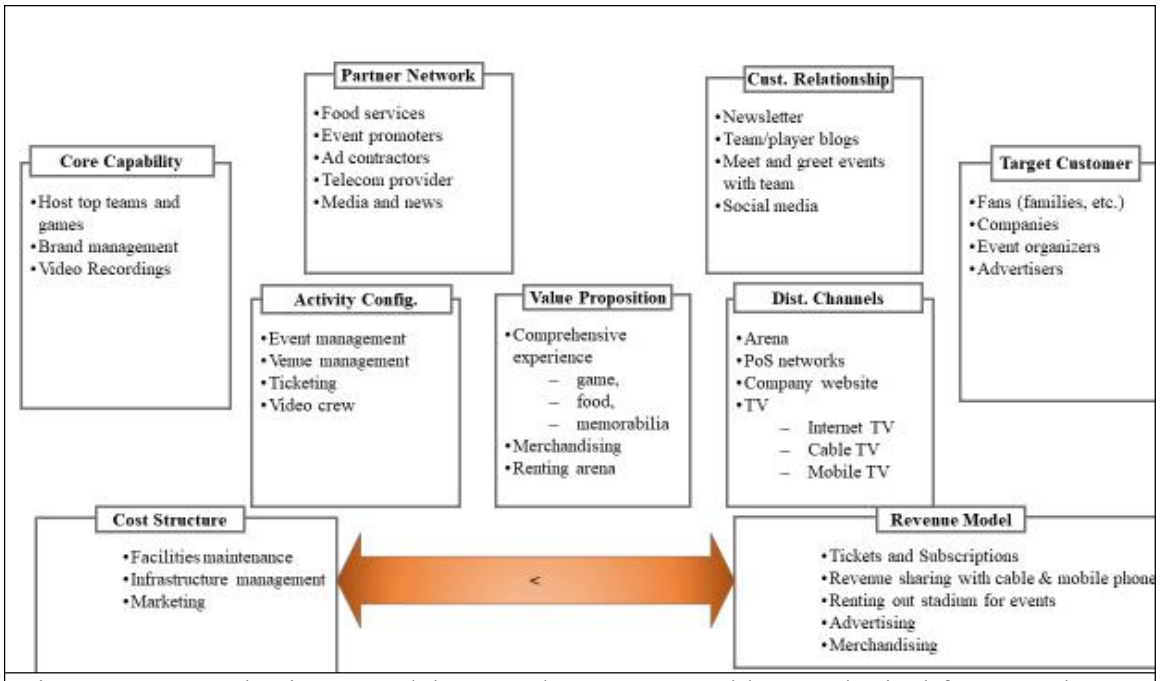

Figure 3. SAM's business model mapped onto Osterwalder ontological framework

Figure 3 is a minimally expanded view of the internal dynamics of the interdependent pillars of SAM Inc's business model. In other words, an abridged mapping of SAM's business model on the ontological framework of figure 1 yields figure 3. Note that figure 3 already represents the current state of affairs where extant technologies of the internet and mobile TV, as well as Web 2.0 capabilities like Blogs/Vlogs, are already being utilized in the business model of SAM Inc. This also means that the current curriculum that the business students use is assumed to have learning objectives related to these technologies already implemented in the business models of modern organizations like SAM, and that they are poised for the new learning elements that are geared towards understanding and using the emerging technologies of AI, BC and IoT.

As the next step, we are now ready to explore plausible use cases in SAM when the emerging technologies of AI, BC, and IoT are eventually included in their business processes (figure 3).

1. ***AI use case - AI enabled chatbot in SAM mobile apps***
    a. **As-is system**: SAM currently has mobile apps that can be freely downloaded by users and fans to buy tickets and season passes seamlessly. These are prefixed menu driven. Escalations are handled by human operators who engage the user through in-app chat or by calling their registered cellphones.
    b. **To-be system**: SAM mobile apps has AI enabled, learning chatbot that can process natural language, and sense urgency, immediacy and other human sentiment patterns. Up sale of chosen event tickets and cross sale of tickets for other events are seamlessly suggested and processed. Patrons use verbal commands to purchase food and beverage services through the

app. Intelligent chatbots suggest (learnt from previous orders) and take food and beverage orders. Orders are optimally delivered with GPS enabled routing, executed by the waiters who bring the food to the stands. Fanfoot traffic in the stadium area, as well as the concession, stand areas are minimized.

2. ***IoT use case - IoT enabled temperature monitoring of F&B repositories***
    a. **As-is system**: The fundamental nature of business dictates that **S**AM stores food and beverage items in stadia concession storages for long durations with sporadic and intermittent use. This requires regular visits by local technicians to the facilities and make sure that the refrigerated and frozen food and beverage areas are indeed maintained at vendor recommended temperatures. This requires expensive maintenance contracts at all disparate cities and locations where stadia and venues are managed by SAM.
    b. **To-be system**: Food and beverage storages in stadia concession and venue storage areas are now fitted with IP V6 IoT thermometers that are network discoverable. The national footprint of all such IoTs is geographically mapped and visualized on mobile dashboards. A small group of technicians, through a flexible and cost-effective contract now makes sure that the refrigerated and frozen food and beverage areas are indeed maintained at vendor recommended temperatures in every venue and stadium. IoT sensor enabled weight scales are used to validate energy consumption in cooling food and beverages, and data mining opportunities provide further cost-cutting opportunities. Outages and equipment failures are immediately known with the help of automated alarms and quickly attended. Spillage and theft are promptly and meticulously calculated, lost sales are minimized, leading to higher profitability of the venues.

3. ***BC accounting on hybrid IoT-traditional payment use case - venue parking***
    a. **As-is system**: SAM managed venues and stadia house extensive parking facilities. Fans and patrons bring thousands of cars. Entry to these parking garages is timestamped and ticketed. On return, patrons and fans present entry tickets in automated PCI compliant magnetic strip swapping and NFC CC reader enabled exit kiosks which collect payment for metered parking. A separate accounting system collects the payment data and reconciles with maintenance and towing contracts. A dedicated group of attendants assist patron and man exit booths.
    b. **To-be system**: All three different variants of payments are acceptable: (a) patrons with apps on mobile phone drive through open gates in the parking. The app timestamps entry and locates parking spot on a GPS map. Stored credit is debited on exit, (b) IoT enabled cars to enter through open gates and is device-guided to a parking spot. The car IoT device negotiates and delivers payment with the help of stored DC/CC data to IoT payment receptor at parking spot itself, and (c) usual timestamped ticket and CC payment as described in the as-is case. All three payment servers write the

payments on BC blocks. A dedicated BC hyper ledger manages the relationship with the towing and the parking security contractors, whose IoT devices monitor parking garage activities and provide P2P assurance and control.

Finally, we are now ready to identify and isolate the learning elements that the above new technologies would require us to include in the business curriculum for our students to be familiar and conversant with their uses, growth and impact in order to be a successful business manager of tomorrow. A small but characteristic set of use case centric learning elements is listed below. Note that a minimally sufficient (not an exhaustive) set of learning elements, the breadth and depth of which will depend on the actual degree program is the goal, which however is beyond the limited scope of this paper.

Knowledge Domain – Information Systems and Marketing

- **Representative Learning Elements from Use Case 1**
  - Definition, history and development of AI including neural net.
  - Natural language processing and development of IBM Watson. Use of IBM Watson in chatbot (CRM) and diagnostics (healthcare and other expert systems) for rule and case-based reasoning, now with semantic capabilities
  - Semantic databases, Predictive modeling and Data Analytics.

Knowledge Domain – Information Systems and Operations Management

- **Learning Elements from Use Case 2**
  - Definition, history and development of IoT. Device cost and operability.
  - Mashup services and business value of IoT devices overlaid on GPS.
  - Marketing and CRM opportunities that are location resilient.
  - IPV4 and IPV6 compatibility issues, network discoverability and IT security issues.

Knowledge Domain – Information Systems and Financial Management

- **Learning Elements from Use Case 1**
  - Definition, history and development of Block Chain and Hyper ledger.
  - IoT payment, P2P and shared accounting and shared trust.
  - Smart contracts, Ethereum and similar platforms for smart contract development and shared enforcement of accounting control.

It is interesting to note that the isolated knowledge domains are in the interface area of multiple pure domains. However, this is not something that is unexpected. As new IT and IS technologies are incumbent on business models, their understanding would likely need both technical as well as other organization-specific understandings. For example, students may begin to learn about IoT devices, and the IPV4 and IPV6 protocols and their benefits and security risks in there IS classes. Later, they may be exposed to mini or full-length cases in OM area where IoT augmented process optimization is compared and contrasted against traditionally served business processes, e.g., in SC management.

Between these two sets of input, students will not only be able to appreciate the value of IoT networks in business, they will also be able to identify opportunities and evaluate the opportunistic deployment of IoT networks in business decisions.

Figure 4 is an embellished view of figure 3, where the above learning elements are actually manifest in terms of business decisions/strategies/artifacts and are shown on the business model of SAM Inc., which as explained earlier, is in turn mapped on our chosen Ontological framework of Osterwalder Model.

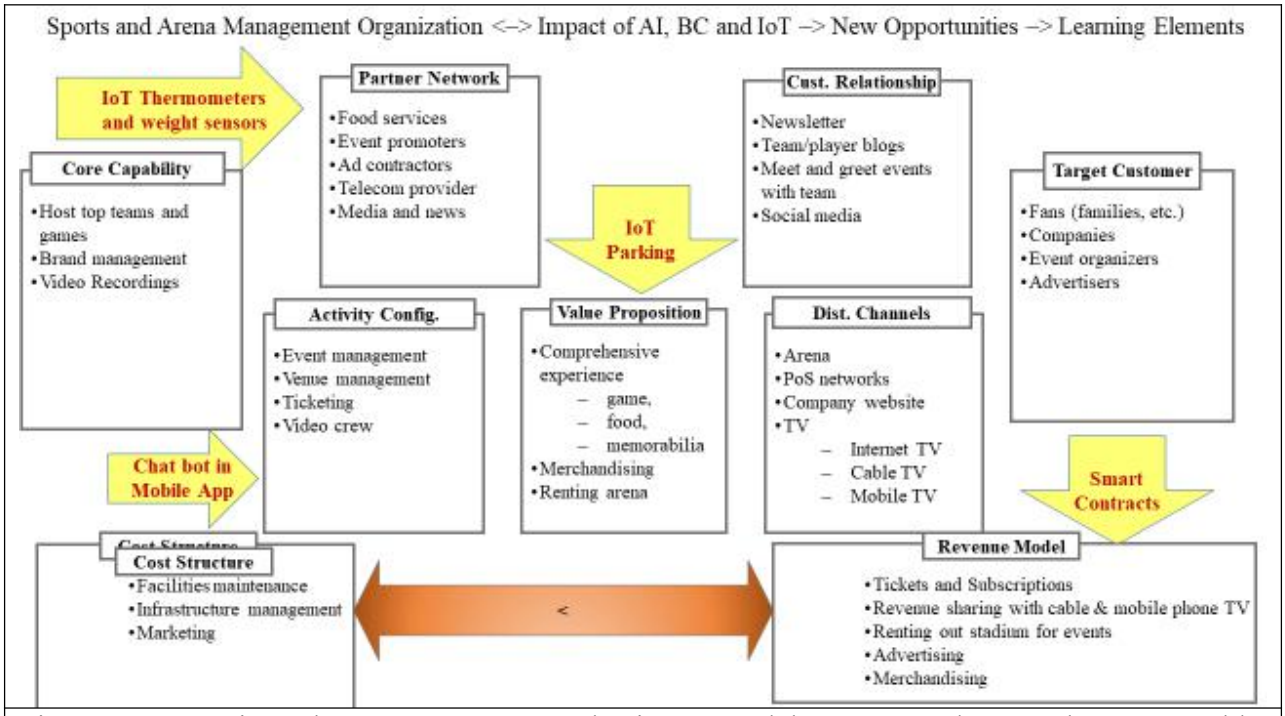

Figure 4. Learning elements on SAM's business model as mapped onto the Osterwalder ontological framework

6. Future Research and Concluding thoughts

Curriculum renewals are infrequent, painstaking and laboured processes that must pass through myriad decision chains in a university. On the contrary, the technologies of the 4th. The industrial revolution is evolving rapidly. The impact of these technologies on business processes, decision frameworks and strategies are also deep, immediate and unrelenting. Competitive survival of organizations in the fast-moving world requires smart, appropriately trained and learning managers. In turn, business schools need a process that ensures continuous renewal of curriculum that is in effect marked by the market in terms of the knowledge and skill demand.

Facing the above, we suggest business programs mimic the agile paradigm of software development and use an appropriately chosen ontological framework (Osterwalder model here), to assess the impacts of new technologies on businesses. Learning elements identified from such assessments can guide educational initiatives that upcoming students

will experience. This will ensure that our graduates are competitively and gainfully employed in the business world.

This is new research and is a part of a more significant effort to a planned programmatic curriculum design process. The main objective of this paper is to propose a viable theoretical framework to analyze the organizational impact of emerging technologies and isolate knowledge elements essential for the managers to learn. The immediate goal of this paper is to present the idea with preliminary assessments to peer groups of business faculty and seek feedback to develop a broad roadmap. Our future plan is to build a model of the impact of emerging technologies on business processes that are specifically focused on providing a bottom-up curriculum renewal process in business education through a collaborative, continuous and agile approach.

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