A business simulator for reality mining

Emergent Research Forum Papers

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Introduction

Interest in "Big Data" has undoubtedly increased since the turn of the millennium. ProQuest peer reviewed publication data (2015) shows one publication in 2000 and 676 in 2014. One aspect of the concept is reality mining (RM), often seen as investigating complex social behaviour from machine-sensed environmental data (Eagle and Pentland, 2006). Organizations, developers and consultants have all hailed this new mantra. Analyzing personal data from mobile phones and other user devices was considered one of the breakthrough ideas for 2006 (Gardner et al., 2006).

A big challenge facing academia is finding ways to integrate emergent concept into educational settings. During the past two decades several concepts have arisen and affected business/IT education. Many could be mentioned. Knowledge management, data warehousing, business intelligence, cloud computing and, in a bigger picture, enterprise resource planning, would certainly be valid candidates. In recent years, we have also added reality mining to that list for the undergraduate business/IT ERP program.

Adding further to this challenge is the need to develop teaching cases which enhance students' learning in relevant areas and inspire to discussion. This research in progress paper presents ideas for a teaching case with relevance both to business simulations, learning, and reality mining. With input from teachers, researchers and practitioners our aim is to develop a framework which can be helpful when creating a (for academia) free simulator/generator of RM and Big Data which enhances student learning. We plan to let the future simulator collect (generate) and visualize data from a (fictitious) shopping mall in order to trigger discussions on value creation for involved businesses. We have selected a shopping mall as our initial location as almost every student has a relation to such a facility.

In summary, the paper is a *call for participation* or at least a *request for ideas and advice* for the development of our proposed application. It is not only a matter of building the simulator. It should also work towards better student understanding of related concepts and increased interest knowing more. Hence, insights in the application area are vital – as is an interest in innovative teaching and learning practices.

Reality mining

Reality Mining has brought new ideas to Business Intelligence and Data Mining. Coined by researchers at MIT (Eagle and Pentland, 2006), the RM concept targets information access, social relations and user group (*tribe*) behavior (Eagle, Lazer and Hanson, 2009). It builds upon "Big" data (Datt, 2011; Sheridan, 2009) – large amounts of data generated from individuals and their devices. The data is in itself lots of little data: examples mentioned are entered cell phones numbers, addresses in GPS devices, website visits, online and ATM transactions, and other activities adding digital trails (Eagle and Greene, 2014).

Data collection from mobile devices – and where the collection does not require explicit consent from the carrier/individual – is often named "unobtrusive" (Gil et al., 2012). Typical applications include shopping mall visitor flow analysis (Galati and Greenhalgh, 2010; You et al., 2011) and services to help visitors find a location (Ausmeier et al., 2012; Takeuchi and Sugimoto, 2009).

There is – and has been for a number of years (Johnson et al., 2004; Joseph and George, 2002) – an ongoing discussion on content in ERP classes/degrees in general and also specifically with regard to Data Mining (Wu, 2012). Searching Summon, a ProQuest service (2014) indicated however that Reality Mining was not common in any curricula yet. Not even a paper with specific focus on the ACM SIGKDD (Knowledge Discovery and Data Mining) base curricula (ibid.) mentioned keywords such as "Business Intelligence" or "Analytics". Although changes most often will – and probably need to – take time, it seems as if insights from earlier research not always find acceptance in the short (currently, 13 years) run:

...volatility and change has been the hallmark of technology, and Enterprise Resource Planning (ERP) may not be immune from such changes...(Joseph and George, 2002)

It is unlikely that a topic such as Reality Mining or insights about mobile Big Data currently, and in a foreseeable future, will be at the center of ERP education. There are however many indications(Ho et al., 2011; Vaughan-Nichols, 2009) that LBS (Location-Based Services) data will both expand over time and become further interesting from many perspectives. Mobile phone subscriptions are predicted to reach 9.5 billion by the end of the decade, with 6.1 billion smartphone subscriptions. Almost 90% of mobile subscriptions (overall) will be able to handle broadband, and 90% of people aged six years and over are predicted to have mobile phones by 2020 (Qureshi, 2015). Data generated from mobile sources will, as we see it, be increasingly important over time as part of Big Data and part of Data/Reality Mining.

If a goal is to let students better understand the data they analyze and how it has been generated, initial trials indicate that active engagement in the data generation itself, in a simulated environment, may be one way to reach such a goal; merely looking at "what RM data looks like" will probably not do the trick. A simulator, able of both generating reasonable "big" volumes of data, combined with exercises which can highlight important concepts and a sense of being part of the data is an interesting idea. Before continuing on a more concrete suggestion, an overview of work related to the topic seems in place.

Business simulation in IS education

Business simulation has been used in educational settings within organizations since the mid 1950's (Mahboubian, 2010). As ERP and Decision Support Systems (DSS) started to be used in academic courses in the 1990's, one teaching approach was to use business simulations. One example is ERP-Sim (Léger, 2006), another to simulate CRM procurement processes (Heim et al. 2005). There are also examples involving business simulations when training IT consultants (Ben-Zvi, 2010). Business simulation refers here to exercises that represent processes involved in productions and services (Mahboubian, 2010). One important aspect of these simulations is to imitate operations of real world processes (Heim et al., 2005) and hence to teach a specific process within a specific environment (Mahboubian, 2010). In our case the idea is to simulate such real world processes through data generated by "visitors" in a shopping mall.

The literature review identified many positive effects of business simulation in IT education. One example is the use of a business simulator in order to demonstrate how information systems support business strategies (Hopkins and Foster, 2011). Another example reporting similar positive effects is that business simulations support participants to work collaboratively using a variety of skills to achieve a common goal (ibid.). There are also claims (Léger, 2006) that business simulations will support students' understanding of the value creation process in modern business. Perhaps the most important positive effect of business simulations in teaching is that they raise student engagement and motivation (Lin and Tu, 2012; Tao et al., 2009), vital for reaching higher understanding/better knowledge transfer (Leger et al., 2010).

Business simulation is also related to different learning traditions. Many articles view learning by doing as a philosophy (Deshpande and Huang, 2011; Léger, 2006) while other argue that business simulations are related to problem based learning (Léger et al., 2011) which then relates to the ideas of learning by doing. A third suggestion mentioned sees business simulation as highly connected to *experiential learning* which describes an encounter where a phenomena is being studied rather than merely thinking about that encounter (Heim et al., 2005). Experiential learning has its roots in Kolb's theories of learning (Heim et al., 2005). One important aspect of experiential learning is reflection (individually and in group) which is crucial when it comes to understanding relationships or structures (along with its components) in the information to be analysed (Pasin and Giroux, 2011).

In order to express the students' expected learning outcome from our teaching case we plan to adopt Bloom's revised taxonomy (Krathwohl, 2002). The main reason for doing so is that the taxonomy fits very well with experiental learning (Heim et al., 2005). It has also been used as a tool to identify learning outcomes in ERP education (Ben-Zvi, 2010; Johansson et al., 2014). In the revised taxonomy, there are two dimensions (Krathwohl, 2002): a cognitive process dimension and a knowledge dimension.

There are six categories in the cognitive process dimension: to remember, understand, apply, analyse, evaluate and create. Remembering is about retrieving relevant knowledge from long term memory. Determining the meaning of instructional message and communication is referred to as understanding.

The third ("apply") category deals with carrying out or using a procedure in a given situation. To analyse, the fourth category, is described as relating parts to each other and to an overall structure or purpose. Other authors (Mayer, 2002), focus on analysis in terms of an important learning outcome. Making judgements based on criteria and standards is the fifth category, referred to as evaluate. The last category, create, puts elements together to form an original product.

The knowledge dimension contains four main categories (Krathwohl, 2002); factual, conceptual, procedural, and metacognitive knowledge. Factual knowledge is described as students dealing with the basic elements within a discipline in order to become acquainted with that discipline. Conceptual knowledge contains relationships among basic elements and a larger structure enabling them to function together. Procedural knowledge focuses skills, methods and techniques. The fourth (metacognitive) category is seen as knowledge of cognition in general as well as awareness and knowledge of one's own cognition.

Setup of teaching case

In a pre-study (Svane, 2014) we tried out an approach with manual input combined with application generated data. It is difficult to find RM data for a classroom setting so students were asked to actively take part in data generation by scanning QR (Quick Response) codes. We created a fictional but realistic shopping mall which they "visited". Adding further to the realism, a complete concept for registering visitor data was set up, engaging shop owners and facility management (all fictional). Finally, we created incentives (a "lottery" where each scanned code represents an entry/ ticket in a later – also all made up – drawing for prizes) to invoke student discussions even further (Figure 1). The setup of the teaching case matches the idea of a business simulation (Mahboubian, 2010). The fictional realism of the shopping mall that the students encounter in the teaching case is seen as an example of experiental learning.

Our first tool for analyzing results (called the VisiTracker concept) got its own website describing the idea and a "selling video" to boost the idea further. We created close to 50 personas (shop owner profiles) and made six short videos where shop owners spoke about the coming event (the QR code days in the shopping mall). As described earlier create is a cognitive process (Johansson et al., 2014). In comments from students, the package was perceived as very realistic, which is a fundemental idea in business simulation (Heim et al., 2005). One important effect of business simulations is that it raises student engagement and motivation (Lin and Tu, 2012; Tao et al., 2009). One example of raised engagement in the pre-study was that some students took on roles as shopowners in the mall. From speaking to the students after the workshop, it would seem as it enabled them to get a better understanding of Data Mining in general and the potential of Reality Mining specifically.

Figure 1: Overview of first version of simulation (shopping mall and resulting data)

Data mining and reality mining are examples of conceptual knowledge (Krathwohl, 2002) and understanding is a cognitive process that is supported in the business simulation (Pasin and Giroux, 2011). In discussions on emerging interaction technologies and demonstrations of the mobile phone as part of the SMILE acronym (Svane, 2013) this first setup has also proven useful. SMILE stands for Speech, Movement, Image, Language and Environment (new interaction forms).

The application as well as exercises and workshops building on the proposed concept will require further refinement over time as mobile technology and ideas for services develop. This approach connects well with business simulation findings and many cognitive processes such as to analyze and create (Krathwohl, 2002). It is a first step in introducing concepts which often are difficult to demonstrate with standard ERP data. An approach recognizing learning-by-doing (Léger, 2006) would, we believe, be an interesting twist.

Generated student data is not currently integrated in the university's course ERP system but data can be analyzed with packages used for other ERP/BI exercises or through the simulator. It is impotant during the analysis of the data that the students are given the oppurtunity to reflect individually and in group from different perspectives. A student session generates useful data but not "big" (in volume) data so added, fictional data points are needed. But from student comments there seem to be an added interest when using "own" data in the exercise.

Although field data was very limited the demonstrations also raised awareness among students when it came to their own/personal and constant transmission of data when at locations where such information can be gathered – which, at least in a modern society, is almost "everywhere". While data collection merely records device location and behavior, most group discussions seemed to end up in addressing concerns for the individual, more than systems and technology. The idea of group discussions that supports reflection is also highlighted in the literature (Pasin and Giroux, 2011).

Improving and revamping a Reality Mining Simulator/data generator

It is imperative that different areas of expertise easily could provide useful and multi-faceted input especially when it comes to analyzing data from reality mining. We have already discussed with colleagues in mathematical modelling, algorithms and AI and we would of course welcome further interest in participation also here. A different end of the spectrum would highlight input from disciplines such as economics and sociology...from behavioral sciences in general. Expertise input from within our own areas (IT and IS, ERP systems etc.) would also be greatly appreciated.

The first prototype of the "new" simulator will be built in the spring of 2015. The "Shopping Square" will be just that – square – to make movement calculations easy in our first attempt. Parameters will also be limited to only a few for initial simplicity. We hope however the project will gain momentum fast if we can trigger interest in participation. Slightly biased, we see this as both a fun and an interesting challenge.

Without foregoing valuable suggestions from the intended community, let us briefly mention some ideas that have come to mind. The application will be PC based, meaning it will be run offline, with its data generation only affecting a local machine. Becoming involved (with an option to download the software) will be online as will discussion forums for application development and teaching practices. For generated data sets, we initially propose an XML format for simple integration with various analyzing tools. Visualization may be both local and web based. If student data input will be part of such data, it will be through apps or machine-sensing technology (but we anticipate there are few at this time that has such an option).

In a later version, users may add their individual mall layouts. Shop data could also be extended i.e. floor size would determine the maximum number of store visitors at any given time, as perhaps a value for how many shop assistants/points of sale there are, and an indicator for how long a fictitious customer will wait to be served. Simulations can be simple and (is there a limit?) extremely advanced. Our first goal is to get input, expand the spring 2015 prototype to include some of the suggested features, and then evaluate and report on experiences and insights from that process.

Expected Outcomes

Parallel with application development will be a refined specification of models and parameters and, we hope, a forum for discussion also on the teaching aspects: how can we build this simulator so it adds value to understanding, interested and inspiration. Working with development may also add to our own insight about how simulations can be used in teaching in our discipline. With many engaged, we can share our experiences, exercises, workshop setups... There is however a definite need for a critical mass to succeed.

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