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Present and Future Languages – How Innovation has Changed Us

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Abstract

Given the growth in usage of online social networks, such as Facebook, YouTube, Instagram and Snapchat, which rely on videos and images (such as photos) to relay information between connections, new intuitive languages, though not yet formally recognized, have emerged. We also herein give the example of a new language we have created – the Business Narrative Modelling Language (BNML) – which communicates business perspectives based on pictorial representations, supported by the narrative. Currently, the concept of language is linked to the use of words. We foresee that such a definition of language will have to change to include other structured forms of communication, resorting and relying on graphics, also. We give examples of BNML representations, with regards to two case studies we have performed, based on face-to-face interviews and company visits. At ExpressGlass technology plays an important role, while at Yazaki Saltano a remarkable team effort between Toyota suppliers is made evident, to create innovation.

Keywords: new languages; online social networks; digital revolution; business narrative modelling language; bnml; innovation.

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Introduction

In an increasingly digitally connected world where "contemporary technology innovation is increasingly based on convergence and the multiple uses of products" (Filho, Lima and Lennon, 2014, p.106), modes of communication have changed quite dramatically, and new, often uncharted, languages have appeared. Children communicate quite intuitively with tablets, mobile phones, and computers, and in particular with video games and online social networks. This is done quite remarkably without the normal training associated to technology adoption and transfer (Araújo and Teixeira, 2014). Children who are not yet able to read or write in the formal languages we recognize are able to "speak" other mainly visually-based languages with ease. On the other hand, social media has reduced, or certainly simplified to a large extent, "literacy to tweets and text messages… [and] much has been lost in the era of the instant message" (Holden, 2014).

This article starts by providing a background to the topic of language, then moving on to a discussion of how communication has changed. In particular, our work has led to the creation of a storyline view and a plot view (or integrated view) of data (figure 1), two levels of analysis portrayed after gathering data during interactions with corporations – both a part of our novel Business Narrative Modelling Language (BNML) (Oliveira and Ferreira, 2011; Oliveira and Ferreira, 2012a, Oliveira and Ferreira, 2012b; Gonçalves et al., 2013; Au-Yong-Oliveira and Ferreira, 2014). The storyline view is created using Microsoft PowerPoint software and following interviews in corporations, where stories are relayed using the narrative. Actors are shown to exchange tangible and intangible deliverables, over time, in a process of asset usage and creation. The plot view, in turn, is the next step in BNML, and is created using Graphviz software – open source Graph Visualization Software – for "representing structural information as diagrams of abstract graphs and networks" (Graphviz, 2015) – which almost automatically creates diagrams based on interactions over time (using as an input a simple sequence of terms, simpler than formal programming, though following the same kind of process; the output being visual representations, as in the top of figure 1 (plot view) and in figure 4). We foresee that the supply and demand of such visual representation software will greatly increase in the future, thus more easily making way for the conversion of data into an understandable form and "empower[ing] anyone to read, process, analyze, and visualize data" (Borner and Polley, 2014, pp.2-3). We seek to add with our pictorial representations a novel way to make sense of data (Borner and Polley, 2014), providing an example of how language may formally evolve in the future. The necessity of structure in language is then focused upon before we conclude our article.

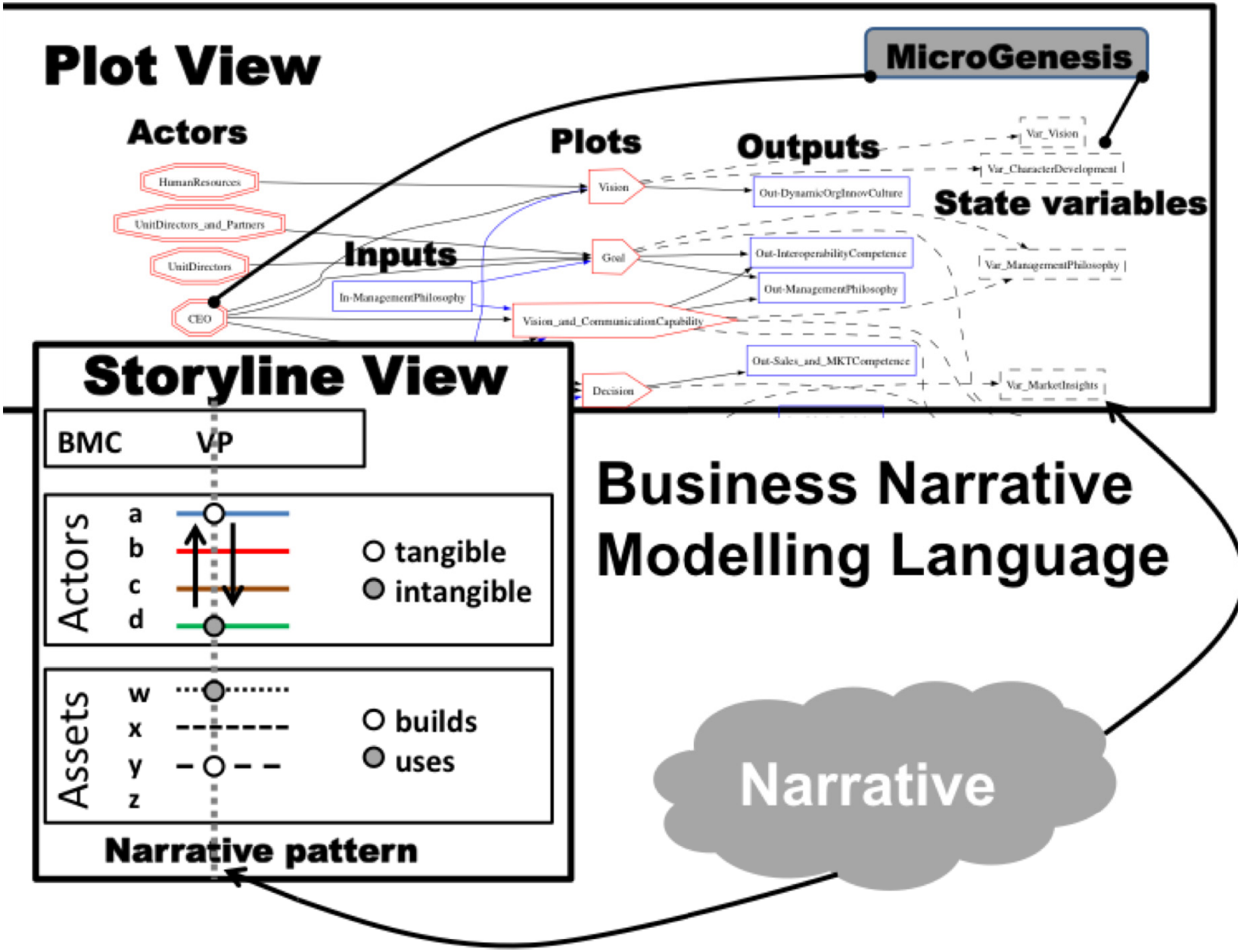
Human evolution - Background

Since the Stone Age human beings have been communicating with each other, to be able to survive and prosper. At that time in particular, collaboration was necessary to be able to hunt animals much bigger, and much more powerful, than themselves. Primitive drawings on cave walls were the first attempts at knowledge capture and transfer, but these drawings had to be left behind when the cave dwellers moved on. In the current age of the portable computer, the tablet, the smartphone, and of the cloud this may seem strange, to not be able to take our knowledge with us, wherever we go… We eventually progressed to capturing knowledge on paper, and this form of communication marked a very significant step for mankind – books were soon born, as were libraries and scholars in ever greater numbers.

Ancient Greece marks the beginning of European civilization, and "if we look for the origins of our philosophy, our art, our literature, our maths, our science, our medicine… we are taken back to Ancient Greece" (Hirst, 2009, p.5). The Greeks were bettered by the warring Romans, but the Greeks were still recognized for their intelect, and so "a member of the Roman elite could speak both Greek and Latin, the language of the Romans" (Hirst, 2009, p.7). The Romans did not suppress local languages, which would have been hard to achieve, but Latin prevailed quite naturally, and was "spoken in the further reaches of the empire" (Hirst, 2009, p.118). Latin is very succinct and the order of words, when putting together a sentence, does not matter (Hirst, 2009), much as the icons on a smartphone or tablet screen can be put in any order without having an effect on the message being communicated. So, our written communication mode started out by being very visual (in the Stone Age), and when words were used in what can be seen as a global form, by the Romans, a lot of flexibility existed. We shall see below that this visual, strangely flexible, yet structured mode of communication, has evolved in our era of technology quite uniquely.

As early as the late 19th century, the importance and relevance of mental imagery had already been recognized, and "in his book Inquiries into Human Faculty and its Development (1883), Sir Francis Galton discussed mental imagery as a special ability of human visual memory" (Laeng et al., 2014, p.263). More recently, Laeng et al. (2014, p.263) "conclude that the generation of mental images relies upon a process of enactment of gaze that can be beneficial to visual memory." If one considers that the role of memory in many human endeavours is essential, as we are basically reliant on learned behaviours and an acquired culture, then communicating with visual representations can be very beneficial, especially when one is called upon to recollect them. "One remarkable finding of several studies of imagery

Figure 1 – The Business Narrative Modelling Language (Oliveira and Ferreira, 2012b)



is that while imagining something there appears to be a lot of motor activity… during visual imagination, movements of the eye-balls was registered, while when thinking, one could register brief contractions in muscles of tongue" (Laeng et al., 2014, p.264). Coupling imagery to imagination is thus activity-generating, and if we see activity as being a positive occurrence, then a new language that promotes this should be welcomed. Albert Einstein, for example, first visualized and imagined, to a great extent, what then led to his theories about space and time, and the theory of relativity, leading to him being considered one of the most important thinkers of the 20th century (Laserna, 2012). What would a beam of light look like when caught up with? asked Albert Einstein (Laserna, 2012).

What we postulate is that new languages are currently being created, though we may not at times be fully aware of them, and these new languages move beyond traditional forms of communicating.

We have used images from our historic beginnings, to now once again move towards communicating essentially with visual images. Graphic facilitation has been used for large groups in corporate settings for several decades, e.g. while in a big group and when someone is talking an element may be drawing pictures of what is being said, on a 15 foot wall chart, thus creating a pictorial representation. Will we in future see graphics searching, much as today we see Google allow for word searches? Visuals manage to achieve what often words cannot. We see parents using iPad tablets as babysitters (we have done so at home ourselves), iPads mainly using the language of film but also of gaming (once again, images in movement). Images, let it be noted, are different (better, we see) to tables. Graphics allow you to see what you are doing, and often no graphics and all words is seen to be bad communication. Pictorial representations, when duly accompanied by the narrative, can improve recall and comprehension, in a number of different topic areas.

This phenomenon is easily explained when we analyse how the brain system functions and handles information in order to try to improve the learning processes and the mechanisms of communication. Our brain is divided in two hemispheres, connected with fibres, which interpret the world differently (Di Carlo, Khoshnevis, and Udwadia, 2009). The left brain thinking or the L-mode is the analytical, quantitative, verbal, rational, linear, step-by-step thinking. The right brain thinking or the R-mode is the integrative, qualitative, holistic, creative, visual thinking.

The latest neuroanatomical and neurophysiologic studies show that the right brain is in charge of image recognition. Pictures are images of the real world and therefore picture recognition is a task for the R-mode that is capable of dealing with complex visual elements (Soliman, 2005). The pictorial representation and the amount of information that it can handle, as well as the facility to be stored in our memory, is frequently illustrated by the aphorism "a picture is worth a thousand words". The "ideal" performance can be achieved with the inter-play between the left and the right brain or the whole brain thinking, which allows mixing science and art, creativity and practice, words and pictures (Ramos, Ferreira and Barceló, 2012).

This is an era in which we can see a number of visual modelling languages appearing, such as in the case of the domain-specific language Collaborative Interactive Application Notation (CIAN) (Molina et al., 2013), for "the modeling of both interactive and collaborative issues" (Molina et al., 2013, p.1772). We are thus not alone in thinking that "business processes are commonly modelled using a graphical modelling language" (Laue and Awad, 2011, p.385). Indeed, "the most widespread notation for this purpose is business process diagrams in the Business Process Modeling Notation (BPMN)." (Laue and Awad, 2011, p.385). Consider a scenario where more such languages will appear, for example Laue and Awad (2011, p.385) stated that "we use the visual query language BPMN-Q for expressing patterns that are related to possible problems in such business process diagrams", demonstrating how visual representations unite with the narrative to communicate and solve problems. Bojanova (2014) speaks of the digital revolution and of disruptive IT (information technology) innovations, and one should acknowledge how this has changed us, namely how we spend our time and how we exchange messages. Moriarty and Honnery (2014, p.32) quote Kurzweil (2005) in stating that "technological change is not linear but exponential" and that "the time between successive major innovations has been decreasing exponentially for at least the past 10 millennia" (Moriarty and Honnery, 2014, p.32). If this is the case, new and improved forms of communication can be expected to appear. Even the popularity of the best-selling Business Model Canvas (Osterwalder and Pigneur, 2010) is a significant sign of change in communication modes, accessible by, as well as extensively used by, the general population interested in management and management-related social science issues. The issue is how well we are prepared to receive messages in, and respond in, intuitive visual form. This capacity has improved due to our interactions with technology on a widespread basis. BNML, described herein, is a language we have created, resorting to images and the narrative, to communicate business concepts and strategic roadmaps. For example, following interviews in a company, to determine how value is created for the customer, we can create BNML representations based on enterprise ontologies, ontologies which are used to provide structure and standardization. Note that the ontologies used may vary, and the language may thus be applied to other areas, such as the life sciences, or energy, for example.

"A nation's language, so we are often told, reflects its culture, psyche, and modes of thought" (Deutscher, 2010, p.1). So, then, do the new languages of the future reflect how the leaders of tomorrow will think: with more images, less words, and more movement visible in the dialogue. We are on a path of change, spurned on by the technology we use in our day-to-day communication, used in increasingly more digital and social network contexts.

For example, should the discussion revolve around which languages we will speak most in 2050 (Franklin and Andrews, 2012)? English, Portuguese, French, Spanish, Chinese? Or should the discussion involve what new languages and forms of communication we will be using in 2050?

What is the real impact of the computer age on language? Including the much-improved capability of computers being able to accurately translate narrative languages, taking as an example Google Translate (Greene, 2012). As technology gets better at translating will conventional languages matter less, much as what occurred with handwriting (Greene, 2012)?

There are currently 7.000 languages in the world (Greene, 2012). However, this number does not contemplate new visual forms of communication currently in use especially by the younger generations.

The change in human communication

Web 2.0 was called the "new lingo" in a world of blogs, tweets, wikis, podcasts, and mashups (Steenburgh and Avery, 2008). Consumers' media habits have rapidly changed: "Not since the advent of television in the 1930s had marketers experienced such radical shifts in consumers' consumption of media. Driven by the proliferation of new technologies like the personal computer, DVD players, and iPods, consumers were tuning out traditional media like television, magazines, newspapers, and radio and tuning in to new media options" (Steenburgh and Avery, 2008, p.2). Thus, new languages are being devised, as we speak, due in large part to how the digital revolution has changed us (boxes 1 and 2).

Box 1 - A number of social networks focus on images and videos – Over a billion users communicating primarily with visual content - Facebook, Snapchat, Instagram, among others. A new language has been created and which is accepted across national cultures:

- "Facebook is a social utility that connects people with friends and others who work, study and live around them." (Facebook, 2014). "Facebook is a popular free social networking website that allows registered users to create profiles, upload photos and video, send messages and keep in touch with friends, family and colleagues." (Whatis, 2014).
- "Capture and Share the World's Moments"; "Instagram is a fast, beautiful and fun way to share your life with friends and family"; "Take a picture or video, choose a filter to transform its look and feel, then post to Instagram - it's that easy" (Instagram, 2014).
- "So what exactly is Snapchat?"; this recently founded company "is essentially a mobile photo and video sharing service" (Covert, 2013).

Box 2 - Young children (i.e. aged 2 years old), who know not how to read or write, can navigate on www.youtube.com for hours, clicking on images of videos they recognize (related to Disney characters, the Barbie doll, among others). This is only achieved because a language exists, consisting of video and images:

- "Founded in February 2005, YouTube allows billions of people to discover, watch and share originally-created videos." (YouTube, 2014a).
- "Share your videos with friends, family, and the world." (YouTube, 2014b).

Has the written word thus been relegated to 2nd place? By the possibility to present and communicate data and information visually and dynamically, in an uncomplicated fashion?

We may need to redefine what a language is altogether. A language is currently defined as: "The method of human communication, either spoken or written, consisting of the use of words in a structured and conventional way." (Oxford Dictionaries, 2014). The redefinition of language could be as follows: "The method of human communication, either spoken, written or based on visual representations, consisting of the use of words or images in a structured way or by using a system that provides structure." (own elaboration).

Pink (2006, pp.1-2) stated that "the keys to the kingdom are changing hands. The future belongs to a very different kind of person with a very different kind of mind". This different kind of person includes creators, pattern recognizers, artists, inventors, designers, and storytellers. Whilst we became used to a logical and linear society and economy, in the Information Age, requiring computer-like capabilities, we need to be prepared for the move to what is more of a Conceptual Age (Pink, 2006). We need to equip our children for the future, states Pink (2006), which will involve knowing how to "detect patterns and opportunities, to create artistic and emotional beauty, to craft a satisfying narrative, and to combine seemingly unrelated ideas into somehing new" (Pink, 2006, pp.2-3). To this we add that not only a whole new mind is required, but a whole new language also, to go with it. That is what we have sought to have done with our novel BNML – a new language we have devised, based on both visual content and on the narrative. BNML starts with a narrative, which can be captured in a business conversation or interview, and sets out to represent how a certain story unfolds, pictorially, evolving along a pattern sequence and showing how assets are used and built in the process.

Concept maps, the Business Narrative Modelling Language (BNML), and the necessity of structure in a language

"In and out of the classroom, we've seen the power of evocative images and complex art to spark students' interest and thinking" (Ritchhart, Church, and Morrison, 2011, p.55). In particular, concept maps, for mapping understanding – going from the generation and sorting of a list of ideas, to the connection of the ideas with lines and explanations, which may lead to new ideas which can significantly expand, extend, and take your initial ideas to a higher level – and thus, in essence "help uncover a learner's mental models of a topic in a nonlinear way" (Ritchhart, Church, and Morrison, 2011, p.125) – are an example of how ways of understanding have evolved. Concept maps help learners organize their thoughts, promoting new relationships between ideas (Ritchhart, Church, and Morrison, 2011). Even with concept maps, however, a structured process for creating them is helpful, "to actively foster more and better thinking" (Ritchhart, Church, and Morrison, 2011, pp.125-126). The same can be said of BNML, whereby a structured process for creating the visual representations, coupled to the narrative, exists (Oliveira and Ferreira, 2011; Oliveira and Ferreira, 2012a, Oliveira and Ferreira, 2012b; Gonçalves et al., 2013; Au-Yong-Oliveira and Ferreira, 2014), a form which is sought out by professionals with a technical (e.g. engineering) background. Award-winning Verna Allee value network representations (Allee, 2011) are the starting point for BNML (Allee, 2000a, 2000b, 2002, 2008), whereby paths to innovation are shown, in complex environments, and value network intelligence is applied, followed by Excel representations of the data gathered, and then finally moving on to storyline representations (done with PowerPoint software) and automatic diagram-generating Graphviz software pictorial representations. The process is fulfilling in itself, providing, in the end, a path to deeper understanding and recall.

Drawing from the example of an in-depth case study we performed of ExpressGlass, based on company visits and interviews, figure 2 shows a Verna Allee-based representation which would be done before BNML visual re presentations. A key question is how does ExpressGlass create value and who is involved in the process?

Figure 2 - ExpressGlass Portugal value network (application of Allee, 2008) (Oliveira, 2012)

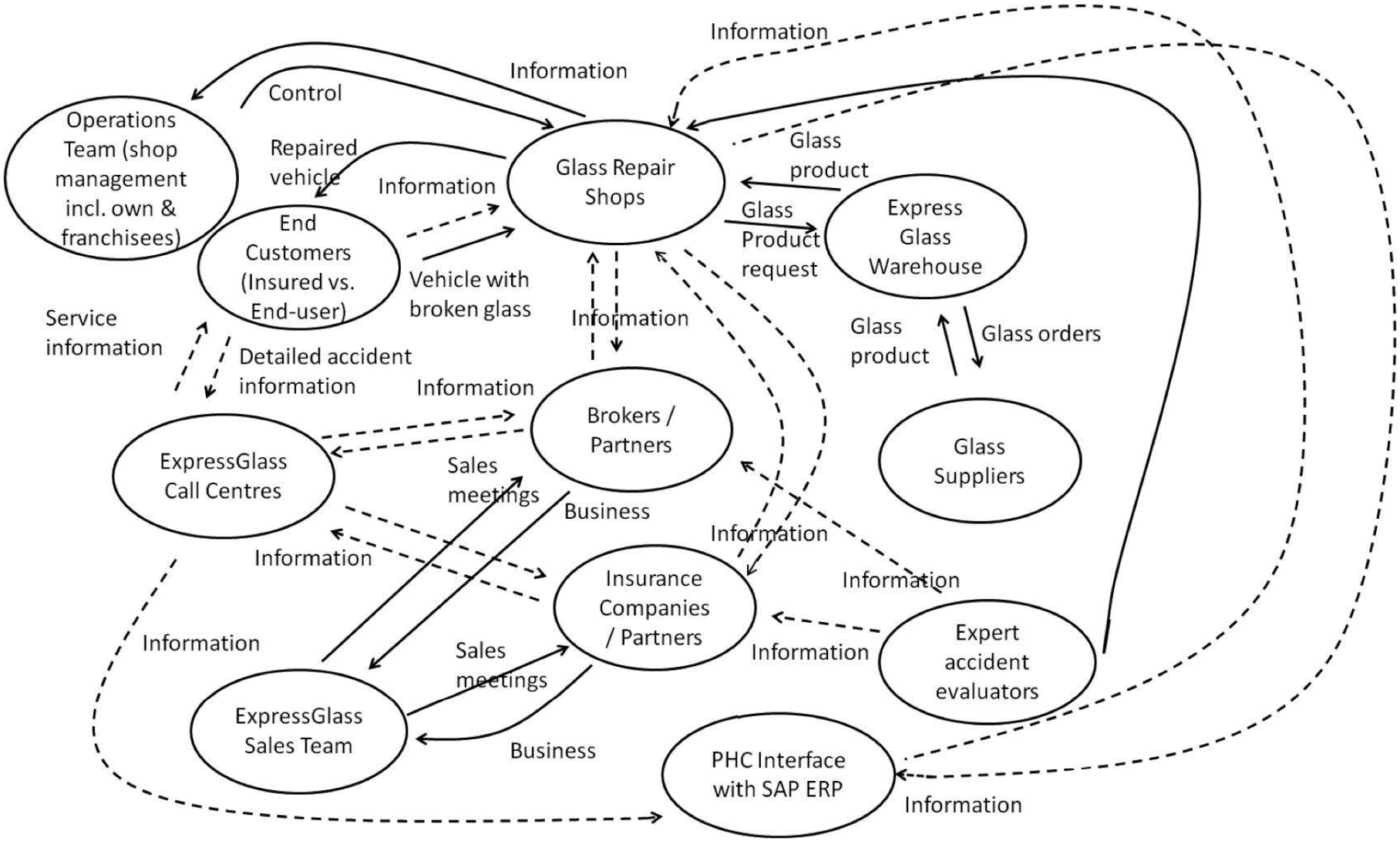


Figure 2 is thus a portrayal of Allee's (2000a, 2000b, 2002, 2008) value network mapping, applied to ExpressGlass. ExpressGlass operates in the auto industry after-market, and undertakes specialized glass repair and replacement. Figure 2 gives a complete view of who is involved (the actors, inside the ovals) in creating value for the end customer.

ExpressGlass, with annual sales of 17 million Euros in Portugal (at the end of December 2010), owned one third of the approximately 100 ExpressGlass repair shops (the other two thirds being owned by franchisees), created since ExpressGlass was founded, in 2002. ExpressGlass is also present in Brazil, where it has been for less time but already having achieved annual sales of 34 million Euros (after two years of business there, using a different business model than the one seen in figure 2, for Portugal). In figure 2, intangible deliverable exchanges are represented by dashed lines, the solid lines on the other hand representing tangible deliverable exchanges (e.g. worth money and involving recordings in the General Ledger). Figure 2 makes evident whether there is a balance (in number) between the intangible and tangible deliverables exchanged in the ExpressGlass network. It is the tangible deliverables that bring in more corporate revenues. Figure 3 is the BNML representation of the ExpressGlass Verna Allee value network. Deliverables (e.g. accident, service, and historic information) are seen to be exchanged between actors (the green, orange, red, brown, grey, black, blue and purple lines, from PHC interface to ExpressGlass sales team) along corresponding patterns (e.g. alignment, collecting, and communication channels) and over time (moving left to right along figure 3). Assets are used and built in the process (e.g. customer relationships, partner network, innovation competence) and are also visible in figure 3. Business Model Canvas ontology terms (Osterwalder and Pigneur, 2010) are visible at the top of figure 3 (e.g. CS – Customers segments, KA – Key activities, and KR – Key resources), so that managers can keep track of what matters most at different stages in the process. Adding a separate, more in-depth depiction of the Business Model Canvas to the process is possible, if so desired by the process manager. Figure 4 is the integrated BNML view (or plot view) of how interoperability leads to innovation at ExpressGlass. Figure 4 was automatically generated by Graphviz software – to have an output such as this only simple code creation was necessary. We foresee that increasingly more software suites, such as the very easily usable Graphviz, will be available in the market, as we move to increased formal pictorial representations and languages.

Graphviz allows the showing of inputs and outputs in a network, and it shows what is used and what is built, over time and in sequence, in the ExpressGlass case analysing how innovation occurs. Namely, the input enterprise interoperability (free flowing communication within the network) will lead to the outputs innovative competence and innovative service (figure 4). In figure 4, the actors are GlassRepairShops, PHC interface and CallCentres, leading into plots (e.g. ProcessSpecification) and microgenesis processes or recursive self-maintenance mechanisms (Aveiro and Tribolet, 2006) (e.g. Var_PartnerSatisfaction – which needs to be measured at every stage in the process, and alterations made if the result is not as good as desired). Figure 4 is drawn following the parameterization of the BNML Storyline view data in figure 3. Excel sheets are used in this process of parameterization, much as engineers do, for example, when analysing corporate business processes. Table 1 is an example of data parameterization, in the ExpressGlass case.

Table 1 represents the structure in BNML, and is based on BNML's storyline representation (figure 3). The inputs and outputs are assets (e.g. ServiceKnowHow and CustomerRelationships) used and built (either white or grey ovals), respectively, in the patterns (e.g. Alignment), in figure 3. Inputs and outputs are triggered by network actors, within plots (e.g. the ForSale plot – see Enterprise Ontology detail in figure 3). For example, for the Alignment pattern, visible in figure 3 and table 1 (analyse the data column by column in table 1), we will have:

- The input service know-how (asset);
- Used to build the output customer relationships (asset);
- Triggered in turn by the actors / roles End-customer and Call-centres;
- This all occurs in the "For Sale" plot (Enterprise Ontology detail);
- State variables are involved, indicative of whether corrective action is needed, with regards to Accident info and Service info (deliverables in figure 3) – which may not be accurate and complete.

Once finished, an Excel functionality for data analysis is then used, on the Excel sheet data – called Pivot Tables. These Pivot Tables help to expose the hidden relationships in the data. Certain sections of the data may then be highlighted to supply us with a view that we are interested in – such as the input In-EnterpriseInteroperability, and the outputs Out-InnovationCompetence and Out-InnovativeService (visible in figure 4).

Figure 3 - ExpressGlass Portugal - BNML representation of Verna Allee value network (Oliveira, 2012)

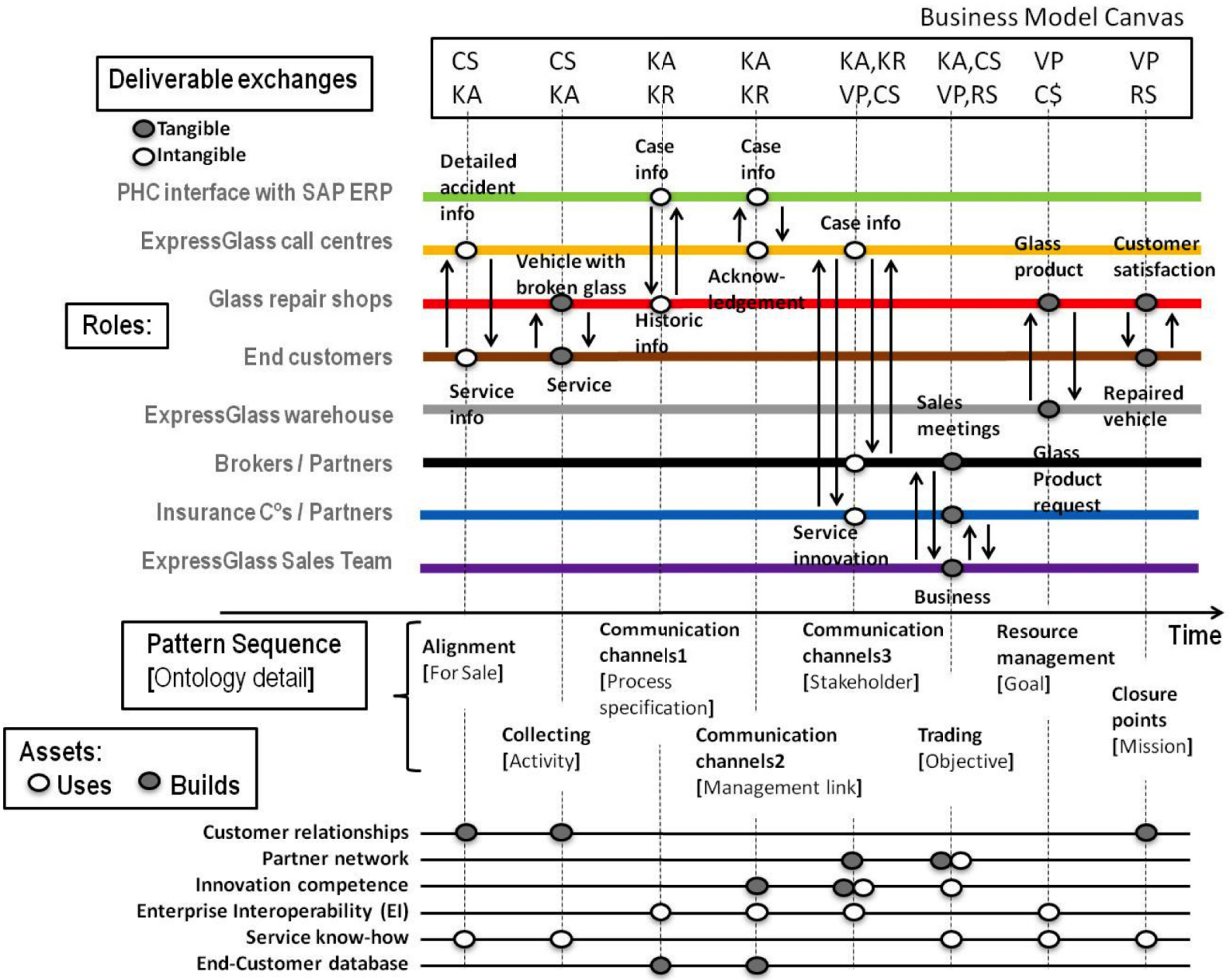


Figure 4 - Integrated BNML view of ExpressGlass - Interoperability leading to innovation (Oliveira, 2012)

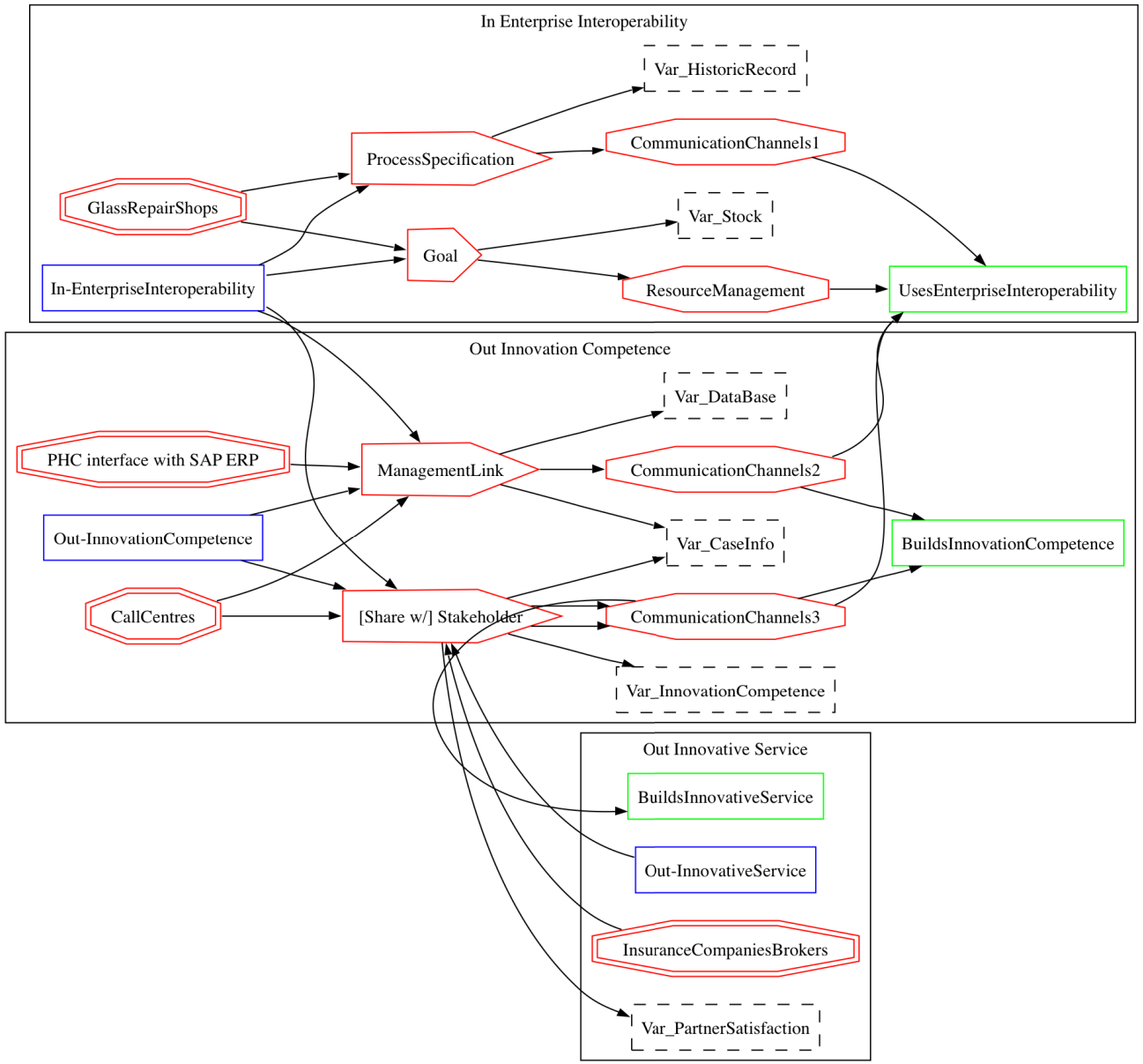


Table 1 - Excel sheets and parameterized data – The step between the Storyline BNML view (figure 3) and the integrated BNML view (figure 4) (Oliveira, 2012)

Pattern	Input/Output	TriggeredBy	Plot	StateVar
Alignment	"In-ServiceKnowHow"	EndCustomer	ForSale	Var_AccidentInfo
Alignment	"Out-CustomerRelationships"	CallCentres	ForSale	Var_ServiceInfo
Collecting	"In-ServiceKnowHow"	EndCustomer	Activity	Var_VehicleForRepair
Collecting	"Out-CustomerRelationships"	GlassRepairShops	Activity	Var_CustomerSatisfaction
CommunicationChannels1	"In-EnterpriseInteroperability"	GlassRepairShops	ProcessSpecification	Var_HistoricRecord
CommunicationChannels1	"Out-CustomerDataBase"	GlassRepairShops	ProcessSpecification	Var_CaseRecord
CommunicationChannels2	"In-EnterpriseInteroperability"	CallCentres	ManagementLink	Var_CaseInfo
CommunicationChannels2	"Out-CustomerDataBase"	CallCentres	ManagementLink	Var_Acknowledgement
CommunicationChannels2	"Out-InnovationCompetence"	PHC interface with SAP ERP	ManagementLink	Var_DataBase
CommunicationChannels3	"In-EnterpriseInteroperability"	CallCentres	Stakeholder	Var_CaseInfo
CommunicationChannels3	"Out-InnovationCompetence"	CallCentres	Stakeholder	Var_InnovationCompetence
CommunicationChannels3	"In-InnovationCompetence"	InsuranceCompaniesBrokers	Stakeholder	Var_ServiceInnovation
CommunicationChannels3	"Out-InnovativeService"	InsuranceCompaniesBrokers	Stakeholder	Var_PartnerSatisfaction
CommunicationChannels3	"Out-PartnerNetwork"	InsuranceCompaniesBrokers	Stakeholder	Var_PartnerNetwork
Trading	"In-ServiceKnowHow"	SalesTeam	Objective	Var_SalesMeetings
Trading	"Out-PartnerNetwork"	InsuranceCompaniesBrokers	Objective	Var_PartnerNetwork
Trading	"In-InnovationCompetence"	SalesTeam	Objective	Var_PartnerSatisfaction
Trading	"Out-Business"	InsuranceCompaniesBrokers	Objective	Var_Sales
ResourceManagement	"In-EnterpriseInteroperability"	GlassRepairShops	Goal	Var_Stock
ResourceManagement	"In-ServiceKnowHow"	Warehouse	Goal	Var_DeliveryTime
ClosurePoints	"In-ServiceKnowHow"	GlassRepairShops	Mission	Var_DeliveryTime
ClosurePoints	"Out-CustomerRelationships"	EndCustomer	Mission	Var_CustomerSatisfaction

Table 1 actually quantifies the number of inputs and outputs for a given pattern. For example, the pattern CommunicationChannels3 has two inputs and three outputs, making it a central aspect of the ExpressGlass value network – the inputs innovation competence and enterprise interoperability lead to the outputs innovation competence, innovative service, and partner network. The number of outputs versus the number of inputs is a sign of how productive a given pattern is.

BNML in action – The Toyota Production System (TPS) case
For another example of BNML in action, please see figure 5, which is part of a case study we performed, about the Toyota Production System (TPS). How did Toyota become the major player that it is, in the automotive industry? What assets were leveraged and who contributed to the gaining of a global leadership position? The answer is made evident by our BNML representation (figure 5), in which various ontologies (Uschold et al., 1998; Osterwalder and Pigneur, 2010), actors, patterns and assets explain the TPS story. Note the colour in the dynamic storyline interactions and how movement over time (from left to right, in figure 5) is emphasized.

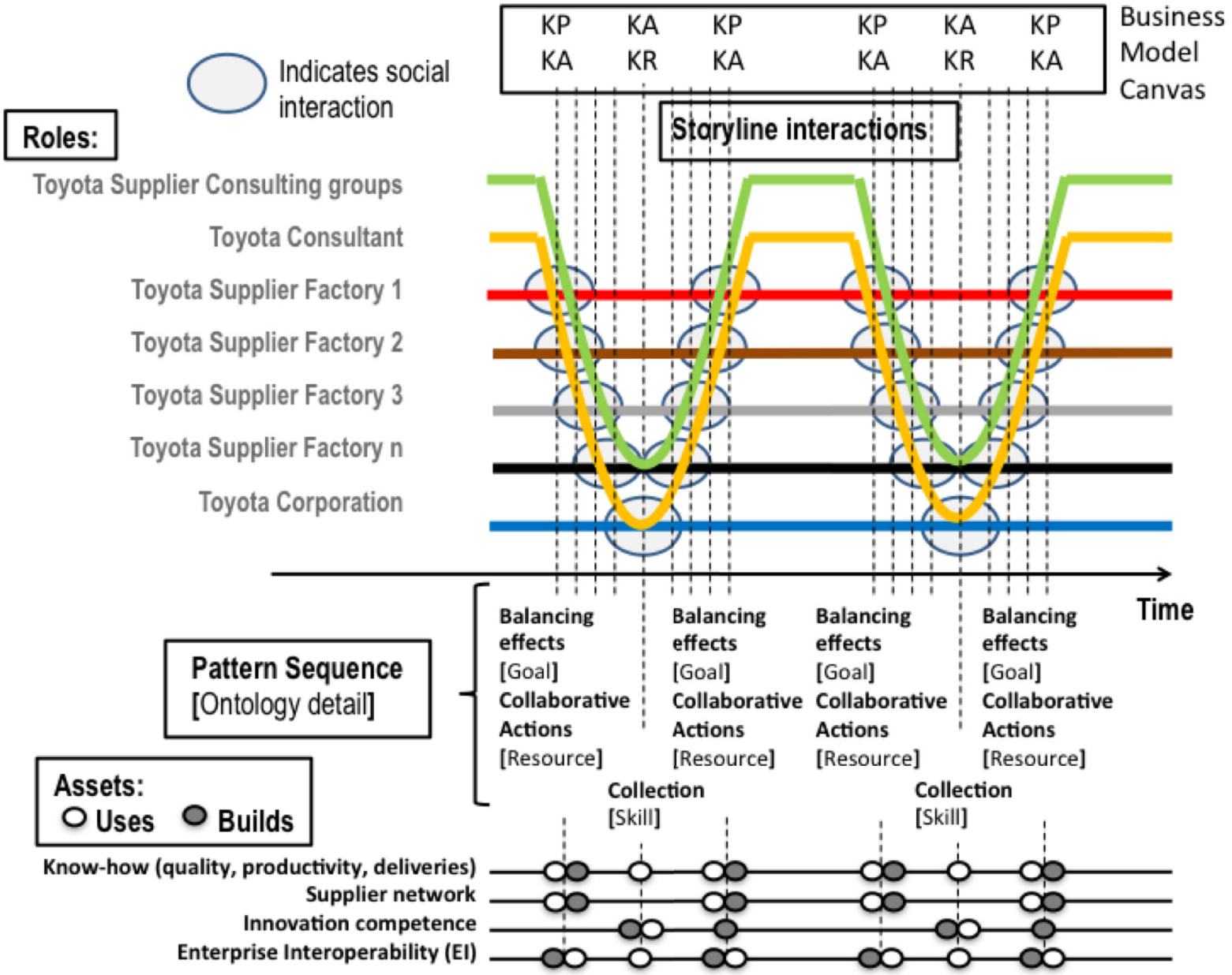
Figure 5 thus depicts the TPS, which has a number of actors, represented by the coloured lines and who interact over time (green, orange, red, brown, grey, black and blue lines – representing, respectively, Toyota Supplier consulting groups, Toyota Consultant, Toyota Supplier Factory 1, Toyota Supplier Factory 2, Toyota Supplier Factory 3, Toyota Supplier Factory n, and the Toyota Corporation). Note how the green and orange lines are the more active subjects, moving up and down and visiting the Toyota Supplier Factories – to learn from them, to gain know-how – and, finally, also visiting the Toyota Corporation to communicate their findings (again, know-how). In effect, these interactions use and produce assets over time – know-how, a supplier network (involving, in effect, all of the actors depicted), an innovation competence (any strategic advantage created by Toyota will be a consequence of innovation (Porter, 1990)), and enterprise interoperability (a free flowing communication capability between network actors) (the white and grey ovals at the bottom of figure 5 show which assets are used and which are built, at different points in the storyline). Japanese auto industry manufacturer (and Toyota supplier) Yazaki Saltano, in Portugal, is a part of this TPS, described by Yazaki Production Director and interviewee Gilberto Rachão, as follows:

"I am sincerely a faithful follower of TPS. And at this moment Toyota, in Europe, is doing something which I think is extraordinary, something called T.E.A.M. – Toyota Europe Association of Manufacturers – where there are 180 suppliers of Toyota. And what did they decide to do? They selected 42 suppliers, some better, some medium, some very good; and they put them in 7 groups of 6 [the Toyota Supplier Consulting Groups in figure 5 – represented by the green line], and those companies will visit each company [Toyota Supplier 1, Toyota Supplier 2, Toyota Supplier 3, Toyota Supplier n – represented by the red, brown, grey and black lines in figure 5], and do a sort of consulting service – always with a Toyota member with them [Toyota Consultant – represented by the orange line in figure 5]. What is Toyota trying to achieve with this? They are elevating the level of all of their suppliers [by circulating the asset know-how between them] and it is Toyota herself who is going to benefit with this (T.E.A.M. was mainly put together to elevate supplier levels in the following areas – quality, cost, delivery times, and for the sharing of production knowledge). I think Toyota has a fabulous strategy. I am really convinced of that. But we go to those suppliers, too. They come and visit our factory, we go and visit their factories, and we give our suggestions, and that's how Toyota intends that all [in the Toyota Supplier Network – an asset used and built upon, at the bottom of figure 5] improve their level of quality, productivity, deliveries. For example, there was a company that took great advantage of our system of warehousing and deliveries. Because we have 100% delivery performance and they had around 60+%. In consequence of this Toyota benefited and that company benefited also, logically."

In sum, within the Toyota supplier "web", information and knowledge is shared, freely and easily, this interoperability (Oliveira and Ferreira, 2014) leading, in turn, to innovation – not only product innovation, the most popular form of innovation, but also process, position and/or paradigm innovation (Tidd, Bessant, and Pavitt, 2005). Toyota has successfully created a family of companies, with its suppliers, a process in which they each provide help for each other, for the greater good – the growth and survival of those in the network, in an ever harsher global competitive environment. "Knowledge is the fundamental element (material) in the development of products" (Morgan and Liker, 2006, p.114), but this is also true in the evolution of processes, of production and distribution, in the search for added value for customers.

Figure 5 is an attempt at representing the symmetry in the TPS, whereby all network partners contribute, but also benefit. The patterns of action, or pattern sequence, which are followed are also represented in figure 5. These patterns (balancing effects, collaborative actions, and collection), taken from Bjork and Holopainen (2005), are present at various moments in time. The patterns are linked to ontology terms (e.g. goal, resource, and skill) taken from Uschold et al. (1998). The reason we resort to Bjork and Holopainen (2005) and Uschold et al. (1998) is to provide more structure and repeatability between case studies, and thus more

Figure 5 - The Toyota Production System (TPS) – BNML in action (Oliveira, 2012)



structure to the BNML language, as the alternative would be to constantly create new patterns and terms, seen to be an unnecessary usage of energy if one considers that the essential difference between cases is actually defining who the actors are and how they interact over time (storyline interactions). Finally, Business Model Canvas ontology terms (KP – key partners, KR – key resources, KA – key activities) (Osterwalder and Pigneur, 2010) are to be seen at the top of figure 5, supplementing what each storyline interaction involves.

Conclusion

Significantly, BNML figures add the passage of time, as well as the notion of precedence, to Verna Allee value network representations, a theme that Langley (1999) speaks of (in figures 3, 4 and 5 – BNML representations – we see time represented along a horizontal axis, which does not exist in figure 2 – a Verna Allee-based representation). What is important to retain is that we can represent perspectives of respondents / interviewees pictorially, according to a structured language we have created – BNML – and which can provide an alternative means and tool for business process analysis.

In the ExpressGlass case we saw how a timely entrepreneurial effort led to the successful appropriation of a gap in the market, for replacing glass in automotive vehicles, in Portugal. To this end technology (PHC interface with SAP ERP) played an important role, enabling the timely exchange of customer information and industry knowledge between network actors. In the Toyota case a remarkable team effort between Toyota suppliers is made evident, again know-how, an important asset, being interchanged freely (enterprise interoperability) to create innovation – including product, process and organizational innovation (OECD and Eurostat, 2005). The ability to promote this type of fruitful collaboration (through superior communication) was termed an innovation competence (asset).

YouTube and Facebook and other such social network sites have created new languages that we are using, without us having properly defined the existence of such new modes of communication. Herein, we have sought to demonstrate how new [structured] languages can be created, and are being created, by tuning in to what we do best. Futhermore, by combining various sensemaking strategies, such as text and the narrative, as well as visual mapping and quantification, BNML achieves a high scoring with regards to accuracy, simplicity and generality (Langley, 1999) – essential to any current human endeavour.

Machines are ever more important (Watson, 2012) and we need new ways to keep up. It may well be that right-brainers will indeed have a hold on, and rule, the future (Pink, 2006; Watson, 2012). Pattern recognition and the creation of "big pictures" is already important today – what we need to realize is that this will increase into the future, as the babies of the turn into the 21st century grow up and take charge of significant positions in both industry and society. "Logic will get you from A to B. Imagination will take you everywhere (Albert Einstein, quoted by Watson, 2012, p.43).

Human beings will always require some form of language to communicate, in particular in an era where "the sharing of technological knowledge between firms or within the same firm is becoming essential to develop innovations" (Petronia, Verbano and Venturini, 2015, p.52). Innovation networks, such as those depicted herein, emphasize "linkages of a variety of actors with the purpose of innovation" (Pinto, Noronha, and Faustino, 2015, p.83). We have discussed how there will be an explosion of intuitive languages as well as more structured languages, appearing in the 21st century and beyond, as technology pushes our limits out ever further. Changes in our behaviour will accompany disruptive leaps in technology, taking us to levels hard to predict except for the significant change which will certainly be involved.

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References

ALLEE, V. (2000a). Reconfiguring the value network. Journal of Business Strategy, 21(4), July-August, 1-6.

ALLEE, V. (2000b). The value evolution – Addressing larger implications of an intellectual capital and intangibles perspective. Journal of Intellectual Capital, 1(1), 17-32.

ALLEE, V. (2002). A value network approach for modelling and measuring intangibles. Paper presented at Transparent Enterprise, Madrid, November.

ALLEE, V. (2008). Value network analysis and value conversion of tangible and intangible assets. Journal of Intellectual Capital, 9(1), 5-24.

ALLEE, V. (2011). Verna Allee. Available at: http://www.vernaallee.com, accessed on 14-06-2015.

ARAÚJO, C., and Teixeira, A. (2014). Determinants of International Technology Transfer: an Empirical Analysis of the Enterprise Europe Network. Journal of Technology Management & Innovation, 9(3), 120-134.

AU-YONG-OLIVEIRA, M., Ferreira, J.J.P., 2014. What if colorful images become more important than words? Visual representations as the basic building blocks of human communication and dynamic storytelling. World Future Review, March-April, 6(1), 48-54.

AVEIRO, D., Tribolet, J. (2006). An ontology for organizational functions: the recursive self-maintenance mechanism of the enterprise. 10th IEEE International Enterprise Distributed Object Computing Conference Workshops (EDOCW'06). IEEE Computer Society.

BJORK, S., Holopainen, J. (2005). Patterns in game design. Charles River Media, Hingham, MA, USA.

BOJANOVA, I. (2014). The Digital Revolution: What's on the Horizon?. IT Professional, Jan.-Feb., 16(1) 8-12.

BORNER, K., Polley, D.E. (2014). Visual insights – A practical guide to making sense of data. The MIT Press, Cambridge, Massachussetts, USA.

COVERT, A. (2013). What is Snapchat? At CNNTech, November 14. http://money.cnn.com/2013/11/14/technology/social/snapchat-primer/index.html, accessed on 22-04-2014.

DEUTSCHER, G. (2010). Through the language glass – Why the world looks different in other languages. William Heinemann, London, UK.

DI CARLO, T., Khoshnevis, B., Udwadia, F. (2009). Whole Brain Thinking in Systems Architecting. Systems Engineering, 12, 265-273.

FACEBOOK (2014). Available at: www.facebook.com/home.php□, accessed on 12-07-2014.

FILHO, E.J.M.A, Lima, R.M.C., and Lennon, M.M. (2014). How to Justify Purchase of an iPad: Users of the Latest Launch. Journal of Technology Management & Innovation, 9(3), 106-119.

FRANKLIN, D., Andrews, J. (Editors) (2012). Megamudança - O mundo em 2050 [Megachange – The world in 2050], The Economist Newspaper, Gestãoplus Edições, Portugal.

GONÇALVES, R., Martins, J., Pereira, J., Oliveira, M.A., Ferreira, J.J.P. (2013). Enterprise web accessibility levels amongst the Forbes 250: Where art thou o virtuous leader? Journal of Business Ethics, 113(2), 363-375.

GRAPHVIZ (2015). Available at: http://www.graphviz.org, accessed on 13-06-2015.

GREENE, R.L. (2012). Revoluções culturais [Cultural revolutions]. In: D. Franklin, J. Andrews, (Editors), Megamudança - O mundo em 2050 [Megachange – The world in 2050], The Economist Newspaper, Gestãoplus Edições, Portugal, 78-92.

HIRST, J. (2009). The shortest history of Europe, Old Street Publishing Ltd, Brecon, UK.

HOLDEN, S. (2014). Intellectual dueling at a prep school - Clive Owen and Juliette Binoche star in "Words and pictures", Movie review The New York Times, May 22, Available at: http://www.nytimes.com/2014/05/23/movies/clive-owen-and-juliette-binoche-star-in-words-and-pictures.html?_r=0, accessed on 11-11-2014.

INSTAGRAM (2014). Available at: http://www.instagram.com, accessed on 22-04-2014.

LAENG, B., Bloem, I.M., D'Ascenzo, S., Tommasi, L. (2014). Scrutinizing visual images: The role of gaze in mental imagery and memory. Cognition, 131.

LANGLEY, A. (1999). Strategies for theorizing from process data. Academy of Management Review, 24(4), 691-710.

LASERNA, D.B. (2012). Edição especial – Einstein – A teoria da relatividade – O espaço é uma questão de tempo [Special edition – Einstein – The theory of relativity – Space is a question of time], National Geographic, Lisbon, Portugal.

LAUE, R., Awad, A. (2011). Visual suggestions for improvements in business process diagrams. Journal of Visual Languages and Computing, October, 22(5), 385-399.

MOLINA, A.I., Gallardo, J., Redondo, M.A., Ortega, M., Giraldo, W.J. (2013). Metamodel-driven definition of a visual modeling language for specifying interactive groupware applications: An empirical study. Journal of Systems and Software, July, 86(7), 1772-1789.

MORGAN, J.M., Liker, J.K. (2006). Sistema Toyota de desenvolvimento de produto – Integrando pessoas, processo e tecnologia [The Toyota product development process: Integrating people, process and technology], ARTMED® EDITORA S.A., São Paulo, Brazil.

MORIARTY, P., Honnery, D. (2014). Reconnecting technological development with human welfare. Futures, 55, 32-40.

OECD & Eurostat (2005). Oslo Manual - Guidelines for collecting & interpreting innovation data. 3rd ed. European Commission. OECD Publishing.

OLIVEIRA, M.A. (2012). Fostering innovation through the creation of an interoperability capability: An analysis using the Business Narrative Modelling Language. Unpublished PhD thesis. Faculty of Engineering, University of Porto, Portugal.

OLIVEIRA, M.A., Ferreira, J.J.P. (2011). Facilitating qualitative research in business studies - Using the business narrative to model value creation. African Journal of Business Management, 5(1), 4th January, 68-75.

OLIVEIRA, M.A., Ferreira, J.J.P. (2012a). How interoperability fosters innovation: The case for servant leadership. African Journal of Business Management, 6(29), 25th July, 8580-8608.

OLIVEIRA, M.A., Ferreira, J.J.P. (2012b). BNML representations: A storyline view and a plot view of how interoperability is an antecedent of innovation at IP BRICK. African Journal of Business Management, 6(15), 18th April, 5338-5361.

OLIVEIRA, M.A., Ferreira, J.J.P. (2014). Interoperability: Working Together to Enhance Innovation - What increased interoperability within and between teams means for management and business. The Futurist, World Trends & Forecasts, WordBuzz | COMMERCE. March-April, 48(2), 6-7.

OSTERWALDER, A., Pigneur, Y. (2010). Business model generation. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.

OXFORD DICTIONARIES (2014). Oxford Dictionaries online, accessed on 27-02-2014.

PETRONIA, G., Verbano, C., Venturini, K. (2015). Determinants and catalysts in intrafirm technology transfer: Learning from case studies. Journal of Technology Management and Innovation, 10(1), 52-69.

PINK, D.H. (2006). A whole new mind – Why right-brainers will rule the future. Riverhead Books, New York, USA.

PINTO, H., Noronha, M.T. de, Faustino, C. (2015). Knowledge and cooperation determinants of innovation networks: A mixed-methods approach to the case of Portugal. Journal of Technology Management and Innovation, 10(1), 83-102.

PORTER, M.E. (1990). The competitive advantage of nations. Harvard Business Review, March-April, 71-91.

RAMOS, A.L., Ferreira, J.V., Barceló, J. (2012). Model-Based Systems Engineering: An Emerging Approach for Modern Systems. IEEE Transactions on Systems, Man, and Cybernetics – Part C: Applications and Reviews, 42(1), 101-111.

RITCHHART, R., Church, M., Morrison, K. (2011). Making thinking visible – How to promote engagement, understanding, and independence for all learners. Jossey-Bass, San Francisco, CA, USA.

SOLIMAN, S. (2005). Systems and Creative Thinking. Center for Advancement of Postgraduate Studies and Research in Engineering Sciences, Faculty of Engineering, Cairo University.

STEENBURGH, T., Avery, J. (2008). UnME Jeans: Branding in Web 2.0., Harvard Business School Case 9-509-035, 1-27.

TIDD, J., Bessant, J., Pavitt, K. (2005). Managing innovation – Integrating technological, market and organizational change. 3rd ed. John Wiley & Sons Ltd., West Sussex, England.

USCHOLD, M., King, M., Moralee, S., Zorgios, Y. (1998). The enterprise ontology. The Knowledge Engineering Review, 13(1) (1998) 31-89.

WATSON, R. (2012). Future files – A brief history of the next 50 years. Nicholas Brealey Publishing, London, UK.

WHATIS (2014). Available at: http://whatis.techtarget.com/definition/Facebook, accessed on 12-07-2014.

YOUTUBE (2014a). Available at: https://www.youtube.com/yt/about/, accessed on 12-07-2014.

YOUTUBE (2014b). Available at: http://www.youtube.com, accessed on 22-04-2014.