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Enabling Customer Experience and Front-Office Transformation through Business Process Engineering

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Abstract— In the past, the scope of business processes has been circumscribed to the industrialization of enterprise operations. Indeed, Business Process Management (BPM) has focused on relatively mature operations, with the goal of improving performance through automation. However, in today's world of customer-centricity and individualized services, the richest source of economic value-creation comes from enterprise-customer contacts beyond transactions. Consequently, process has recently moved out of its traditional court and is becoming prevalent in less traditional competences such as marketing operations, customer-relationship management, campaign creation and monitoring, brand management, sales and advisory services, multi-channel management, service innovation and management life-cycle, among others. These competences host customer-enterprise co-creation activities characterized by innovation, human creativity, and new technologies. Above all, these work-practices call for continuous differentiation, instead of "pouring concrete" on emerging business processes.

While BPM will continue to make important contributions to the *factory* of enterprises, **Business Process Engineering** (BPE) is chartered to provide a holistic approach to new opportunities related to the *life-cycle of enterprise customers* and the transformation of so-called *Front-Office Operations*. More broadly, Business Process Engineering fosters a new space for the multi-disciplinary study of process, integrating individuals, information and technology, and it does so with the goal of *engineering* (i.e., designing and running) innovative enterprise operations to *serve customers and improve their experiences*. Furthermore, given past challenges in the *Back-Office*, it is imperative that managers focus on *processes* in the Front-Office where the software industry has jumped into with solutions that bury key processes within applications, thus making differentiation and agility very difficult.

BPE stresses the critical importance of the integration of *Information* and *Behavior* and it is this goal that links it with Business Informatics: the *information process in organizations and society*. Since behavior and information are complementary and inseparable domains of concern, current approaches to decision making based on data-only evidence should be reexamined holistically: it may be catastrophic to explicate or predict the behavior of organizations or individuals meaningfully by insisting on the ongoing divorce across the two domains. In particular, Business Informatics and Business Process Engineering offer an opportunity to address potential benefits of "big data" and "business analytics" beyond the IT domain. Having IEEE lead these directions means an opportunity for stimulating new research and practice on the most fundamental problems that enterprises and customers face today in dealing with each other.

Keywords— business process engineering; customer experience; business process management; business informatics; enterprise engineering

I. PROCESS IS OUT OF THE INDUSTRIALIZATION BOX

Business process has been at the center of the stage in both research and industry for several decades. Under the brand of Business Process Management (BPM), business process has attracted a great deal of attention from many practitioners and scholars. BPM has been defined as the analysis, design, implementation, optimization and monitoring of business processes [70], [219], [79], [229], [230]. In [266], Van der Aalst defined some targets of BPM: ' *… supports business processes using methods, techniques, and software to design, enact, control and analyze operational processes involving humans, organizations, applications, documents and other sources of information*" [1].

While the above definitions are quite comprehensive and broad, in reality most BPM research and industry activity has grwon upon the motivation of reducing operating costs through automation, optimization and outsourcing. There are a several schools of thought and practice (such as lean, lean six-sigma, and others [172], [6], [4], [5]) and a myriad of related literature in the last 40 years that serve to illustrate the focus on cost contention. Around the middle of the past decade, T. Davenport stated in a celebrated Harvard Business Review paper [54] that processes were being "*analyzed, standardized, and quality checked*", and that this phenomenon was happening for all sort of activities, stated in Davenport's own terms: "*from making a mouse trap to hiring a CEO*". The actual situation is that industry investment and consequential research have stayed much more on "trapping the mouse" than in differentiating customer services through innovative and more intelligent processes, let alone hiring CEOs. This may be explained partly from Davenport's own statements: "*Process standards could revolutionize how businesses work. They could dramatically increase the level and breadth of* **outsourcing** *and* **reduce the number of processes that organizations decide to perform for themselves**" (bold face is added here for emphasis).

With the advent of different technologies such as mobile, cloud, social media, and related capabilities that have empowered consumers, the classical approach and scope of business process have begun to change quickly. Organizations are adopting new operating models [100] that will drastically affect the way processes are conceived and deployed. As stated by many authors in the last four decades, business process work is supposed to cover all competences in an organization, irrespective of the specific skills from human beings participating in such operations. However, in an unpublished inspection of about 1,300 papers conducted by

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[1] Van der Aalst excludes *strategy processes* from BPM, a remarkable point that will be revisited in more depth later in this paper.

the author and some of his collaborators[2], most process examples shown in the literature deal with rather simple forms of coordination of work, mostly exhibiting a flow structure and addressing administrative tasks (like those captured in early works on *office information systems*). Furthermore, the examples provided usually deal with rather idealized operations, probably offered as simple examples with the only purpose of illustrating theoretical or foundational research results. Thus, radically simplified versions of "managing an order", "approving a form", "processing a claim", "paying a provider", "delivering an order" etc. are among the most popular examples of processes found in the literature.

The lack of public documentation of substantial collections of real-world processes is remarkable. The authors in [106] both confirmed the dominant focus on simple business processes and also suggested potential practical consequences of related research: *"… there is a growing and very active research community looking at process modeling and analysis, reference models, workflow flexibility, process mining and process-centric service-oriented architecture (SOA). However, it is clear that existing approaches have problems dealing with the enormous challenges real-life BPM projects are facing […] Conventional BPM research seems to focus on situations with just a few isolated processes …"*. Of course, the list of available real-world processes would be a lot richer if one included the set defined by enterprise packaged applications [219]. However, this comprehensive collection is proprietary because it constitutes a key piece of intellectual capital coming from software vendors or integrators in the industry.

The traditional focus on process has also raised much controversy. At the S-BPM ONE Conference in 2010, a key-note speaker [176] remarked: *"Let me be as undiplomatic as I possibly can be without being offensive* […] *The academic community is as much to blame* […] *as the vendors of BPM systems, who* **continue to reduce the task of managing business processes to a purely technological and automation-oriented level"**. While other authors in the same conference debated "who is to blame" very animatedly [78], [234] it is important to highlight that the statement from Olbrich (in bold face above for emphasis) reinforces that BPM has mostly followed the obsession of automation and optimization by means of Information Technology.

A detailed inspection of the extant literature confirms that business process work has been devoted to a rather small fraction of the actual variety and complexity found in enterprise behavior. This behavior enacts many value-generating capabilities that organizations cultivate based on skills provided by their own workforces and through rich interactions with other enterprise stakeholders, particularly customers. The following points offer a simplified summary:

(1) Business process research in Computer Science has been traditionally focused on certain classes of enterprise operations, mostly involving simple coordination mechanisms across *tasks*. This type of coordination and the overall behavior represented in underlying models reflect very much an "assembly line" where work is linearly synchronized to deliver a desired artifact or outcome. Simplicity of the choreography is ensured by removing any form of overhead in communication when moving from one stage to the next. Unlike other more complex business processes, many software applications do have this simplified structure. In fact, a trend since the early 2000's is to separate the specific application logic from the coordination / choreography needed across modules, and both of them from the actual data contained in a data-base management system. Different foundations and a plethora of languages have been created to capture this semantics of coordination such as Business Process Modeling Notation (BPMN), Business Process Execution Language (BPEL), Unified Modeling Language (UML), Event Process Chain (EPC), Petri Nets, etc.

(2) Resulting process models have typically yielded the form of a "workflow" [228],[280]. This means that the activation of a task in the assembly line only occurs when certain predefined events take place, one or more previous tasks are completed and their produced artifacts transferred to the next task in the pipeline for continuing "the assembly". In fully automated systems, like software applications, this is a good abstraction (see Figure 1). On the other hand, in actual business processes where humans participate or supervise the individual tasks, workflows do not always capture the actual pattern of work, including the contractual commitments made across role-players. Consequently, IT systems used to implement such workflows, called "Business Process Management Systems" (BPMS) in IT jargon[3], are not suitable to communicate the nature of work to business stakeholders. This point has been extensively addressed in recent Enterprise Engineering work [62], such as DEMO and related contributions [2], [3], [9], [197]. The issue of clarity was brought up by Dietz eloquently during a key-note entitled "Processes are more than Workflows" in the 2011 KEOD Conference: *"With modeling techniques like Flowchart, BPMN, Petri Net, ARIS/EPC, UML and IDEF you get easily hundreds of pages of process diagrams. Nobody is able to understand such models fully. Consequently, nobody is able to re-design and re-engineer a process on that basis"*.

Beyond communication, the distinction of contexts between an organizational design concern and an IT concern should also be carefully addressed.

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[2] At the time of this publication in IEEE, the mentioned work still remains unpublished. The co-authors are L. Flores and V. Becker both from IBM.

[3] The term BPMS is somewhat questionable because it implies that these IT systems implement processes while they actually do so only for very special types of processes, i.e., workflows. Thus, the earliest denomination of Workflow Management Systems (WMS) is more adequate. As an example, *Cases* emerged later in the software industry and model complex processes. The term Case Management Systems (CMS) has been used to distinguish them from BPMS. This incorrectly communicates that "cases are not business processes".
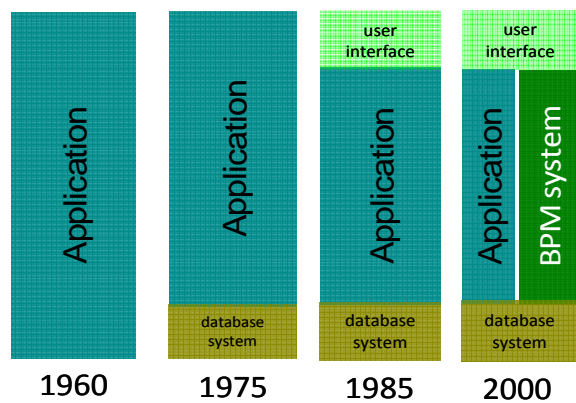
Figure 1. The evolution of information systems development and the role of BPM systems in the newest generations of software (from [Van der Aalst, 2012]).

In the workflow abstraction, the potential role-players assigned to the execution or supervision of the individual tasks will be "idling" unless they get activated through the pipeline. This model of reality is well-suited to fully automated tasks (like those realized by software) but unsuited to other situations in organizations where humans take part of the process execution. Indeed, the *factory* model of operations captured into a workflow implies that people are actually "doing nothing" unless their "activation" occurs by the preceding tasks in the pipeline. The latter is far from modeling accurately the reality of work in most enterprise processes.

(3) The tradition of process optimization works on the assumption that the investment made in optimizing a process is recovered through the repeated application of the transformed process for a long-enough period of time. The principle is that economic benefits will accrue from accumulated cost reduction obtained by the application of the optimized process over and over again. This approach reflects a true *'factory'* in the conception and modeling of organizational behavior. Furthermore, the idea of perfecting the process with such an effort paying off through hundreds of thousand repetitions or even millions of interventions done with the same process is adversarial to the business need of introducing modifications. As organizations have been progressively more affected by sudden change or in operations where change is a common requirement this type of *factory optimization* does not work. In fact, rigidity of process models has been a long-standing and bitter finding. More recently, the broader issue of process evolvability in the presence of continuous change has been the subject of solid research, including a recent PhD thesis [269] and references therein.

(4) Implicitly or explicitly in the traditional approaches to business process, it lies the Taylorian principle of replacing individuals by applying automation whenever possible. As in other business theories that build on a "dehumanization" of enterprises, the consequence is that the role of humans as sources of value-creation in processes is ignored. The connection of this foundation and BPM work has been openly

recognized by Van der Aalst in his recent review of a decade of Business Process Management conferences [260]: *"Adam Smith showed the advantages of the division of labor. Frederick Taylor introduced the initial principles of scientific management. Henry Ford introduced the production line for the mass production of black T-Fords. It is **easy to see that these ideas are used in today's BPM** systems"*.

In close connection to this moral coming from certain economics and business schools, it also resides the goal of avoiding *variation* of the process by all possible means. This good idea originally coming from manufacturing practices (i.e., reducing variation as a means to controlling quality and cost of the resulting production) has been translated to other forms of operations (such as *services*) where variation is inevitable when interaction with non-automated agents becomes an integral part of the actual production process[4]. Inevitable process variation is a significant sign of 'lost control', as organizational capabilities go from the tangible to the less tangible. As said in [138], *the less tangible the capability, the more control will be ceded to the customer*. The tradition of BPM work contrasts sharply with Enterprise Engineering [62], a theory in which humans are seen as a precious source of value, particularly for achieving improvements and differentiation. In particular, all processes involving interaction with customers offer this opportunity (services researchers often call this concept "co-creation").

(5) It is important to recall that existing *process classifications* such as the Process Classification Framework [184] reveal common areas of work in organizations that do not follow the BPM tradition in the sense that they do not represent work amenable to workflows. Indeed, PCF is a standardization effort in different industries that includes many non-factory areas of an enterprise. Consequently, these operations are not adequately addressed by the application of existing BPM research, methods and tools. The clarification from Van der Aalst and his collaborators when excluding *strategy processes* from the scope of their work was an excellent sign, although "strategy" should not have been the only area excluded from the scope of their contributions. There are other critical business processes in enterprises beyond "strategy" that do not fit workflow models, Petri Nets, BPMN, or related instruments popular in Computer Science [223]. Specifically, these other forms of organizational behavior beyond '*the factory'* involve complex activities carried our by humans in collaboration with one another and with the support of technology in ways that are observable and may also be captured into process models. This point can also be easily illustrated by using some of the Process Classification Framework (PCF) content.

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[4] Most call centers begin all their interaction with customers by following pre-established routines. In some cases, this may disgrace the effectiveness of the service and satisfaction of the caller. A known example is when reasonably educated customers are asked first whether their obviously non-functioning product is plugged to the power supply, to unplug and plug it again, try to turn it on once more, and so on.

While some people may argue that this framework may arguably be called a process architecture [179], [71], [167] it still provides a solid clue of many operations that are either common across industries or unique to specific industry segments such as retail banking or consumer packaged goods. None of these enterprise operations can be modeled by workflows.

In addition, the componentized business architecture and its resulting industry models addressed in [223] are also very useful to illustrate the same points. In these approaches, there is no functional decomposition at the heart of the modeling, unlike in PCF, and thus the resulting construction follows more closely some of the core principles of Enterprise Engineering [62]. This will be addressed briefly in the next section.
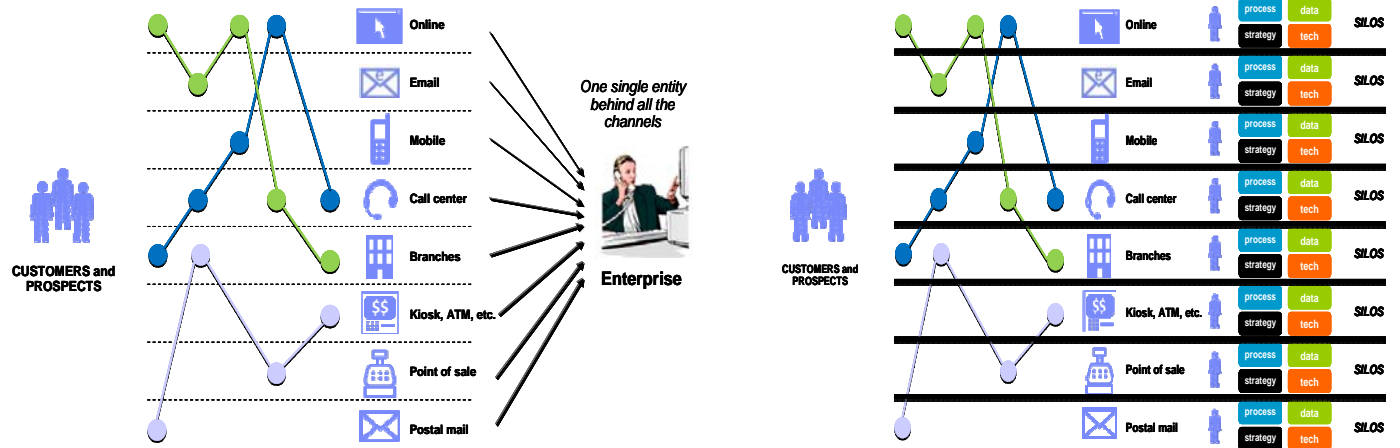
described in known terms rather than artificially fitting it into a process diagram".

II. PROCESS AND THE BROKEN CUSTOMER EXPERIENCE

In the context of this paper, *customer experience* is the conjunction of all experiences a consumer has with an enterprise over the duration of their relationship [100]. The advent of multiple channels of engagement for the same enterprise exposes deep gaps that organizations have in dealing with their own customers. This trend leads organizations to revisit some of their core capabilities and competences in dealing with customers [5]. There are two sources of evidence. First, there are a number of key capabilities that organizations have been growing and harvesting over the last decade in order to improve *customer experience*. These areas are starting to yield best-practices and newer economies of scale. Key capabilities such as customer

Figure 2. Customers and prospects deal with an enterprise through a number of channels by following patterns or *journeys* that vary according to individuals' circumstances and behavior. The picture on the left represents the expected experience of meeting the enterprise as a single and well-integrated entity. However, reality is very different as channels are isolated and disjoint, represented visually by the horizontal silos of the right hand side picture. Each silo has eventually their own processes, data, strategy (goals and incentives) and IT.

(6) Another important evidence that process has moved out of the industrialization box is *Case Management* (more recently also called *Adaptive Case Management* by the authors in [244] and *Dynamic Case Management* by analysts in Forrester). The need for Case Management has been illustrated with different enterprise operations such as claim processing in Property and Casualty Insurance, customer applications in Social Services, Health Care claim processing, Judicial Cases [213], and so on. Van der Aalst and others [263], [267] presented *Case Handling* as a new paradigm for supporting *flexible* and *knowledge intensive* business processes. In his work on case management, De Man [58] states that 'workflow' is an adequate representation for factory-type, highly predictable behavior admitting for little or no deviation from pre-established models. In recent literature [122], the argument in support of the need for Case Management hinged around the fact that "*Case Management allows the business to be*

service management, brand monitoring, campaign design and deployment, enterprise marketing operations, product and service innovation, customer loyalty and advocacy management and others are examples of the top priorities where organizations are experiencing the emergence of business process [100]. Second, enterprises are focusing on services that bring value to customers and then, aligning end-to-end business processes that enable service delivery is essential. These needs are in sharp contrast to those approaches to business process instrumentation based on packaged applications that, in conjunction with custom BPM

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[5] In North America, 80% of clients are happy with their bank service but only 50% say they will remain with their current bank over the next 6 months. This reflects the finding that globally, only 42% of bank customers have rate their experience as being positive. Furthermore, satisfaction levels with branches, despite being the most expensive and most developed channel, averages 40% world-wide with highest being 60% in North America.

systems, have created *fragmented* or *completely broken* customer experience. This is an observation coming from direct practice in the field and it can also be corroborated by exploring current business literature. The point stressed here is that **new sources of customer information and much more engaged consumers through multiple channels will make the already disrupted customer experience *unmanageable* for large enterprises**. If front-office processes are not addressed according to the new business and societal needs, the ongoing fragmented experience will result in additional loss of loyalty and consequently, further customer equity or profitability issues [273].

Figure 2 illustrates typical *customer journeys* [6] across different enterprise channels (left), in which monetization is eventually reached after a number of interactions. A broken customer experience generally results from each channel behaving as a silo (right side of Figure 2) one having its own processes, data, strategy and technology. Probably, to the surprise of many analytics advocates, the more emphasis enterprises make on individualizing customers and "inferring their behavior", the more broken customer experience if current operational practices are not drastically changed. The reason is that customers will increase their expectation for personalized services while the ability for organizations to provide them is far from the current state-of-the-art. This issue will become particularly challenging for some services industries because (i) such personalization may not be viable; (ii) regulatory limitations may prevail; or (iii) scalability of good quality customer service may be at odds with profitability targets.

Another worrisome issue worth noticing is that these emerging practices are being made into software without adequate exposure of their underlying business processes. This should constitute a warning to management as **these applications bury rich business processes into their packaged software**, thus signaling the same issues experienced in other more matured operations. This warning is a significant call for the adequate research and practice necessary to **surface the key processes before they are fully embedded into "concrete"**, a fact that will impact agility as the frequency of change in these processes is a lot higher than in those modeled in conventional enterprise resource planning.

Business analysts characterized the new process trend directly affecting customer experience under different names and also alerted practitioners, researchers and process professionals about different shifts taking place along the entire "hype cycle" of process evolution. In particular, Forrester used the name "tamed processes" and characterized them as follows: *"Tamed processes are designed from the outside in, can be driven by big data and advanced analytics, support social and mobile technology, provide end-to-end support across systems* of record and functional areas, and link on-premises and cloud-based services" [138].

III. PROCESS IN CRITICAL AREAS OF THE FRONT-OFFICE

Some emerging process areas in organizations may also go beyond the purpose of dealing directly with customers. These enterprise capabilities and competences support customers indirectly but their economic effects on customer equity are radical. Thus, these operations are also essential in the scope of Business Process Engineering because they encompass key work practices in the Front-Office of enterprises. These operations involve humans and collaborative activities deeply interrelated with technology and information, and their patterns of work are also emerging, become more and more visible, being subjected to *white box modeling* rather than remaining as *black boxes*. In these new process areas, Information Technology will still be essential but in radically different ways from "the factory" of enterprises. Actually, translating those experiences from Information Systems in the Back-Office to the Front-Office is a sure recipe for disaster. This inadequate translation would also add significant long-term strategic and cost-centric consequences to the ongoing broken customer experience.

Searching for further practical evidence on the emergence of non-traditional enterprise areas needing process study, it is important to revisit in depth some theories of organizational design and related work by different business research schools [189]. Specifically, Figure 3 shows an organization of the resource-base of a typical enterprise into four types and the corresponding bundling of such resources into disjoint business components. Each column on the right hand side of the figure represents one typical competence whose organization is described by the generic concepts of the column on the left, as presented in [223]. Although a different language was used, the foundations of the structure of a generic competence should be honored to Brumagin in [30], among other more recent business researchers[7].

Notice that the *hierarchy* of resources represented in Figure 3 does not mean the same as the classical management concept of "control". Instead, it only represents an arrangement in which different skills, information, assets (intangible and capital) and derivative entangled capabilities are bundled together to produce one or more relevant outcomes. Likewise, the components are not necessarily aligned with traditional Lines-of-Business and do not intend to map departmental capabilities or other conventional "reporting structures" in enterprises. Revisiting Penrose [189], the components highlighted on the right may be thought as the formalized grouping of resources whose entanglement produces those

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[6] This term has probably been coined by some technical and business people with the goal of not implying that the concept would be made part of the classical "process grinding" experienced though four decades. Beyond communication intent, *journeys* are processes and this is a well-supported fact in Social Science work.

[7] This is probably the only known actionable model derived from the general and powerful concepts running under the denomination of Resource-Based View (RBV) in the theory of the firm. Business process researchers are strongly encouraged to delve into RBV, search for cross-pollination with related Social Sciences work, and revisit business research topics such as those addressed in Organizational Behavior schools.

core services (internal or external) that the organization needs to serve all stakeholders. Some enterprises may be endowed with some of these resources in unique ways, being also more idiosyncratic for some industries than others.

Concrete models recently built for many industry segments by following the modularization principles summarized above reveal that there are hundreds of business components that the business process tradition has failed to address. In fact, most processes available from the research literature fall in the

years. The BPM tradition has adequately responded to the need of minimizing transaction costs across the enterprise and builds upon existing governance mechanisms defined as true *systems of control* aligned with functions [138]. In that sense the traditional approach has followed closely the enterprise disconnection and rigidity leading to the present state-of-the-art in customer experience. Moving the foundational basis to address the next generation of business process (called "*hybrid connected processes*" in [138]), cross-functional and complex processes (i) cannot be made or realized into workflow
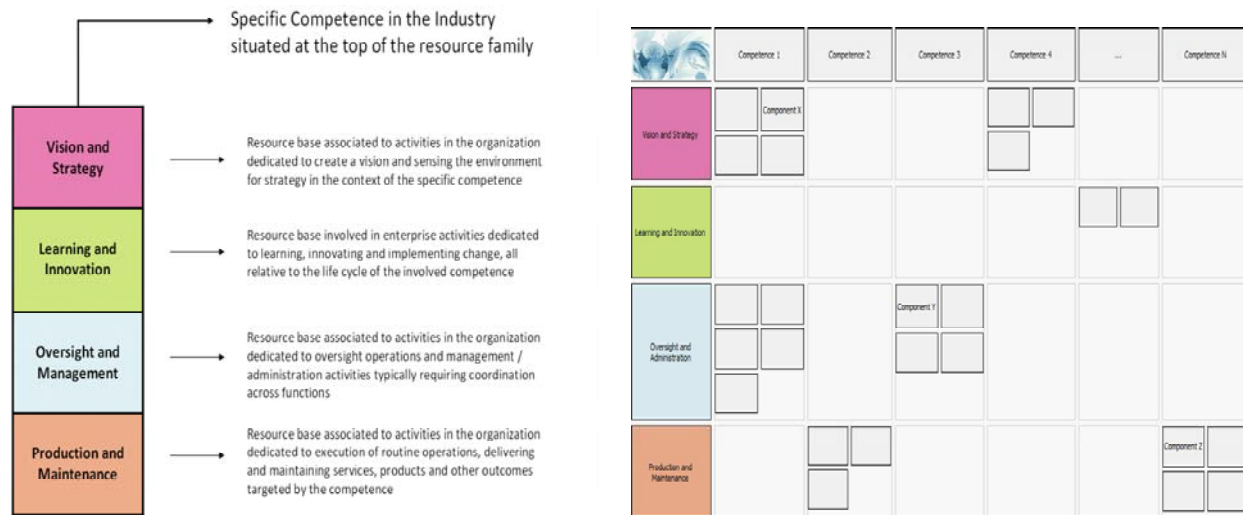

Figure 3. The four types of resources defined according to the different forms of behavior that are observed in a generic enterprise (left). Componentized organization of such resources based on different competences (right). Each of these components deals with a number of core *subjects* [171] whose evolution is key for the definition of corresponding competences (columns in the picture)

category of operations involved in the last row of business components, i.e., *production and maintenance processes*. As the level of involved resources moves into *oversight and management*, several interesting examples of *cases* may be found and used to illustrate the type of operations at play. Going further into *learning and innovation*, traditional contributions fade quickly or disappear entirely. Interestingly, the top row of Figure 3 includes the 'strategy processes' that Van der Aalst and collaborators explicitly excluded from their foundational work in the early 2000's. However, a diversity of processes like those needed for controlling the quality of a cartoon in an entertainment industry enterprise, managing the pipeline of compounds in a pharmaceutical company, and disseminating the learning harvested from a specific family of consulting practices throughout a services enterprise should not be included under the term 'strategy'.

There may be still an argument that processes in classical BPM work aim at modeling operations *across the components and not inside them*, i.e., end-to-end processes also called '*value streams*' in some business literature. However, this argument does not necessarily follow from inspecting the work reported in more than one thousand papers in the last 12

structures and (ii) new languages are needed to close the remarkable communication gap left in the cross-enterprise process space. It would be impossible to address these statements in full detail here but it should suffice to say that *loss of visibility* in cross-enterprise processes is a proven pain-point [171] still yielding well-identified *performance* and *communication problems* in many firms. The "hundred of pages" alluded by Dietz are real and the insight that these many pages have unraveled is minimal.

From a research perspective and practical point of view, the reader is referred to the recent work from Nandi in [171] for evidence that the main 'value streams' across an enterprise are in fact *progressions of core subjects* and not *life-cycle of objects*, at least when the latter is understood in the tradition of *state-machines*, i.e., artifacts evolving through a number of micro-states that separate the initiation and completion of "tasks". This fact goes back to the fundamental way metaphysics of processes has been approached in Social Sciences [208] and the conceptual duality between process

and *subjects*[8] in the organization of the world of a generic enterprise. Indeed, *subjects* are higher level abstractions than conventional *objects* and their evolution is thus subjected to lots of asynchronous activity taking place across the enterprise. The delivery of outcomes produced by these asynchronous activities signals the completion of necessary results as agreed in pre-determined cross-functional *commitments*. These commitments are, in fact, a form of organizational contracts and may be regarded as quite granular macro-states in the evolution of an individual *subject*. These 'states' are called *milestones* in [171].

The need for aligning the research agenda to the main challenges faced by industry was also called out in the closing recommendations from the BPM study in [112]: " *... despite being an actively researched field, anecdotal evidence and experiences suggest that the focus of the research community is not always aligned with the needs of industry"*. A couple of years have elapsed since the above papers were published but the situation has not changed much. The authors in [206] also addressed the importance of rooting BPM activities in industrial practice and correctly questioned the understanding of the actual adoption of BPM by organizations: "*... it may come as a surprise that contemporary insights are missing into which categories of organizations are adopting BPM and which type of BPM projects they are carrying out"*. Actually, Van de Aalst did some justice in his recent review of research in the last decade of BPM Conferences and highlighted that this work mostly addressed automation concerns [260]. In particular, Van der Aalst revisited BPM systems as an opportunity to further position BPM tools as valuable instruments to build better software applications.

While this traditional BPM research work and practices should definitely continue, new market trends and needs from new enterprise capabilities strongly suggest that business process focus has to shift in order to contribute to other urgent goals in organizations. Business process is called to play as a key instrument for achieving the *customer experience* needed in *front-office* operations and deep end-to-end integration of the latter with the *back-office* in enterprises. The main motivation for the new work needed does not hinge around cost reduction, industrializing routine operations or building better software with BPM systems.
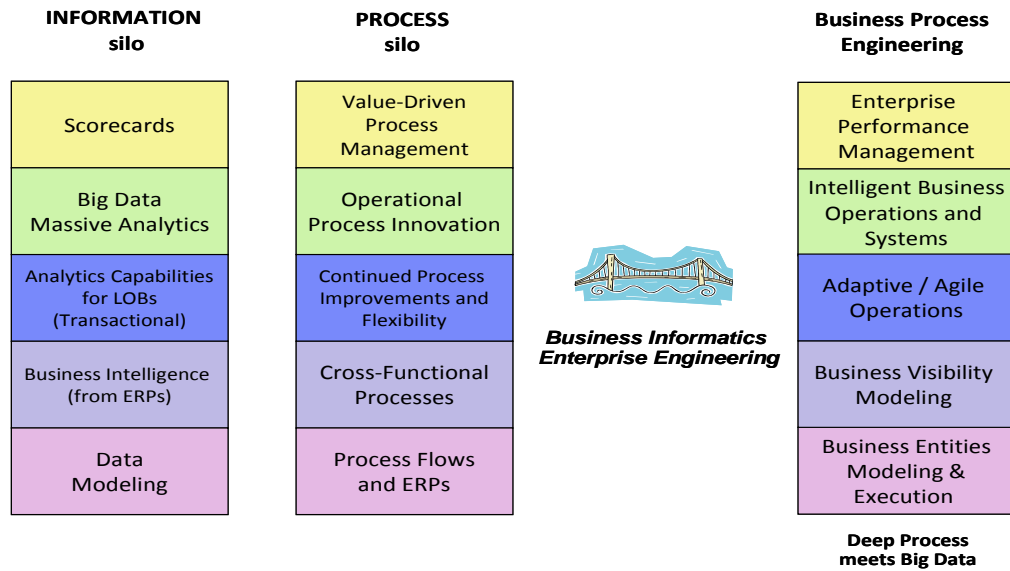
IV. BACK TO PROCESS FOUNDATIONS

The evolution of business process has not happened without significant divergence and to some extent, also confusion. The state-of-the-art is plagued by language chasms, cultural silos and idiosyncratic viewpoints. Some of these challenges were documented in [112], [58], [202], [206] and others. In [206], the authors state the challenge in clear terms: "*Considerable confusion exists about what Business Process Management entails ..."*. Indeed, the definition of business process is still

troubled by ambiguity and adding the term "management" has done little to clarify the confusion. A plea for this clarity has been articulated by Olbrich in [176]: "*It seems a pity that a lot of current research fails to provide a basic definition of what underlying understanding of 'process' and 'BPM' it bases its work on"*. In further exchanges in the same S-BPM conference, other authors such as Singer, Zinser and Fleischman agreed that the problem goes further into a lack of clarity on the very definition of BPM [78], [234]. A review of the literature shows that there is not a single and agreed definition of these terms. While "*... a scientific foundation is missing"* was clearly stated by Van der Aalst back in 2003, the review of BPM Conferences published by the author a decade later confirms that the fundamental shortfalls have not been overcome yet [260]. The underlying reason is deeply related to the nature of business process being a *socio-technical system* and thus, its complexity cannot be approached by a narrow focus on technology dimensions. In Fleischmann's own words: "*... sociological systems like organizations are combined with technical systems like information and communication technology. For a holistic view of business process management we have to consider all aspects"* [78]. In [278], Weske also highlights the deep nature of process: "*a business process consists of a set of activities that are performed in coordination in an organizational environment. These activities jointly realize a business goal.*" While using different language, other authors also defined business processes [53], [92], [238], [55], [118], [181] and the list goes on.

The Object Management Group recognized the foundational problem with the definition of process. In [231], the leader of the BPM group stated: "*there is no agreed-upon industry definition of Business Process. Instead, there are multiple definitions, each looking at the field from its own unique point of view, concentrating on its own set of concerns"*. Certainly, it is not a matter of one definition being right and the others being wrong. Rather, the issue is about the varying points of view used. As a consequence, the main efforts in process modeling standardization have not yet yielded the expected outcomes, as discussed in [202], more broadly exposed in [112] and highlighted in [260]. Unquestionably, most people do have a similar and informal notion of "business process". But this intuitive agreement does not mean a convergence across viewpoints. In fact, the variations in the definition of process may suggest that the term is a *boundary object* across disciplines, individuals from different units of an organization or communities of practice.

Other researchers in Social Sciences and Philosophy have also focused extensively on the concept of process and its definition. Van de Ven [256] addressed the topic in the context of one of the most complex types of processes in organizations, i.e., the strategy process. The depth of Van de Ven's classification reveals the foundations underlying most business process definitions. In spite of having been published two decades ago, this work has gone unnoticed in most of the

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[8] The word "subject" here means "theme" or "topic". This differs from the interpretation of subject as an actor carrying out an activity, and thus, it should not be confused with related semantics in S-BPM.

INFORMATION silo	PROCESS silo	Business Process Engineering
Scorecards	Value-Driven Process Management	Enterprise Performance Management
Big Data Massive Analytics	Operational Process Innovation	Intelligent Business Operations and Systems
Analytics Capabilities for LOBs (Transactional)	Continued Process Improvements and Flexibility	Adaptive / Agile Operations
Business Intelligence (from ERPs)	Cross-Functional Processes	Business Visibility Modeling
Data Modeling	Process Flows and ERPs	Business Entities Modeling & Execution

Business Informatics Enterprise Engineering

Deep Process meets Big Data

BPM literature [248], [1], [144], [123], [178], [178], [124], [201], [252], [260].

Another language chasm across different schools of thought or communities of practice is the unclear relationship between the concept of business process and that of *organizational routine*. Rich literature is available on the study of routines [19]**Error! Reference source not found.**, the significance of routines as a unit of analysis for organizations [190], [140] the collectivist meaning of routines and the need for establishing solid micro-foundations [73] and others. It is very likely that business process and routine address identical concerns in organization theory; however, in spite of the prolific technical production in the two subjects during decades, their formal relationship and the reasons for keeping two different terms remain unclear.

Finally, there has been a fundamental piece of work in process that builds upon a reconciled view of process and information available since the early days of the Information Engineering schools in Europe. This approach to business process goes under the brand of *entity-centric operations modeling* [222] and offers a holistic approach that reunites different types of processes under the same conceptual understanding. This entity-centric concept has been used intensively by Ould in [181], [178] and although the notion of life-cycle is from the early 1980's, several important contributions has been made in

seat as a mere "after-thought" in the modeling of behavior or becomes confused with "state model", being the latter a common misunderstanding incurred by most computer scientists as Van der Aalst remarkably noted. The point of reunion of these seemingly related modeling techniques does not reside in "artifacts" or "object life-cycle" but instead, it goes back to the Social Sciences in the sense that the unifying concept is the very epistemology of process, i.e., "things in the making" [249], [250]. Consequently, process design is about describing *the evolution of a core subject*. While the roots of this approach come from several decades of work and different schools of thoughts, not all process researchers and practitioners seem familiar with these concepts and related literature sources.

V. SOME TOPICS IN BUSINESS PROCESS ENGINEERING

It would be inadequate to propose here a complete agenda of research and practice in Business Process Engineering. Like in any other emerging field of work, only the pass of the time, community activities and market consolidation will determine its boundaries and shape its ultimate priorities. However, based on current work and ongoing industry needs, it would be safe to highlight some important areas with the purpose of stimulating further research. This is a first pass through such a list:

(A) Establish a foundation for understanding and modeling

Figure 4. Silos in information and process management have deepened with the evolution of each domain. This gap is more notorious after the advent of business analytics, scorecards, performance management and value-driven process BPM

different industries and software to merit a detailed inspection in Business Process Engineering [210], [220], [170], [246], [26], [43], [154], [155].

Quite interestingly, another related approach has recently emerged to model cross-functional end-to-end processes in enterprises based on the notion of *subjects* and *nexus of commitments* [171]. The foundation for all this work appears as a solid step toward the design and construction of different process types, including the so-called *value streams,* by using a common approach in which information does not take back

the *journeys* that customers follow in their multiple touch-points when interacting with enterprises across different channels. These journeys are probably the most loosely-coupled type of processes, i.e., they are highly unstructured but they are not random walks at all. This type of interactions is also found in other collaborative work in enterprises [99]. In addition, as involved interactions combine and alternate human-to-human and human-to-digital contacts, these journeys are rich in information and behavior. Then, their adequate understanding is imperative for the next generation of

customer experience. Some work has been done on this topic but there are no foundations yet with a theory that explicates the journeys and how behavior of the actors should be guided from footprints of customer contacts and previous experiences.

(B) Reconcile the ever-deepening silos of Information and Process. As suggested by the different levels shown in Figure 4, the information and process domains have traditionally evolved in almost complete isolation from each other. As damaging as this disconnection may result for the well-being of any organization, the problem has stayed unresolved throughout several decades. In fact, the gaps have widened and got deeper as the new "business analytics" trend has been getting momentum in enterprises and gathering the attention of Chief Marketing Officers. The introduction of "big data" and other marketing concepts in Information Technology has continued to widen the chasm. Hopefully, by building on a new foundation where the Information Process in organizations and society is repurposed as a single phenomenon through Business Informatics, new bridges will be built across the two silos. This reunion is dubbed "*Deep Process meets Big Data*" on Figure 4. The need for this integration will reposition "process analytics" as the integration of on-line (real-time) analytics and customer journeys.

(C) Discover customer-enterprise co-creation mechanisms and have them reach a massive scale through innovative processes. This will support the social transformation necessary for the information coming from social data to become a **trustable source of actual behavior and intent of individuals**. While social media means a flood of useful data, inferring human intention and behavior from these sources remains illusory. *Co-creation processes* deploying collaborative and mutually beneficial practices appear essential for the next generation of customer experience. Explicit provision of knowledge on an individual could be then done in exchange for personalized services or some other form of tangible value-propositions. This will lead individuals to provide trustworthy evidence of their behavior and intent. Designing and implementing the necessary processes to reach the scale needed requires deep socio-technical innovation. These processes will also help encourage full transparency from consumers and enforce accountability from companies. The latter will help replace today's legal disclaimers in which consumers are asked to resign their privacy rights under terms-and-conditions that probably few people read and even fewer understand.

(D) Clarify the distinction, if any, between the Social Science concept of *organizational routine* [191] and the broader meaning of process coming from Business Process Engineering. This will help reconcile work across the different schools of research in Social and Computer Sciences. While practitioners seldom use the word "routine" (and when they do, they imply repetitive or boring tasks which is not the meaning in Social Sciences), it is important to benefit from cross-insemination between Enterprise Engineering and Social Science research [137] for better understanding of organizational design and behavior.

(E) Create a theory of Process Modularization that is consistent and evolvable with change. This work has been initiated by different colleagues in [269]. As the "unit of change" in Process gets progressively more clear, the topic of Process Evolvability will also become connected to modularization, thus addressing the need for managing combinatorial effects (as already addressed by the general principles of Normalized Systems Theory in [151] for the case of software systems).

(F) Provide data-only analytics and related statistical modeling with a better foundation through behavior-based causation. This should help foster a blended approach through "white box" Enterprise Engineering modeling for today's decision-making techniques based on "black-box" statistics. Among other areas of critical enterprise value, this topic should also help define an enterprise business performance framework that integrates behavior and data in organizations. This goal corresponds to achieving the important integration shown in the top level of Figure 4.

(G) Create a "sociology of the customer" that helps understand the effect of using mass processes even with individualized clients in the pursuit of 'profitability'. If economic analysis renders it viable, data footprints left by consumers will not be the only hint to infer customer behavior (which is an erroneous approach to understand people's needs and true expectations anyway). Furthermore, the integration of process and big data will allow for full operationalization of "insight", thus making the latter move from "interesting discovery" to a Social Science-supported theory to enhance services and provide enterprises with higher customer equity.

(H) Benefit from Enterprise Engineering principles to reposition the role of humans in the value-creation of customer-centric processes. This topic has several deep social connotations and it should include the provisioning of economic evidence of the scalability (or lack thereof) of human-centric methods for understanding individual behavior of customers.

(I) Propose complete Front-Office operational models that represent the actual work enterprises do with their own customers. This should include *process and performance frameworks* for *all* those key competences and capabilities in the enterprise that belong to the Front-Office operations. In particular, the creation of solid Process Reference Architectures for emerging operational areas in marketing, brand management, campaign management, etc. would be critical for accelerating industry value of new research. As suggested earlier in this paper, surfacing and documenting these new work-practices is essential. Software packages are already in the market and these applications bury important processes whose frequent change is imperative for flexibility of Front-Office operations.

(J) Create industry-specific multi-channel customer journey models for key services industries such as banking,

insurance, and telecommunications. Link to and support these customer journeys with knowledge-based representations that bridge process and knowledge management. This is a significant area that will pave new integration of Process with Knowledge Management by creating a *customer-centric knowledge based organization of the enterprise*. The meaning of the latter statement is about making all pertinent information from an enterprise to be organized and be made available to customers in new, intelligent ways in which "process footprints" serve as a historical base to reorganize and find information personalized to individual customers (this comment comes from a private communication with P. Nandi).

(K) Propose new tools that further the current state-of-the-art of Information Technology for process design and construction in the concert of a Business Process Engineering approach (in this connection, the generation of code is a secondary concern but flexible and open end-to-end integrated capabilities would be a breakthrough). These process tools will be the carrier of data analytics in real-time while supporting the delivery of personalized services to individual customers.

Acknowledgments

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