A Holistic Work System Framework (HWSF) Development Using Systems Thinking

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***Abstract*—Technology and Engineering Management Activities induced the awareness of Work Systems (WS) in Business Conduction. During WS activities and decisions settings, typically technical perspectives are espoused heavily. Although, remedies of this kind require holistic approaches, such approaches are not very common. One of the main reasons for this inadequacy is the lack of conforming guidance. In this work, the aim is to create a framework as guidance for WS activities. The Holistic Work System Framework (HWSF) is based on Alter's Work System Framework (WSF) and enhanced with Systems Thinking in accordance with today's Business Contexts. In this manner, it is expected that the HWSF would redress the deficiencies of current guides.**

I. INTRODUCTION

Today corporations continuously seek to achieve Business Value Gain. This is the highest goal for corporations regardless their types, either academic institutions, industrial corporations, or even government agencies. Systems Implementation and Process Management are the most common practices of Technology and Engineering Management used for this purpose [1], [2]. These practices yielded transformations in the routine natures of corporations [3], [22], [24] inducing the awareness of Work Systems (WS) in Business Conduction [4]. Still, big failure stories are recurrently seen during WS activities, as obstacles for Business Value Gain. When these failure stories are analyzed, the common root cause seems to be underestimating the sociotechnical features of WS and taking decisions based on technical features confoundedly [5]. Actually, remedies of this kind require holistic approaches supported with balanced perspectives. Such approaches are not very common and mature enough both in research and in practice. One of the main reasons for this inadequacy is the lack of conforming guidance.

In this work, a conceptual framework, referred to as *Holistic Work System Framework* (HWSF), is created as a research design artifact to guide researchers and implementers during WS activities. HWSF is based mainly on Alter's Work Systems Framework (WSF) [10], strongly supported with the concepts given in several other existing guides and optimized with Systems Thinking in accordance with today's Business Contexts. In this manner, it is assumed that the HWSF would redress the deficiencies of current guides and also suitably serve as a foundation for the other WS related pursuits.

II. SITUATIONAL ANALYSIS

Today various forms of WS are being used during business conduction progressively. They all support the seamless flow of Information and the transparency of the Business Processes (BP). Formerly, WS were regarded as the platforms or applications only. But, with the aid of the *Systems Theories* [27], they can be considered as more *Systems* than the *Tools* they own [6], [7], [19]. WS is generally defined as the Systems including participants, equipment and information to perform a specific work with methods, measurement and management [8].

By definition, WS holds both technical and non-technical entities. For that reason WS should be considered as a Socio-technical System and analyzed by using both Technical and Behavioral Perspectives with clear understanding [9]. *Technique* can be defined as the systematic methods or body of knowledge used to bring about a result. Accordingly, *Technology* is evident with specific tools, materials, and methods or techniques to invent resolutions for practical problems. *Information* has been taken within the *Technology* in many existing guides. But with the progresses on Information-Based Products, today it is perceived as an independent dimension with different levels [10].

Non-technical perspectives may be supported by *Behavioral Disciplines* strongly and instanced in WS as *Management* and *Organization* concepts. *Management* is actually leading an *Organization* by inferring the situations faced, perceiving the challenges and creating opportunities within the business environment in addition to coordinating existing activities and allocating resources [9]. *Organization* is defined as a social, stable and formal structure taking resources from its environment and processing these resources to produce outputs [11]. Research results on WS show that central to the failures in WS implementation and adoption is the lack of considering all these perspectives and their instances in WS.

Both in research and practice, holistic interdisciplinary efforts are neither very common, nor mature enough yet. The technical and non-technical dimensions have been debated separately and actions on WS had been done on Technology Dimension. There is a strong need for actions with holistic interdisciplinary approaches. Increasing the quality and quantity of such efforts requires suitable guidance for depicting the frame of reference for WS works. There are valuable frameworks, models and even standards those may guide WS activities [16], [17]. But still, their scope, level of conceptualization and contents need enhancements to be suitable and sufficient for supporting today's business' conditions and WS [5].

For more information, the interested reader is referred to Appendix I and II of this paper where a detailed analysis of

the Business Concepts of today and a comparison of existing WS Guides are presented respectively.

III. FRAMEWORK DESIGN PROCESS

The *Scope* of this research work is to fulfill the guidance demand by defining a conceptual framework, which is covering all necessary Interdisciplinary Perspectives with related Dimensions, Components, and Levels with visual representation and high level definitions in Systems Thinking. For this reason, the artifact is named as the Holistic Work System Framework (HWSF).

The existing suitable guides in the literature have their own characteristics, with strong and weak sides. When each guide are put under *Comparative Analysis* in terms of scope details, it is easily seen that they are either not well supported by necessary disciplines in a balanced manner, or they are lacking entities demanded today, or they are having low usability due to the complexity or conceptualization level. This foundation formed by the literature research and comparative analysis aid the HWSF composition and evaluation processes [9], [10], [12], [26]. Both processes are based on *Descriptive Methods* [12]. Design Process has a top-down approach supported by the harmonization of the strong sides, improving the weak sides, and finally adding unique enhancements in accordance with today's business trends.

A. Environment

In most of the former guides, *Environment* is touched in a very abstract way, as the ambient where the business is done, as well as the problem domain and object of interest reside [9]. In the last version of Alter's WSF, *Environment* was shown and defined as an external entity explicitly, but its entities were also not clearly mentioned enough [7].

In the HWSF, *Environment* is the external ambient, where the *Stakeholders*' needs reside. From these needs, the problems and resolution opportunities are perceived to create *Contexts*, *Models* and *Concepts* for Business [13].

B. Results

The results of the WS are actually the products. The term, *Product*, strongly reminds of final physical products. Today, WS *Results* have various other types than final physical products and are more information-based and service-oriented, like prototypes, feasibility reports, preliminary design documents etc.

For this reason, Products and Services; are clearly depicted as *Results* in the HWSF, as a collaborative output of *Stakeholders*.

C. Stakeholders

In existing guides, the Stakeholders are referred to roughly as the Customers and the Producers. In the dynamic Business Contexts of today, the Stakeholders are the contributing and affected parties of the Results. In addition to the two mentioned before, new types of Stakeholders exist today, like Strategic Alliance Partners, Suppliers, Providers, Retailers, Distributers etc.

The results given in Section III so far are harmonized in Fig. 1. Any WS is formed by the contribution of the Stakeholders. Stakeholders collaborate on a business Results with their selected WS Cores. The contribution of each Stakeholder is shaped by the Context, Model and Concept of the business case. The WS Results are created by this collaboration in order to resolve an issue or satisfy a need elicited from the Environment [25].

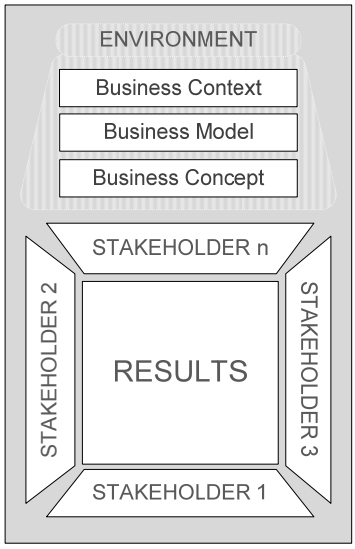

Fig. 1 – WS : Environment, Stakeholders and Results

D. WS Core

Stakeholders have different core systems for specific functions. These systems form the internal WS Cores. One WS Core may be utilized for Inventory Management, the other for Supply Chain Management. Hence, in this scenario, Stakeholder *n* may have *m* WS Cores, servicing on a unique *Result* in a specific WS. Each WS Core may be in interaction with other WS Cores of other *Stakeholders*. Different constellations of these WS Cores are the foundation of specific WS. Hence, a Business Value Web is a System of WS Cores of relevant Stakeholders. In Alter's WSF, the WS Core is defined as the place where the work is done [10].

In the HWSF, WS Core is also tailored with respect to the today's Business trends and WS Literature. WS Core in the HWSF is formed by 4 dimensions referred to as Management, Organization, Information and Technology.

1) Management

Management is the execution of necessary activities to enable WS operation and exploitation in order to produce the *Result*. In this sense, it is the most subtle element of the WS. In most of the guides, *Management* and its components are mixed by other concepts or even totally missed. In the HWSF, Management Dimension is defined clearly and

positioned separately, as an umbrella entity to aid other WS Dimensions, and serves as an interface to the WS Core.

Management is performed in three levels, as shown in Fig. 2. Goals and Strategies of the Organization are created in Senior Level Management by eliciting Business Concepts in the Business Environment. The Middle Level Management performs Program and Process Management activities. The Low Level Management focuses on Transactions and Operations.

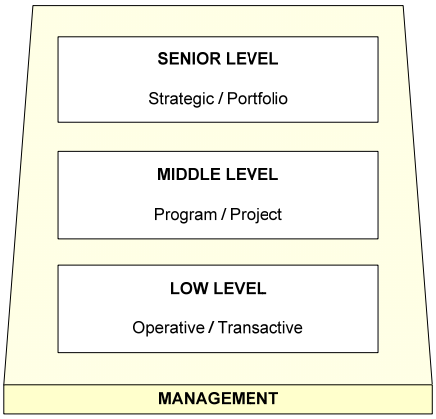

Fig. 2 WS Core – Management Dimension

2) Organization

Although this dimension is more concrete with respect to *Management,* still it is subtle with respect to remaining dimensions. One can sense the product, service, information or technology of WS concretely; whereas the organization structure, culture, and management regulations are sensed only after they are documented and executed. This is one of the main reasons why organization and management are put in frameworks in different orders, totally depending on the perception of the author. In the HWSF, Organization is defined as an independent entity of the WS Core. This entity is shown in Fig. 3, formed by the Structure, Culture and Participants components [20].

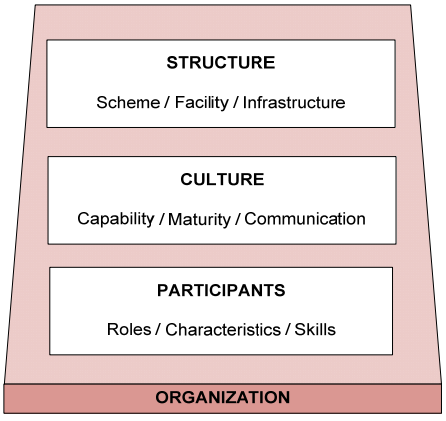

Fig. 3 - WS Core – Organization Dimension

*Structure*s help to guide and see where a participant works and how communication can be done. They are also vital for positioning the roles and the function areas. Today, Structures are becoming more horizontal and dynamic. *Culture* is mostly analyzed in Behavioral Perspectives and mostly skipped in Technical Perspectives. It is based on shared ideas and behaviors which are mostly based on intangible knowledge developed over time. Hence, it is unique to the Organization. *Participants* are the actors who perform the work with the aid of technology and information. They may have different roles for different tasks according to the Characteristics and Skills. With respect to all these criteria, Participants are positioned different Management Levels in accordance with Organizational Structure and Culture.

3) Technology

In all guides reviewed, Technology Dimension is explicitly shown and somehow defined, as a common point. This situation shows the weighted Technical Perspective in general. Still, Technology is not defined clearly in many of them, rather refers to the hardware and software used by the Participants in order to output WS Results.

In the HWSF, Technology is the total Techniques (or Methods), Tools and Materials specific to the WS, used by Participants to create Results as shown in Fig. 4. The HWSF's another novelty is defining BP as a means of Technique under technology in alignment with the definitions in Social Disciplines and BP history [21], [23].

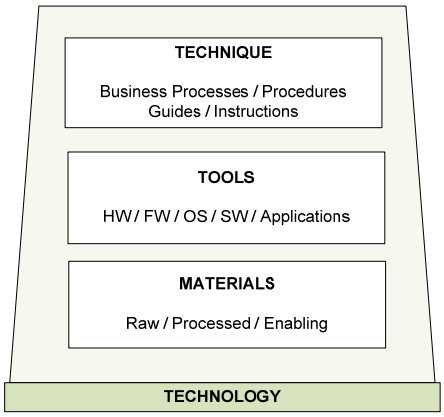

Fig. 4 - WS Core – Technology Dimension

4) Information

Although, *Information* is the core of today's business with WS, it is not addressed directly in many guides. Information is processed, stored and retrieved in WS with the aid of Technology to achieve a specific Result by the Participants. Due to the excessive usage of Information in WS and its increasing percentage within the Results, it is vital to dedicate an independent dimension on Information in the HWSF, with necessary levels, as data, information and knowledge. *Information* is the processed data which is mapped into shape with suitable arrangement and form for WS Participants' understanding and usage. *Data* is the representation of raw

facts. *Knowledge* is the ability of using Information, insights and ideas guiding decisions and deeds. It may be tangible, explicit or intangible, tacit, as shown in Fig. 5.

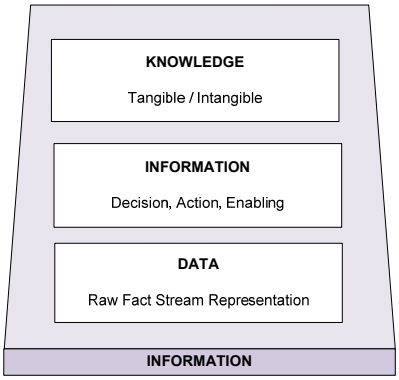

Fig. 5 - WS Core – Information Entity

5) Final WS Core

Positioning and harmonization of the Components in a framework is essential for clarifying its Context. Dimensions and Levels definitions of existing literature were very useful for the developing foundations of the HWSF. These harmonization considerations, explicit depictions, clear definition and reallocation of the Components when necessary are novel sides of the HWSF with respect to other guides.

In the HWSF's WS Core, Management Dimension is an umbrella for the remaining ones, as shown in Fig. 6. The policy and requirements on Organization, Information and Technology change dramatically with respect to the Management Level they participate in. Participants at Senior Management Level perform executive BPs serving like Strategic or Portfolio Management areas. They perform unstructured decisions makings. For this reason, the tools are based on advanced Information and Communication Technology (ICT) for graphics and communication.

E. Final HWSF View

In the HWSF, all Stakeholders, regardless their functions in the Business Value Web are presented around the Result / Outputs. Results in the HWSF are the outputs of the interaction of the Stakeholders on the Business Concept, where all Stakeholders act with their specific WS Cores. Hence, the collaborated Results / Outputs in the HWSF are more than the Products / Services as connectors between the Customers and the Producers as in Alter's WSF. Each Stakeholder works with own WS Cores. The collaboration is aided by the seamless workflows of the Information and Materials via different BPs of WS Cores [18]. For the sake of simplicity, the details of the WS Core given in Fig. 6, is eliminated in final the HWSF view as shown in Fig. 7.

With this manner, only one WS Core is shown but their multiple alternatives are referenced with the letter *"m"*. The collaboration on the Results and bi-multilateral interactions between each other is represented by double headed arrows. In addition to dimensioning; the floating components around the WS Core in Alter's WSF are cleared. In the HWSF, they are embedded in the related Components with respect to today's Business Concepts. This had well cleared the ambiguity in the representation and in the relation of WS Core between Environment, Infrastructure and Strategy in Alter's WSF.

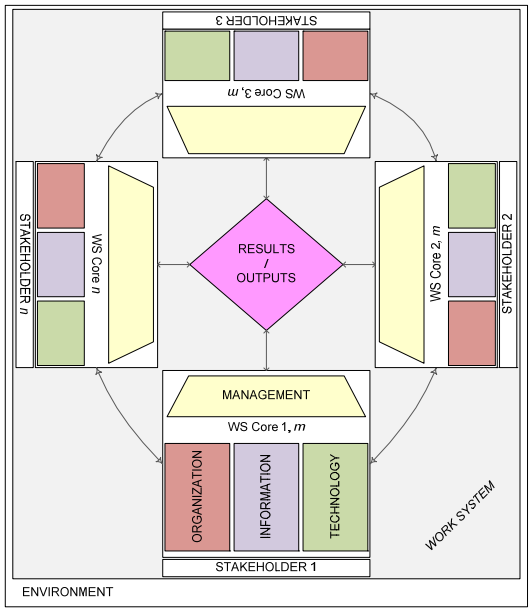

Fig. 7 - Holistic Work System Framework, the HWSF

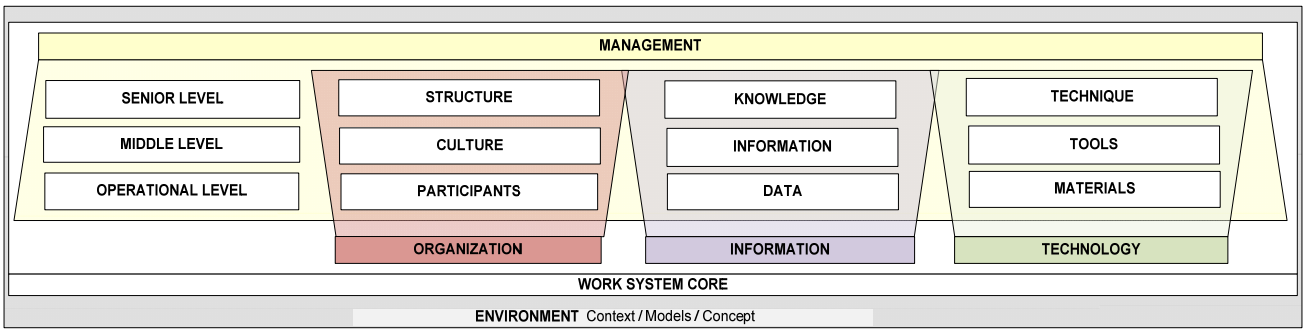

Fig. 6. - WS Core of the HWSF

IV. EVALUATION

The Design Evaluation Clause of Hevner's IS Research Design Science Guidelines, as shown in Table 1, is used to evaluate this work. In this work, Descriptive and Analytical Methods of this Guideline are implemented. These methods are utilized due to the Design Process nature of Conceptual Frameworks. Intrinsically, the Evaluation Process took part in concurrence with the Design Processes in the whole life cycle of HWSF composition [12].

TABLE 1- IS RESEARCH DESIGN EVALUATION METHODS

Type	***Application***
1. Observational	Case Study
	Field Study
2. Analytical	Static Analysis
	Architecture Analysis
	Optimization
	Dynamic Analysis
3. Experimental	Controlled Experiment
	Simulation
4. Testing	Functional Testing
	Structural Testing
5. Descriptive	Informed Argument
	Scenarios

A. Descriptive Evaluations

Situational Analysis and Literature Research with Domain Requirements Elicitation and Gap Analysis are given in Section II. Design Efforts are presented in Section III. They are all based on information from the Knowledge Base formed by Academic and Practical Literature on WS Studies and include case studies, field studies and their combination [6], [9], [12]. All these works ascertain the lack of Holistic Approach supported by Interdisciplinary Perspectives and Systems Thinking in WS efforts and the demand of suitable guidance [5]. In Section III, these Informed Argumentations are used as the descriptive design guide. Still, they are the evidences for the Descriptive Evaluation of the work scope, the HWSF Goal, and the HWSF structure.

B. Analytical Evaluations

In order to apply *Static Analysis* on the HWSF, its structure is examined with respect to static qualities of content spectrum and complexity. In order to achieve holistic view, the HWSF included all perspectives of socio-technical systems. In this sense, former frameworks also had the same aim. The advantage of the HWSF becomes more explicit during complexity evaluation. While holding all necessary contents, the HWSF's structure is kept pure and unadorned. As a comparison, Laudon's IS Perspective also aims to hold necessary contents, but to achieve this, it needs secondary frameworks like Enterprise Frameworks which increases the complexity. The complexity even increases in Alter or Hevner's frameworks. Unhelkar's work, with 4 dense views, is totally complex. Hence, the HWSF has the advantage of catching Holistic View in a compact manner with respect to the existing frameworks.

With the aid of *Architecture Analysis,* it is obviously seen that, with its structure, dimensions, levels, components, the HWSF is absolutely suitable for sociotechnical system perspectives. Perspectives are defined within WS Core by the Dimensions. The 3 staged Leveling both in Core and Environment ease users' analysis of a WS. The structure of the WS Core is suitable to represent various Stakeholder Work Systems and interrelations with other WS either internal or external to the Stakeholder. Components show the necessary elements of today's business context in accordance with the related literature [14], [15]. When the existing guides' architectures are analyzed, they lack one or several of the concepts and implementations regarding the dimensions. This makes them unable to reach interdisciplinary approach and hence unable to fit for WS purposes.

Optimization maybe is the strongest part for both Design and Evaluation phases of this work. All components and dimensions proposed in the WS guides existing in the literature are studied carefully. They are comparatively analyzed with respect to the perspectives of sociotechnical systems. With the aid of the findings, Dimensions and Levels are composed, Components are allocated accordingly. This step, aided by the Systems Thinking, formed the Holistic and Interdisciplinary base of the HWSF. When the former frameworks are analyzed carefully, one can see the flaws, for example merging or skipping of some necessary dimensions; disambiguation on dimension contents; wrong entity assignments which should not be a dimension or component.

C. Future Work Plan

As a future work plan, it is aimed to demonstrate the utility of the HWSF in a work environment and business context, as a means of Observational Evaluation. This step would enable the validation of the HWSF complementing the verifications presented in the Sections IV.A and IV.B. This complementary plan also conforms to the Evaluation Methodology of the IS Research Design Science Guideline [12]. This validation would lead to refining the definitions of the components and their relations with respect to the dimensions, levels and environment. Such future work would support an important virgin area, Business Modeling including BP Improvement, Re-engineering, Management (BPI, BPR, BPM) and Enterprise Architecture (EA) issues in addition to sole WS implementation and utilization activities. The HWSF would also aid research on these practices efficiently [2], [24].

V. CONCLUSION

The research design artifact of this work, the HWSF, is a novel framework aiming to guide researchers and practitioners during their WS activities and related works. Interdisciplinary Perspectives are highly credited and adopted to the HWSF with Systems Thinking. The HWSF is kept conceptual with Visual Depictions and High Level Definitions. Holistic Approach is achieved by harmonizing

different dimensions and levels. All framework entities are researched thoroughly in various disciplines and kept up-to-date with respect to today's literature and business contexts. With these features, the HWSF is a suitable guide participants working on Engineering Management, Portfolio Management and Process Management works with intensive WS utilization in various other sectors like Infrastructure, Service, Logistics, Education and Health. With such a novel guiding, critical points for WS adoption would be elicited in the early phases, their transition to failures would be eliminated and WS utilization success would be enabled successfully.

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APPENDIX I – WORK SYSTEMS & WS GUIDES

I. SYSTEMS AND GUIDES

Systems are organized structures with purposes, composed by interrelated elements . This interrelation is the core of the system activity, existence and goal [28]. In daily life, many systems, for example electricity grid, traffic system or an information system. are used with or without awareness, These systems serve users to reach their goal in an orderly and organized way; increasing the efficiency, quality and satisfaction and decreasing the discrepancy, latency and risks. Because of this reason, they are important in business, academy and daily lives. Today, in the age of Information and Communication Technology (ICT), the Systems and their Results are more information and service based. They are less concrete than their pioneers in the Industry or Agriculture ages. These former ages' Systems and Results were composed of mostly machines or materials, which were more observable and controllable during all processes and phases of their lifecycle. Same is true for the Business Processes also. Today, the analysis, planning, execution, test and integration phases and processes of products are no more cascaded and independent as in former industries or businesses used to have. They are very overlapping and feed backing each other. Due to these transformations, the importance of analysis, planning and design phases of Systems, Results and Processes became even more significant with respect to implementation of them [10].

Among many systems, Work Systems (WS) are roughly defined as the Systems including humans, information and equipment to perform a specific work with methods, measurement and management [8]. Today various forms of WS with different configurations and lays are being used during business conduction progressively. They all support seamless and fast workflow of information and materials, observability and controllability of the entities and transparency of the Business Processes (BP) [19]. In Table 2, some samples for such Systems are given [9]. Formerly they were perceived as only technical infrastructures composed of platform, tool and applications. But, with the aid of the WS Approach, they can now be considered as Systems holding technical (methods, measurement and equipment), non-technical (humans), and hybrid (management and information) entities [7], [10]. For that reason, WS should be considered as Socio-technical Systems, and should be analyzed by using both Technical and Non-technical Perspectives [12], [29], [30].

The conceptual versions of systems are vital, especially during analysis and planning phases. They do not only strongly help to understand clearly the systems (and their entities), but also aid their design, and implementation. By this way, failures and risks are fetched at the earlier phases of the system lifecycle [10]. In the systems of today, this elimination is either impossible at later stages or with extremely high costs and risks which might lead direct cancellation of the system rather than reworking on it. The conceptual versions of Systems basically act as guiding forms. Conceptual versions of WS can be used for guidance in the forms of Frameworks, Models, Standards, or other forms like Body of Knowledge (BoK), Architecture, etc.

TABLE 2 – WS USED IN BUSINESS

System Type	System Sample
Enterprise Systems	Enterprise Resource Planning Systems
	Supplier Change Management Systems
	Customer Relation Management Systems
	Fully Automated Systems
	Self Service Systems
Functional Systems	Sales and Marketing Systems
	Manufacturing and Production Systems
	Finance and Accounting Systems
	Human Resources System
Management Systems	Executive Support Systems
	Decision Support Systems
	Management Information Systems
	Transaction Processing Systems

A. Frameworks

Frameworks are abstract, brief set of ideas and assumptions for organizing a conceptual system in a generic way. They are simply the skeleton of the asset system to be designed, which would later be developed with details and enhancements. Frameworks are widely used in research and practice as important elements of the knowledge base through which implementation can be executed and finalized successfully. They present an approach to an idea, a solution for a specified problem domain, or aid design with high level identification of the related topics. With such nature, Frameworks are mostly taken as intermediate theory interrelates to most of the aspects of work under investigation. Frameworks are like road maps that guide the implementers of the related work and they are coherent to empirical research [10].

For this reason, Frameworks are very valuable as an initial step before starting a research or solution proposal to a problem inquiry, which will continue to guide with its possible revisions throughout the lifecycle till the solution is reached [12]. When the project failures and lessons learned on Software Projects, Information Systems and e-Business Initiations are reviewed, the vitality of this point would be clearer. Lack of systematic approach, careful planning and framework usage in industry and lack of academic and research support for these issues are the main reasons of these failures [5]. There are many frameworks that may be used for guiding WS issues, some of which are sampled in the next section.

B. Models

Models can be created by embedding the representations of the entities and relations forming a specific interest into the structure given by a reference framework. Hence, models are not as conceptual or generic as Frameworks. They are the imitations of a reality without all details. Hence emphasizing

some features, and underestimating or even overlooking some other features of the related concept is normal in modeling [10]. CMMI and OPM3 are instances for organization and process PI modeling [31], [32].

C. Architectures

Architectures have been residing as organizational meta-models for enterprises or institutions [33]. DoDAF and TOGAF are two of the most popular samples for architectures, which are somehow routed from Zachman's Framework [17], [34], [35].

D. Standards and BoKs

Standards and *BoK*s are strong tools for the users in business and academy. They guide users to analyze a concept by serving a simplified imitation of that concept. They are not as high level definitions like the former ones. They may owe frameworks, models and architectures within, or refer to. They do not have high level of definitions like Frameworks or Models, more supported with textual definitions. They claim to give a complete '*what to do*' definitions. These are the definitions for the process and activities based on Best Practices, Common Usages and Lessons Learned in the specific field. They leave '*how to do*'es to be tailored and defined by users, in order to be non-specific and non-restrictive. This situation makes them more normative, informative and definitive. Descriptive, prescriptive and explanatory features are left to specific guidelines created within the corporation. These features yield these guidelines to be field or application specific. Existing standards or BoKs for technical, organizational and management processes are well defined or adopted by bodies like ISO, IEEE, ANSI, PMI, INCOSE and ECSS. CoBIT and ITIL are also good examples for standardization for best practices in IT field.

E. Existing Guides Analysis

The samples given for frameworks, models, standards, architectures are the outcome of the literature survey on the WS research and practice. They create a big set with wide ranges of status (active, revised or obsolete), types (framework, standard or model) or forms (textual, graphical). They are valuable alternatives for WS issues. Still, they are not caught by the researchers and implementers enough. One of the main reasons is their specific strengths on some perspectives and impotency in others. Secondly out-of-datedness with respect to today's business context, in where processes, lifecycles, results and enterprises are in transition [23]. Thirdly, the fuzziness in the aimed level of conceptualization, lack of clear demonstration and definition for the necessary dimensions, entities, relations are also observed in most of the existing guides. All these cause difficulties for participants to understand and apply the concepts clearly. When, this big set is evaluated with respect to these 3 criteria mentioned, the works of Alter, Laudon, Hevner and Unhelkar are chosen to be the knowledge foundation of this work with their Conceptual Framework features such as Visual Depiction, High Level Definitions, balanced and relatively actual contents.

II. FRAMEWORK GUIDES FOR WS

A. Work Systems Framework (WSF)

Alter defined many of the Systems given in Table 2, as specific instances of Work Systems, and proposed a framework as a WS Guide, referred to as Work Systems Framework (WSF) [10]. WSF has been revised by his other works and the latest version is shown in Fig. 8. Revision offers had been brought to literature by other researchers as well. According to WSF, WS are the Systems in Business Environments run by the participants with necessary resources, in order to perform the related BP to provide results for the customers. The Participants may be humans or machines. The Resources may be composed of information or materials. As referenced by many research and practice works, WSF served as a powerful tool in the fields of Information Systems and or Industrial Engineering [2].

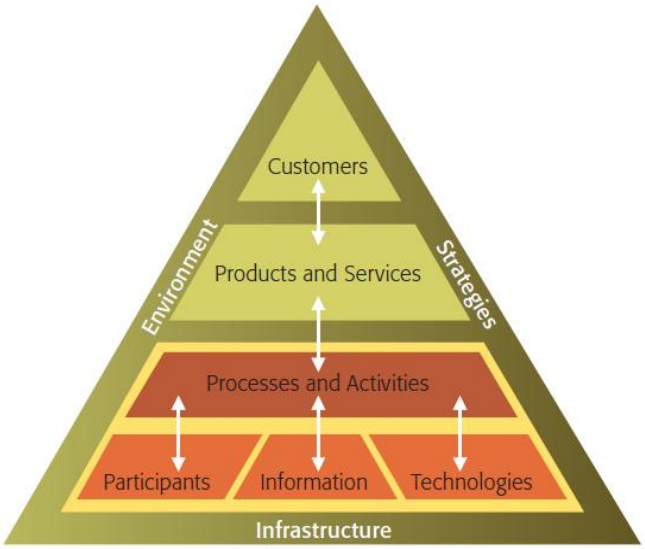

Fig. 6 - Work System Framework, © [10]

WSF included seven main entities. It defines well technical entities like technologies, information and infrastructure and also non-technical entities like participants, customers and strategies. The customers are the people who use and receive direct benefits of the products and services produced by the work system. Customers may be external, internal customers, end-users or other stakeholders. Products are combination of physical things, information and services that work systems produce for their customers. The reason of the existence of the work systems is to produce these products. The group formed by the four bottom entities (Business Processes, Participants, Information and Technology) in WS is defined as the WS Core, where the actual work is done. Business Process is defined as set of work steps or activities performed within the work system in

this framework. Information is the information used by participants to perform the work. Technology is the hardware, software, systems and other tools and equipment's used by participants to perform the work. Participants are the people performing the work.

Showing Strategies as a clear component is a big advantage of WSF, as Business Strategy is vital for the alignment of BPs with the Business Goal. Infrastructure and Environment entities are skipped in many existing frameworks. Mentioning them clearly is also another strong side of WSF. With such features, WSF tends to use holistic approaches with interdisciplinary perspectives. Hence, WSF becomes a very strong member for WS Guidance Foundation Base.

Still, in WSF, some points need improvement. The dimensions and levels, as the instances of necessary perspectives, are lacking in WSF. First of all, Management and Organization notions are totally skipped. Mansar introduced Organization concept in WSF as a slight cure, where its position is questionable [2]. The external entities' positions are floating and their definitions and relations are not clear enough. WSF is highly BP centered. Stakeholders are only represented by Customers and WS Core, but their collaboration is totally missed. These issues are the main barriers for the approach of this framework to embrace Systems Thinking fully.

B. IS Perspectives Framework

IS has already invaded our professional and daily lives. Their wide adoption and usage is increasing with their sophistication. Before, IS was seen as a tool set of platforms and applications for management. Today, research and industry began to perceive IS as a WS and working on concepts emerging with the usage of IS. Examples for these are mobile enterprises, networks for cars, pervasive computing, context aware systems, and many others. The concepts and the usages of IS in academic literature are defined as interrelated components collect, retrieve, process, store and distribute information to support organizations. From this point, IS becomes a strategic asset for organizations to support their decision making and work control, increasing efficiency and enabling effectiveness, in order to gain business value. Along these, Laudon proposed a framework for IS Guidance, namely IS Perspectives, as in Fig. 9, [9]. IS Perspectives FW is included to the knowledge base of this work as IS are generally analyzed within the WS Approach in the current research trend [6].

This framework highly conceptual and it depicts three orthogonal dimensions; namely Technology, Organization and Management. Demonstration of dimensioning explicitly is the strongest advantage of this framework. These dimensions are supported by different social and technical disciplines enabling interdisciplinary approaches, like Computer Science, Management, Operations Research, Sociology etc. This is the evidence for the collaboration demand of technical and social approaches for IS research and design. This interdisciplinary approach has an important role on understanding the IS as a WS and its sub-elements of information technology, computer science and other engineering fields within the technology dimension of IS.

Fig. 7 - Is Perspectives Framework, © [9]

According to this FW, Organization is defined as a social, stable and formal structure taking resources from its environment and processing these resources to produce outputs. Organizations have people, structure with different levels (senior, middle, operational), business process, policy and culture. With these elements, two views analyze organizations; Technical and Behavioral. Technical View takes Organizations in an Input, Process, Output view, here inputs are labor and capital, outputs are product and services, and process is the transformation of inputs to outputs via any business processes and supporting methods. Secondly, Behavioral View defines organization as a collection of rights, privileges and responsibilities balanced over a period through conflicts and resolutions. Hevner also relates these two views to IS [12].

Management in this FW is eloborated as making sense out of the situations faced and perceiving the challenges in business environment, setting strategies and decisions for challenges, developing corrective actions and achieving success by correct allocation of the resources. Such a strategic coordination of work is more than running or administering the existing processes for sure. In this FW, the Organization and Management dimensions are highlighted, enabling IS to be perceived as a socio-technical system. Now it is widely spoken that the success of IS adoption is strongly related with technology, infrastructure, adoption and governance together.

Still, this framework solely is not holistic enough to be used as a mature WS Guide. It mentions only the three main dimensions of IS, but there are still discussions on the elements, their borders and interactions. In IS Perspectives, depiction of Information as an explicit and independent dimension in relation with other entities is totally missed. Clear depiction of the Levels within the entities is also a need. Strategies and Environment need more clear depiction. Clearer positioning and definition of these components in one

framework is lacking. To compensate this, additional models again from Laudon, namely Firm Management Model and Enterprise Architecture Model should be taken as complementary in order to depict WS concepts totally.

In these complementary works, the levels of Management and Information are defined. Management is given with 3 levels; Executive, Middle, Operational. Information is composed of 4 different levels; those are *Data*, *Information*, *Knowledge* and *Wisdom*. Laudon briefly defines information as formed data which is meaningful and useful to users. After relating information with data by definition, he describes data as raw facts representing events. Moreover, he defines the evolution line of data to information, knowledge and wisdom briefly. Information is the core of today's WS, especially information based WS. This hierarchical representation of information is actually dual with the level of the organization where the level of the data is used. Data workers work with data at the operational management level. Knowledge workers use data and information to create knowledge (which can be tangible and intangible) in the organization at the middle management level. Senior Management Level employees work with structured and highly sophisticated level of data, to perform long term strategic decision making.

C. Mobile Business Framework

Unhelkar also proposed a conceptual framework, namely Mobile Transition Framework (MTF). Like IS Perspectives FW, MTF can be taken as WS guidance, but specific for Mobile Business (*m-Business*). MTF is important as m-Business is an emerging concept with special environment, context and disruptive technology. MTF mentions the important points for the transforming the conventional enterprises to mobile enterprise.

MTF is not a unified framework, but composed by several views of Economic, Technology, Process and Social perspectives. In the Process View of MTF, four BP Levels are given as *Informative*, *Transactive*, *Operative* and *Collaborative*, according to the information level utilized as shown in Fig. 10, [26].

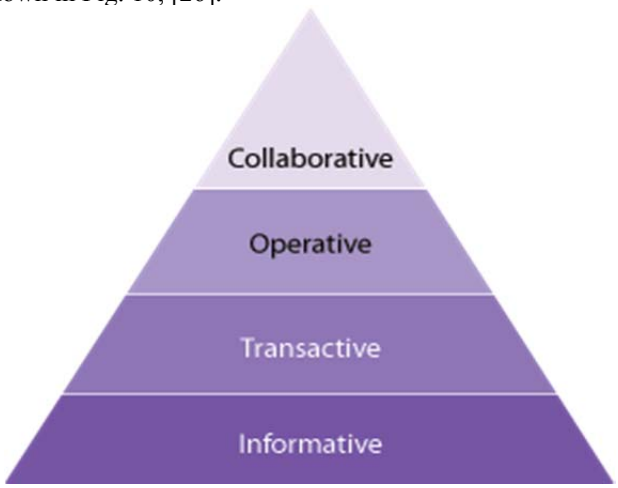

Fig. 8 - MTF, BP Levels © [26]

According to this pyramid, in the lowest layer, information is utilized in business communication for informative purposes, i.e. providing information from one peer to another. It is a one way direction of information flow. Security requirement level in this layer is minimum compared to upper layers. Today, this is the widest layer, as the information flow is excessively informative in business conduct. In transactive layer, the flow of information is defined as multi-way between the users in the business, like order and acknowledgement processes in money transactions or payments. Here the security level increases, although the users of the processes are known to the business. This layer may also utilize the wider informative layer. In the third layer, operative processes are conducted which are internal core processes for any business such as inventory management processes. Finally, the collaborative layer comes to the scene depicting the cooperative work of the parties in order to achieve the business value.

This model is very useful in seeing the position of information in new business models. The products are more service and information based. Also information today is not only an input nor control value for output/result production, but also a real semi or final product with different levels of sophistication. This situation is somehow dual with information leveling in Laudon, from data, to information, knowledge and wisdom. According to MTF, *Management* is performed by *BP*s with the aid of different levels of *Information*. BP Levels of MTF is directly related with the level of *Information* utilized during m-Business. MTF's BP Levels are highly coherent with levels defined for Management Dimension and Information Entity in IS Perspectives and complementary models. Hence, BP Levels at MTF are strongly related with Management Levels they are operated at. Viewing WS with various dimensions and levels according to the Business Context of today is the strongest attribute of this MTF view.

As a weak point, it is strongly specific on m-Business, where the details may not be easily tailored in other fields, even in e-Business where m-Business is even evolved from. Also the dimensions are so detailed and distributed into four views, decreasing its usability by being far away from a high level conceptual framework.

D. IS Research Framework

Hevner, presented a conceptual framework also for understanding, executing, and evaluating IS research. In this work, behavioral-science and design-science paradigms are well combined. Hevner, defined their main intention as informing the community of IS researchers and practitioners of how to conduct, evaluate, and present design science research. IS Research Framework is given in Fig. 11, [12].

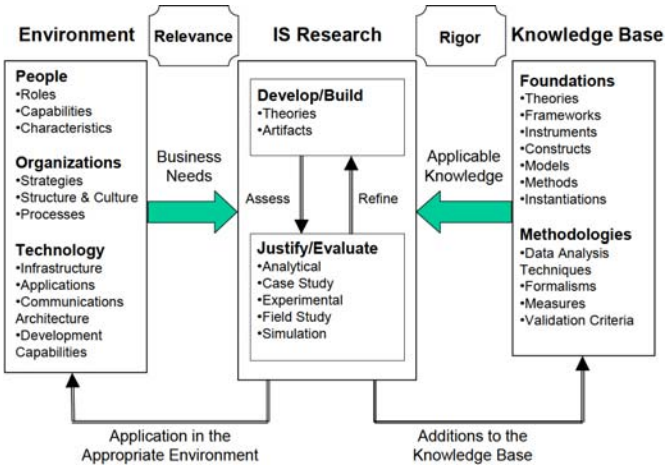

Fig. 9 - IS Research Framework © [12]

According to this framework, environment defines the problem domain. The goals, tasks and opportunities shaping the business needs are all in this environment. In the Environment, these facts and events may be turned into business interests by the People settled in the Organization, with respect to their roles, capabilities, and characteristics. Business needs and interests are assessed and evaluated within the context of the business. *Business Context* is formed by organizational strategies, structure, culture, and business processes. They are situated with the existing Infrastructure, Applications, Communications, and Development Capabilities in the Technology Dimension of this framework. The combination of the People, Organization and Technology is to solve business problems and propose solutions to business needs.

Hevner's IS Research Framework is valuable for showing as many entities as possible in one high level descriptive conceptual framework. It is also important to propose such a FW to IS domain from academy, in addition to other FW proposals those are more industry oriented. These points would aid IS Theory and enhance Systems Thinking for WS activities, rather than technical assets perception. Although the concepts given in this work is extremely valuable, their allocation and relation are weak. Mentioning Organization and Knowledge Foundation clearly is a very strong side but still, clear and rich dimensioning and leveling is lacking.

III. SUMMARY

When the guides are analyzed in detail it is clearly seen that each has its own views and characteristics. Interestingly, major entities are common for all of them. But the allocation of the entities within each FW differs dramatically. In parallel, the dimensioning and leveling within the FW differ dramatically. These differences create their strong and weak sides. In accordance, these differences aid comparative analysis of the guides which are added to each sub-section dedicated to guides definition. In general, it is clearly seen that most of them are lacking high level conceptual representation. Also, mostly they are not addressing all necessary perspectives, hence loosing interdisciplinary approach. Each underestimates one perspective or stresses another one. This brings the unbalance and lack of interrelation of the perspectives, hence losing the Systems Approach.

APPENDIX II – CHANGES IN BUSINESS CONCEPTS

I. BUSINESS CONCEPTS OF TODAY

The technology, tools and communication infrastructures changed the methodologies and results of today's work conduction styles. Especially the fast convergence of Information and Communication Technologies (ICT), and their fast adoption has one of the major roles in this paradigm shift. Collaborative work and cooperation had always been a great demand in human history in any era, in any business. This demand were not well mentioned enough in former WS FWs or models, as it is more formed of intangible knowledge which may quite hard to depict when compared to more concrete nature of Products and Processes.

A. Customers

1) Business Value Models

Today for Business Value, chain model is still excessively used. Chain model show a linear cascaded workflow from Suppliers to Customers. It may include other stakeholders like manufacturers, distributors and retailers with push or pull models as shown in Fig. 12, [9]. The feedback or interactive participation of the stakeholders is not clearly shown in this model.

Fig. 10- Business Value Chain © [9]

The business value acquisition of today can no more be represented with this model,. The product or service needs interaction of the stakeholders for a resolution in common sense. The fast invasion and adoption of communication and information technologies to any market, their fast applications on business processes enabled this situation. This gave rise to the understanding of 'Business Value Webs' rather than Business Value Chains, as shown in Fig. 13. This model is even more correlated with the 5 Competitive Forces of Porter, better showing the stakeholders collaboration [9].

2) Stakeholders

This ever existing collaboration demand is now more visible and more under discussion with the aid of fast changes in Business Environments, Models, Concepts and Contexts.

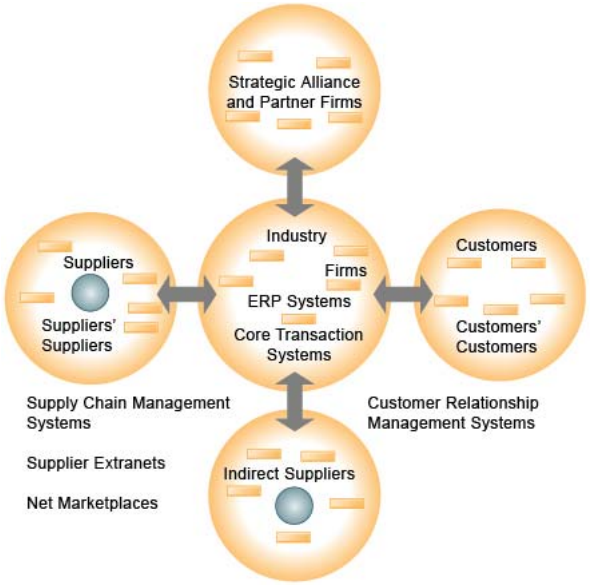

Fig. 11 - Business Value Web © [9]

Today, collaboration is actually much more than just the cooperation of two parties to produce a product for a customer portfolio. The responsibilities, functions and number of stakeholders have also evolved. They cannot be summarized as Producer to Customer chain any more. Content providers, service providers and network providers are some of the current instances for this evolution. Also, Customers or End users became natural Stakeholders of the Value Model. They collaborate with others and aid tailoring of the Result in an interactive way. Hence, evolution of the Business Value Model also aided the definition, visibility and collaboration of the Stakeholders as given in Fig. 14.

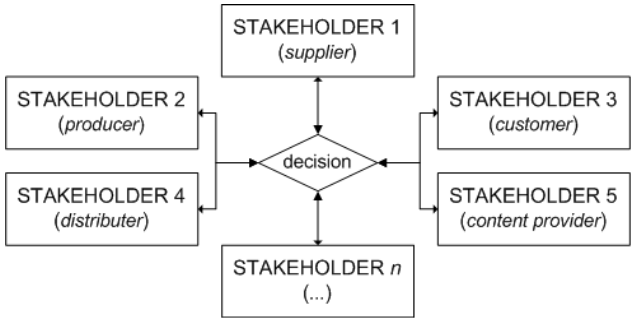

Fig. 12 - Collaboration of Multi Stakeholders

B. Products

Today in any business, the nature of the results output to markets are becoming more and more information and service oriented. This is due to the excessive adoption of Systems in Enterprises and invasion of Information and Communication Technologies in Business Processes. This is more evident in banking and entertainment markets. In developed regions, physical money is almost not used at all, due to enabled e-transaction services via credit cards, e-banking options etc. e-Commerce service is getting more widely accepted, and mobile commerce (m-Commerce) service is rapidly in use. Also today, different forms of information serve as end products especially in Research & Development market. Business Analysis and Feasibility reports or Conceptual Operation and Requirements Documents constitute the final results of many projects with limited scopes.

C. Environment, Strategy and Infrastructure

In WSF, Environment is defined as a surrounding to the WS Core. Strategy and Infrastructure accompany to Environment somehow [10]. This situation is similar in IS Research FW as well. In others, these entities are either overlooked or slightly mentioned, but not depicted and defined clearly [9], [12], [15] [26].

In parallel to technical developments, the Environment concept became obvious in Business. Context Aware computing and m-Business are the major examples for this. Environment is perceived as the surroundings external to the concept under discussion. Actually, Environment is more than that. It is where the Business Concept under discussion is elicited. This fact become more evident today, as the business is not having strict rules as before. New business rules are adopted even by the older markets. The analogy between Lean Management in heavy industry and Agile Methods in software industry is a good example for this. Business is shaped within the Environment more easily today. Environment forms the context for the business to be conducted. Business Models are formed within Business Environment according to the Business Context.

On the contrary, Strategy and Infrastructure are internal to the WS Cores with different dimensions [9], [15]. All these entities are positioned differently in the existing guides. Clear definition and correct positioning for them is a concrete demand for WS works.

D. Work System Core

The four WS Core entities of WSF and their interrelation had always been a discussion. In this sub-section, their definitions and positions with respect to existing WS Guides and Business Contexts is summarized.

1) Participants

In WSF, Participants are the people who perform the actual work. Accordingly, Incentives and Strategic Decisions, like Organization Structures or Product Innovation, are set by the Participants, especially from higher Management Levels. Then these are executed by all Participants from related levels. Organization Culture is shaped by all Participants of the Corporation. Hence, Participants are the concrete actors of the Business Processes to execute. Sometimes, the Technology components may act as the actor of some of these processes, but they always serve (human) Participants as concrete tools to execute their Business Processes [9], [10], [12], [26].

Organization and Management are the instances of non-technical perspectives [9]. They are more abstract with respect to the entities defined in WS Core, and without Participants they are not alive. This is the reason why explicit positioning and definition for Organization and Management dimensions in WS Guides are sometimes lost. In WSF, Organization is not mentioned at all, in order not to create an ambiguity between an 'Enterprise Organization' and a 'Work Organization in a WS'. To ease this blur, Mansar offered inserting Organization concept within Participants element in WSF [10]. Laudon, explicitly mentions Organization and Management dimensions of IS, but the depiction does not lead researchers and implementers clearly enough about Enterprise Organization and Management. Hevner and Alter mentions Management concept verbally within the Environment, without clearly defining such an important element in their frameworks [2], [9], [10], [12].

Today, there is a need to harmonize all the important offer of these views in one framework. But before this, all entities and dimensions should be revealed and updated with respect to the needs of today's business contexts. Without clear definition of Organization and Management as dimensions, definition and positioning of Participants, Structure, Culture, Infrastructure and others cannot be held in a proper way.

2) Information

In today's business, the ultimate importance of the any form of information is better understood by the aid of excessive usage of IS. Before, Information was taken into account just as 'data' to be utilized within the Business Processes, like the material utilized in Technological tools. Today there are various levels of information; such as raw data, information and even knowledge. The organized form of data, which is information, is actively being used in business by middle and lower management levels within Enterprise IS. Applying patterns, rules with regards to context forms knowledge from information. Knowledge and Knowledge Management (KM) is still a research field, and enterprises are investing on KM systems to transform their tacit or intangible knowledge to explicit or tangible in order to enhance the organization memory and culture and hence to gain value.

Various formats accompanying these levels of information are also in use. Hence, Information today is not only used within a business process as a material or a tool in unique format as was before. Information is used in, transformed into, and fusioned into several formats and levels, served as input, output or enabler to a process and may result as semi-product or end-product. Hence in the actual WS of today, Information is an important element as mentioned in Alter's framework, but overlooked in many others. Unhelkar's Business Process leveling is strictly related with the Information level utilized due to the strong emergence of services and information based products of the m-Business. There is a duality between this and the levels of information and management declared by Laudon. With the increasing demand on Information and Information based Systems in business, definition and depiction of Information as a dimension is a must [9], [10], [12], [26].

3) Technology

Technology is the most concrete entity of a System. In all FWs discussed in this work (WSF, IS Perspectives FW, MTF, IS Research FW), there exists the concept of Technology either as an entity or as a dimension. For this reason, there are plenty of good definitions for it. This makes the research and implementation more available on the Technology concept of WS. Like Information, Technology can also play a role in business, as a tool, an end result or a semi-product. Most of the time, Participants tend to follow the Technology in setting Business Strategy or managing Business Portfolios, while leaving out the other dimensions and entities of their WS and Business Environment [9], [10], [12], [26].

Technology and its components are highly evolving today. In former decades, people were quite distant to it, and leaving them to be utilized by their experts. But today, by the aid of converging Information and Telecommunication Technologies, to tools have invaded the daily lives of people. Today, most of the mobile phones, tablets or similar tools serving the senior level managers are also used by teenagers and students as well. The Technology Dimension, with its highly evolving and life style invading nature today should be taken into account seriously and be well defined in WS Guides in order to aid the design and implementation of the systems successfully.

4) Business Processes

Corporations always look for effectiveness and efficiency in order to reach their Business Goals and gain Business Value. Activities regarding Business Process are the most common address for this look. The dictionary definition Business Processes is given as the series of related activities performed together to produce a defined set of results. Upon to this quite mechanic description, definitions with more sociotechnical visions may include people, information, resources and customers as well [2], [9], [10], [12], [15], [26].

These process activities may include, but not limited to, execution, improvement, re-engineering, etc., regardless of the business type. Commonly, they act as the major actors for business transformations as well. When the history of process activities is observed, it is seen that the formal start occurred in the heavy industry field. This field held firstly steel and chemistry industries, which are followed by machine and electronics industries. Emerging markets, like Information and Communication Technology, Aerospace and m-Business, have imported process definitions of the former ones. The enhancement demand on processes is explicitly valid for both relatively newer and former industries. History of the process activities shown in Fig. 15 is valuable for understanding BP.

In this history, concepts like Total Quality Management (TQM), Six Sigma, BP Improvement (BPI), BP Re-desing,

BP Re-engineering (BPR), Material Requirements Planning (MRP), Manufacturing Resource Planning (MRPII), Enterprise Resource Planning (ERP), Customer Relation Management (CRM), Supply Chain Management (SCM) and BP Management (BPM) are met [23].

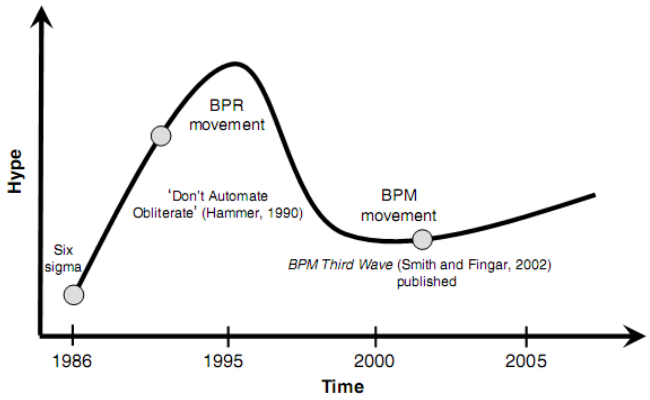

Fig. 13 - Process Improvement History © [23]

According to this history line, BP concept was first highlighted with Six Sigma. Today, in academic literature BPR is defined as changing the total structure of the business processes as a holistic work, whereas, Business Process Re-design is defined as the change of partial, even only one process within whole Business Processes architecture in an organizational structure. With the concepts that are mentioned above, like ERP, CRM, etc., Systems Thinking in Business are enabled. The current trend in the BP field, referred to as BPM, is observed to be the next big-thing in this area. BPM proposes a holistic approach to process activities by common management of BP definition, execution, improvement, re-design, and BPR. BPM's main difference with respect to former BP waves is handling BP with high attention on Participants and Organization entities, in addition to the Technical entities. With this vision BPM highlighted sociotechnical perspectives for process activities.

All these progress aided clarification of BP in WS. BP uses Workflows, Procedures, Tools and Materials to manage the business. Hence, BP is a bridge connecting Technology entities to other WS entities with its socio-technical features. Managing BP is more than executing specific processes or workflows solely, but coordinating various activities in a harmonized way, bringing governance [2], [9], [15], [23].

Accordingly, BP is given at the highest level of WS Core in WSF. In MTF, a special view is dedicated to BP in m-Business. IS Research FW shows it as an Organization entity and IS Perspectives FW, mentions it as a Management entity. On the contrary, Social Perspectives take it under the Technology dimension, as they refer techniques and methodologies as a part of BP, where knowledge may be embedded. As can be seen clearly, an ambiguity for the definition and positioning of a WS entity is apparent for BP in the existing guides evidenced by different perspectives with different weights.