



## A new approach to managing Lessons Learned in PMBoK process groups: the Ballistic 2.0 Model

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**Abstract:**

In any organization, dealing with lessons learned is a complex issue that involves people, processes and technologies. Although lessons learned processes are already well established in the project management community, the use of modern web technologies to support them is still in its infancy. This paper introduces a new model to manage lessons learned in PMBoK process groups. This model draws upon interdisciplinary literature, which embeds lessons learned processes, shared context and Web 2.0 service models. The model is supported by Web 2.0 technologies and centered in PMBoK process groups to allow a thorough overview of the project. An exploratory focus group was set up to validate the model qualitatively within a constructivist ontology and an interpretive epistemology. The adoption of this model can help academics and practitioners using PMBoK process groups to acquire a better understanding of managing lessons learned in projects.

**Keywords:**

IT Project Management; PMBoK; Knowledge Management; Lessons Learned; Web 2.0 Technologies.

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## 1. Introduction

Learning in organizations is a concern that started long ago and still attracts attention nowadays. Senge [1] describes learning organizations as “organizations where people continually expand their knowledge to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together”. One of the main challenges that organizations face, specifically project-oriented organizations, is little incentive or a lack of structure for long-term organizational learning [2]. Additionally, even when organizations provide an appropriate structure for learning, it is not usual for project teams to use stored knowledge from other projects [3]. This complex issue can be addressed with adequate lessons learned (LL) management, combining social interactions, informal dialogue and modern technologies. Unfortunately, LL approaches have received little attention from project management researchers and are underrepresented in literature [4].

Although LL management is covered by the main project management methodologies (PMMs), researchers have found critical gaps in PMMs. Wells [5] found that many practitioners (47.9%) rated the benefits of PMMs as low and considered that PMMs are unhelpful. This fact indicates that PMMs are using an approach that is out of phase with the needs of current projects. From all the issues covered in PMMs, LL seems to be the one with considerable room for improvement. The IPMA [6] and PRINCE2 [7] guides contain 42 and 57 occurrences of the term “lessons learned”, respectively. As for PMBoK, LL has gained more relevance over the last years. The fourth edition of the PMBoK Guide referred to LL 44 times [8]. In the fifth edition of PMBoK [9], this term occurs 71 times. On the other hand, PMBoK has very mechanistic, rigid language, as opposed to LL, learning and knowledge, which are more organic and fluid [4]. In addition, PMBoK describes LL in a limited manner, focusing mainly in the closeout phase as administrative and documented outputs.

In fact, PMBoK seems to ignore the relevance of both knowledge management processes and LL methods [10;11]. PMBoK lacks a prescriptive approach to LL. “A theory of project management should be prescriptive: it should reveal how action contributes to the goals set to it” [12]. To adopt a prescriptive approach to address LL in PMBoK, one should focus on people, processes and methods, and technologies which can cross-cut all PMBoK process groups.

Levitt [13] asserts that PMBoK can be characterized as Project Management 1.0 (PM 1.0), since it lacks agility and a strategic view, being mainly operational, without employing all available knowledge. Besides, PMBoK’s inflexible philosophy is heavy and ineffective, as it focuses on meticulous planning and control of large and extensive projects. In addition, BoKs deal with the project as decoupled from the environment [14]. In this context, a more adequate approach needs to emerge to face the challenges imposed by current dynamic projects. Project Management 2.0 (PM 2.0) is characterized mainly by autonomy and agility, which can meet the needs of team members and project managers [13]. PM 2.0 can be supported by Web 2.0 technologies such as wikis, microblogs and collaborative edition tools. These technologies can improve knowledge management in project management settings. Wikis, for instance, can enhance the learning process [15]. Wikis can be used as a central repository for information, allowing collaboration between organizations and solving the problem of information overload by e-mail [16]. Moreover, wikis are also considered in promoting innovation in organizations [17]. Microblogs have been used to improve project communication and documentation, to record LL in projects [18;19].

In order to contribute with a theoretical approach to PM 2.0, this paper considers that Web 2.0 technologies can help improve LL in contemporary project management practice. The adoption of Web 2.0 technologies, integrated with traditional LL processes, can be a way to make PMBoK guide more agile and flexible. Following this same line, instead of considering PM 2.0 as a surrogate for extant project management, it should be seen as complementary. Therefore, the goal of this research is to introduce a new model to manage LL in PMBoK process groups. This study was conducted within a constructivist ontology and an interpretive epistemology, and it is inductive in nature as it builds a model from data generated in a focus group. Moreover, it uses literature to establish links between Web 2.0 technologies, LL processes the interaction among project members (their shared context) and Project Management in PMBoK. Arguably,

this research can contribute to both the theory and practice of Project Management by formalizing these links in an innovative model to add value for managing LL in projects.

This paper is structured as follows: Section 2 describes the theoretical foundations on which the proposal of this paper is based. Section 3 details the main contribution of this paper, a model to manage LL in PMBoK process groups. Section 4 presents the focus group carried out to validate the model proposed and its results. Section 5 introduces a discussion on the main issues related to the LL processes in project management. Finally, Section 6 concludes the paper and points out the research contribution ideas for further work.

## 2. Background

### 2.1 Lessons learned in literature

LL is a knowledge management mechanism defined by Secchi et al. [20] as knowledge acquired by both positive and negative experiences, and is therefore a guide to a better performance [21]. Lessons learned discipline has been studied in different types of organizations and areas in order to organize and improve their effectiveness. Literature contains lessons learned methods [11;25;39], processes [10;40], and also applications of lessons learned such as models and/or frameworks for knowledge management in projects [41;42]. Some special theories like Situated Learning Theory [43], which is an approach based on social aspects supported by architecture components (Learning Relations, Cognitive Style, knowledge management, learning Mandate and Authority of Pyramid), and the Mutual Caring Theory [44], which highlights psychological causes of the difficulties in sharing knowledge, appeared lately in an attempt to minimize some inefficient aspects of LL generated by the main character of the LL discipline: people.

The purpose of an LL system is to collect and supply lessons that can benefit those who encounter situations where the lesson can be applied [10]. PMI [9] defines LL as “the knowledge gained during a project which shows how project events were addressed or should be addressed in the future with the purpose of improving future performance”, and the LL knowledge base as a “store of historical information and LL about both the outcomes of previous project selection decisions and previous project performance”.

The processes of an LL system are (see Fig. 1): collect; verify; store; disseminate; and reuse. The following are brief descriptions of the processes:

- **Collect:** There are four ways to perform this process. In passive collection, individuals submit their own lesson using a form. Reactive collection means LL are collected by interviewing the members of the organization. After-action collection is generally used by military organizations to collect LL after missions. In proactive collection, the lessons are extracted while problems are being solved. Active collection is an approach in which lessons are collected from within the organization. Finally, interactive collection uses an intelligent system to solve ambiguities by interacting with the authors of the lessons and relevant sources;
- **Verify:** This process is executed by a team of experts who are responsible for validating lessons according to redundancy, consistency and relevance;
- **Store:** This process refers to the representation, indexing, format, and storage of LL;
- **Disseminate:** This is the most important process regarding promoting the reuse of LL. Weber et al. proposed five dissemination methods [10]. In *passive dissemination*, users access lessons in a standalone retrieval tool. In *active casting*, lessons are broadcast to the members of an organization by a dedicated list server. *Broadcasting* is a form of disseminating LL by sending bulletins of LL to all members of the organization. *Proactive dissemination* is a method that uses a system to predict users’ need for LL by analyzing their recent events and sending LL to individuals proactively based on this analysis. *Reactive dissemination* is a method in which users can invoke a system to browse lessons;
- **Reuse:** As a rule, users are responsible for choosing to reuse lessons. Weber et al. [10] identified three categories of this process: *browsable recommendation*, in which the system displays the retrieved lessons; *executable*

*recommendation* is a method in which users choose to execute a specific lesson; and *outcome reuse*, in which the LL system retrieves the results of using a specific lesson, allowing users to know if the lessons are helpful or not.

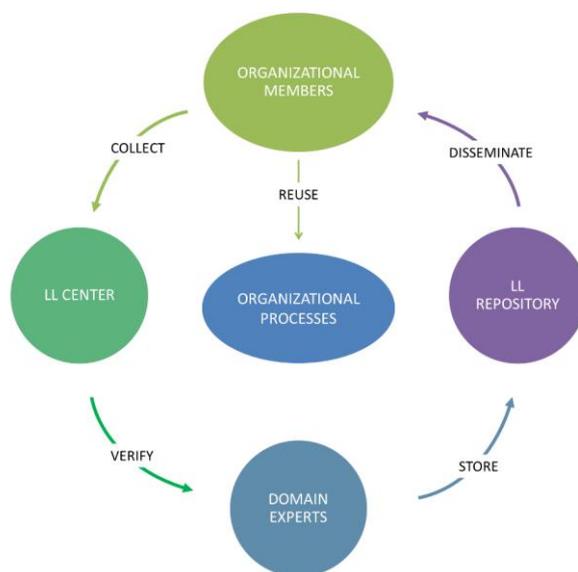


Fig. 1. A generic lessons learned process [10].

LL can be categorized as [10]: (a) informational (e.g. how employees' duties could be changed during times of emergencies); (b) successful (e.g. capture effective responses to a crisis); and (c) problem-oriented (i.e. describe examples of actions that failed and potential ways to resolve them). However, it is also suggested that lessons be categorized by their contribution rather than, or at least in addition to, the type of experience from which they are derived (e.g., success or failure). Lessons can be learned from each and every project, even if the project is a failure, but many companies do not document LL because employees are reluctant to report their own mistakes. Additionally, the organization structure and culture of the company can impact both sharing and using the LL of projects: if there is too much focus on schedule goals, and a non-holistic view of the projects, LL tend to be forgotten [45]. Thus, employees end up repeating the mistakes that others have made, which can be also related to "most companies prefer post-implementation meetings and case study documentation" [22]. The problem is when to hold the post-implementation meeting. One company that uses project management for new product development and production holds a post-implementation meeting to discuss what was learned when the first production run is complete. Approximately six months later, the company conducts a second post-implementation meeting to discuss the customers' reactions to the product. There have been situations where the reaction of the customers indicated that what the company thought they had done right turned out to be a wrong decision. A follow-up case study is then prepared during the second meeting.

## 2.2 Lessons learned in PMBoK

The practice guide in project management from the PMI's PMBoK defines LL as a basis of historical information and LL from the results of previous projects [9]. In this context, the manager and the project team are able to document issues, risks and solutions arising during the project, which can be useful in future projects. In addition to providing useful information for future projects, the basis of LL can provide feedback on implemented projects and assist organizations in portfolio management [9]. The collection, documentation, and use of the LL to solve problems is the project manager's responsibility [9].

PMBoK quotes artifacts of LL as part of the organizational process assets and corporate knowledge base. As part of the process assets, the LL artifacts can be used in and outside the ten knowledge areas (project integration, scope, time,

cost, quality, human resources, communication, risk, acquisition and stakeholders) [9]. The fact that PMBoK [9] mentions LL as an artifact of entry and exit in all ten areas of knowledge implies that LL can be updated at all stages of the project. On the other hand, PMBoK does not prescribe specific methodology for documentation and sharing of LL, although the processes of creating, maintaining and sharing LL are mentioned as best practice for the maturity of organizational project management PMI (Organizational Project Management Maturity Model-OPM3) model [24].

### 2.3 Knowledge management: Shared context

Knowledge management is another central pillar in this paper. Nonaka, Toyama, and Konno [25] describe four types of knowledge: conceptual; systemic; experiential; and routine. Conceptual and systemic knowledge are explicit knowledge, such as product specification, manuals, documented information about clients. Experiential and routine knowledge are shared tacit knowledge based on the hands-on experience of project members, stakeholders and clients. Expertise, organizational culture and organizational routines are other examples of this kind of knowledge. The process of retaining experiential and routine knowledge is more challenging, given its tacit nature.

Nonaka et al. [25] present a unified model of dynamic knowledge creation on which this research is based. Their model unifies the Socialization, Externalization, Combination, and Internalization modes of knowledge conversion (SECI model), shared context (*ba*) and leadership. SECI is a well-known model proposed by Nonaka [26], where explicit and tacit knowledge interact in a continuous process. *Ba* roughly means place and is defined as a “shared context in which knowledge is shared, created and used” [25], since knowledge needs a context in order to exist. The main objective of *ba* is interaction. In the shared context, knowledge needs to be ‘energized’ (stimulated) in order to be active and to have meaning in the workspace. Considering that knowledge needs a physical context to be created, *ba* offers such a context for action and interaction. *Ba* varies according to two dimensions: type of interaction (i.e. individual or collective) and media (i.e. face-to-face or virtual). From these dimensions, four types of *ba* are defined according to Fig. 2.

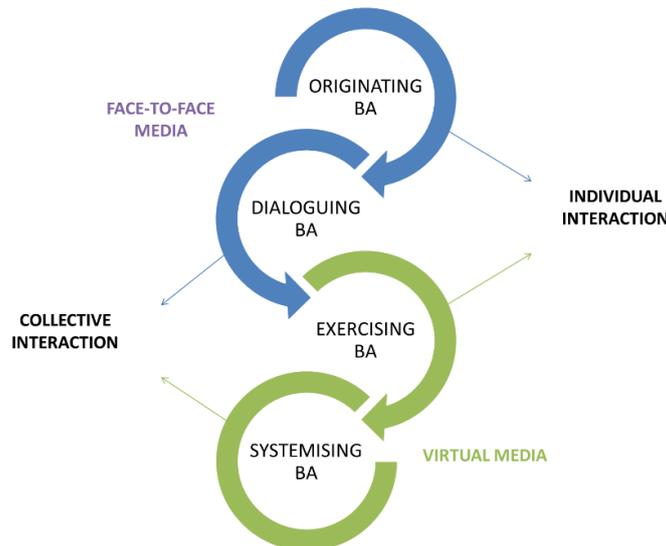


Fig. 2. Four types of *ba*. [25]

Originating *ba* offers a context for socialization, since the individual face-to-face interactions allow for the sharing of tacit knowledge. Dialoguing *ba* offers a context for externalization, as an individual's tacit knowledge is shared and articulated through dialogues among project members. Systemizing *ba* offers a context for the combination of existing explicit knowledge, which can be transmitted to project members in written form, e.g. wikis, web-based office. Exercising *ba* offers a context for internalization, since individuals embody explicit knowledge that is communicated

through virtual media, such as written manuals. Project settings are adequate to implement all types of *ba*, but literature has not yet reported results applying this model to project management. Also according to Nonaka et al. [25], middle managers are at the center of the knowledge-creating process. Project managers can be considered middle managers and they perform a key role to deal with knowledge management processes.

The Nonaka, Toyama and Konno unified model allows dynamic interactions between organizational members, and between organizational members and the environment [25]. These features make this model suitable for the context of project management. In addition, *ba* is appropriate to the dynamic Web 2.0 environment, since it is an open place where project members with their own contexts can come and go, and the shared context (*ba*) can constantly evolve.

#### 2.4 Web 2.0 and service models

O'Reilly [27] defines Web 2.0 as "the network as platform, spanning all connected devices; Web 2.0 applications are those that make the most of the intrinsic advantages of that platform: delivering software as a continually-updated service that gets better the more people use it, consuming and remixing data from multiple sources, including individual users, while providing their own data and services in a form that allows remixing by others, creating network effects through an 'architecture of participation', and going beyond the page metaphor of Web 1.0 to deliver rich user experiences". In fact, Web 2.0 is more dynamic and interactive than its antecessor - Web 1.0. Web 2.0 allows users to access and update Web content faster.

For Thomas and Sheth [29], the major impact of Web 2.0 was the change that occurred with the information being brought by the user. Although Web 1.0 technology allows the reading and recording of information, only in Web 2.0 can users take advantage of this capacity in large scale. The main benefits of using Web 2.0 tools in organizations is the sharing of ideas and the access to organizational knowledge [30].

Web 2.0 platform is a propitious way of developing dynamic and collective learning [28], [29], [31], [32] and promotes continuous interaction between tacit and explicit knowledge. For this reason, Web 2.0 technologies make the process of knowledge creation easier - as the process of knowledge creation proposed by Nonaka [26]. Shang et al. [32] designed a model of knowledge creation, combining Nonaka's SECI model and Web 2.0 technologies. Table 1 shows a brief explanation of the four service models for knowledge creation.

Table 1. Description of the four Web 2.0 service models [32]

Service Model	Description	Web 2.0 applications
Exchanger	Enables knowledge socialization and externalization with low control mechanism. The content of this service model is neither organized nor systematized.	VOIP calls, chat, e-mails.
Aggregator	Enables the knowledge creation cycle from socialization to externalization. The control mechanism is low. Users can share and aggregate information in many ways (video, sound, text).	Blogs, bookmarking, RSS, social networks.
Collaborator	Enables the full cycle of knowledge creation. Users can recreate content and applications. Contains processes for feedback.	Wikis, bookmarking, office applications, games, programming languages.
Liberator	Enables the full cycle of knowledge creation. In this platform, source code is open to users so they can improve it continuously.	Operating systems, Web 2.0 tools, games, programming languages.

### 3. Research Design

#### 3.1 Developing Ballistic 2.0: A model for managing lessons learned in PMBoK process groups

Technologies, people and processes are the elements that compose the model proposed in this paper. Fig. 3 presents an overview of the Ballistic 2.0 model (Ballistic 2.0 stands for *Ba Lessons Learned Information Technologies 2.0*). To manage LL in PMBoK process groups, we analyzed the main LL processes in literature and selected the most appropriate for contemporary project management practice. After this, we identified the main knowledge management processes and theories regarding knowledge creation. We opted for the SECI model, which also recommends the use of *ba* (shared context). We used SECI, focusing on LL and not specifically on the creation of new knowledge. Finally, we chose the most adequate Web 2.0 Service models - Exchanger, Aggregator, and Collaborator - proposed by Shang et al. [32] to support the processes defined to compose Ballistic 2.0.

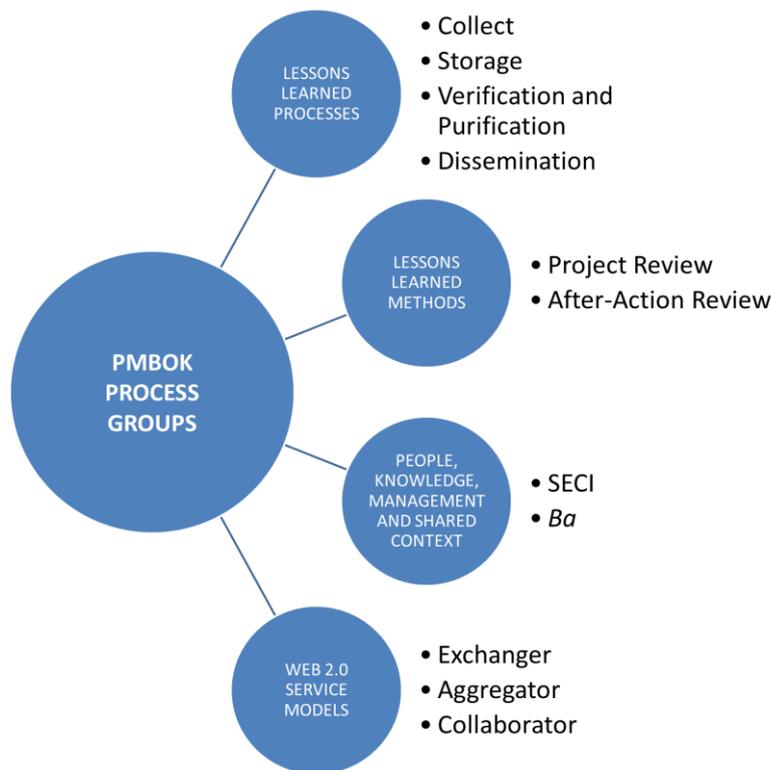


Fig. 3. Main components of the Ballistic 2.0 model

Fig. 4 shows how Web 2.0 service models support the concepts of *ba*. Although originating *ba* and dialoguing *ba* are accomplished with face-to-face interactions, Web 2.0 Service models can serve as a technological platform to store the output of individual and collective interactions, i.e., the LL can be captured using both of them.

Fig. 5 outlines a new model to manage LL in PMBoK. Based on literature [10;11;25;32], our proposal adopts the following processes in the LL life cycle: Store; collect; verify and purify; and disseminate. Most of them come from Weber et al. [10], except purify, which is also a contribution to this paper. Ballistic 2.0 is supported by the LL processes described by Weber et al. [10], *ba* as shared context defined by Nonaka et al. [25] and the service models introduced by Shang et al. [32]. It means that Ballistic 2.0 takes into account processes, people, and technologies. It is also centered in PMBoK process groups to allow a thorough overview of the project.

A new approach to managing Lessons Learned in PMBoK process groups: the Ballistic 2.0 Model

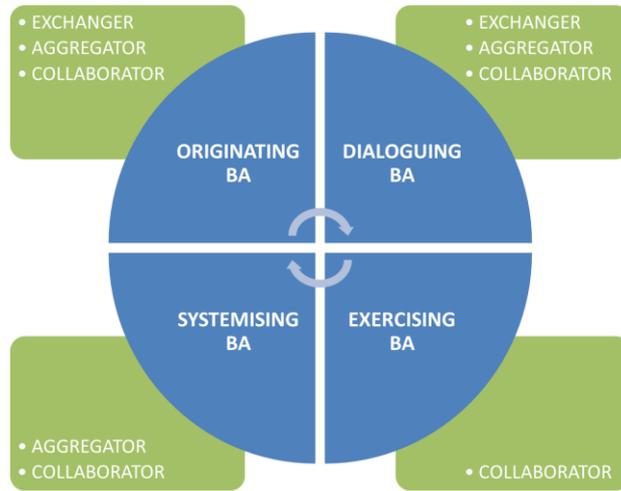


Fig. 4. Ba 2.0 – Extending Ba with Web 2.0 Service Models

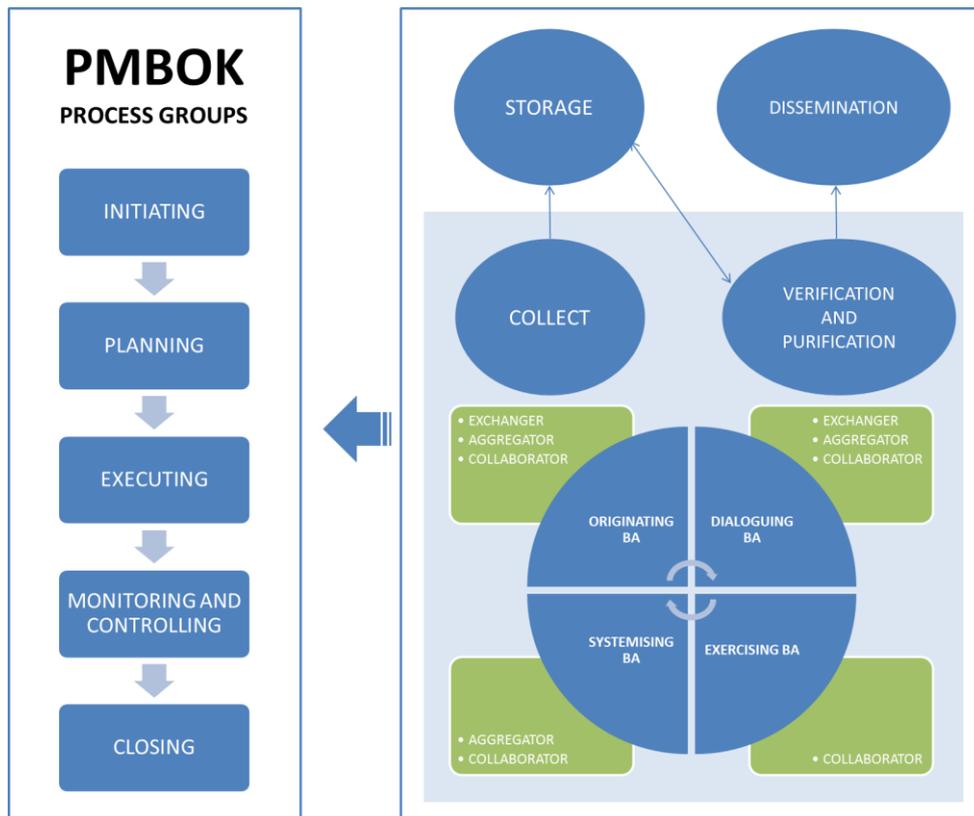


Fig. 5. Initial Ballistic 2.0 model to manage lessons learned in PMBoK process groups

Regarding technologies, collaborator and aggregator Web 2.0 service models support exercising *ba* and systemizing *ba*, covering individual and collective interactions using virtual media, respectively. Originating *ba* and dialoguing *ba* provide the context for socialization and externalization, respectively. The output of both can be stored in some of the Web 2.0 technologies proposed in exchanger, collaborator and aggregator Web 2.0 service models.

LL processes use the shared-context (*ba*) to help project managers to deal with learning in projects. Both the collect, and verification and purification processes are achieved using all four types of *ba*. Originating *ba*, dialoguing *ba*, exercising *ba*, and systemizing *ba*. The store and dissemination processes are related to Web 2.0 technologies. The store process can be implemented using the aggregator and collaborator service models, and the dissemination process can be accomplished using the exchanger and aggregator service model.

Although PMBoK process groups cover a set of processes, we focused on the specific use of Ballistic 2.0 in each PMBoK process group in the description ahead. We also used the Collaborator service model in the examples, since it covers all types of *ba*. Moreover, we assumed the adoption of a corporate wiki as the technological base to implement the LL processes proposed by the Ballistic 2.0 model.

### 3.1.1 Initiating

As regards PMBoK process groups, the Initiating phase seeks to understand stakeholder expectations, defining the project scope, project success criteria, initial resources, and to authorize the project at the end of this phase. Since it is the first process group, it will be the moment to promote *ba*. Originating *ba* and dialoguing *ba* should be encouraged if project members share the same physical place. In addition, systemizing *ba* and exercising *ba* can complement the search for LL in this kind of project. On the other hand, global projects should use systemizing *ba* and exercising *ba* due to the difficulty in holding face-to-face meetings. By using systemizing *ba* and exercising *ba*, project members are able to capture explicit and tacit knowledge in virtual and non-virtual projects.

Moreover, this is also the time to start reviewing the LL repository to search for LL retrieved in previous projects that may be reused in the new project. The project manager should consult the LL repository (e.g. legacy LL systems, corporate wikis or project blogs). The LL obtained from previous projects serve as input to initiate actions in this phase, and even to define possible risks beforehand. The LL can be also used to define the project charter more accurately or even to help sponsors decide whether projects should be authorized or not.

### 3.1.2 Planning

In the planning process, the project management plan is defined, in addition to the project documents that will be used throughout the project. This is an iterative, ongoing process, for it should be revisited whenever new information is obtained that requires the changing of the plan. The four types of *ba* supported by the exchanger, aggregator and collaborator Web 2.0 service models are suitable for this phase. These Web 2.0 service models will support a clear communication with stakeholders, mainly with the project team members who are responsible for dealing with the LL. For example, a wiki or a blog should be configured to facilitate communication with stakeholders. Although this paper focuses on lessons learned, the use of Web 2.0 technologies may be also extended to a wider scope such as knowledge management in a project.

As in the previous process group, it is possible to reuse LL from other projects in order to identify possible risks, to work package valuation and other necessary actions. Since the process is iterative, LL from the project itself can also be reused. Therefore, the reuse of LL may increase for the sake of delivering the project on time and ensuring the highest possible quality.

### 3.1.3 Executing

This phase is composed of several core tasks, including acquiring, developing, managing the project team and distributing information. Specifically, Web 2.0 service models can support the task of distributing information. Encouraging individual and collective interactions can facilitate the comprehension of the distributed information. New LL tend to emerge from these interactions and can be stored using Web 2.0 technologies such as wikis and blogs. The

LL dissemination process (i.e. distributing information) could be also implemented using corporate social networks, RSS and microblogs.

The executing phase enables both the application of LL and the capture of new learning items. The four types of *ba* can also be applied in this process group supported by Web 2.0 service models. For example, when project team members consult solutions in a wiki, they are applying the reuse process. The processes of Collect, Verification and Purification are also applied in this phase. During the executing phase, when project members face some difficulty or an unexpected situation, they can consult the corporate Wiki and verify if members of other projects experienced similar situations. In this way, they can access the repository and if it is applicable, reuse the solution provided. If that specific LL is not useful, project team members can update the corporate Wiki with a new LL. In addition, problems gathered during the meetings must be included as LL in the corporate Wiki with “In Progress” status. Then, these lessons should be analyzed and a solution provided. If this solution works, then the status should be updated to “Resolved”, as per the agreement of both the team and the project management. After this classification, the lesson item can be purified and made available with “Finished” status. A project team member or project manager can do the purification of the items.

#### 3.1.4 Monitoring and Controlling

In the monitoring and controlling phase, project managers can use the Ballistic 2.0 model to create more assertive control processes in projects. Adjustments to budget, timeline, or the desired end-product are often necessary to address unforeseen circumstances. Capturing LL at these times is a challenge for project teams. As Fig. 5 shows, the four types of *ba* support the task of capturing LL.

Project managers need to keep stakeholders up to date with project progress and team performance through reports and ongoing documentation. Web 2.0 technologies facilitate access so the team can quickly find the last adjustments in the project. Moreover, Web 2.0 technologies support stakeholder engagement, as in the history log in a wiki, the number of posts and comments in a blog or microblog, and active participation in corporate social networks. These examples of interactions should use systemizing *ba* and exercising *ba*, which offer a context for combination and internalization, respectively.

In addition, the monitoring and controlling phase is the appropriate moment to establish continuous purification of the lessons retrieved in the corporate Wiki. Following the example given in the executing phase, the lessons marked with “Resolved” will change to “Finished”. We recommend that the members responsible for purifying the lessons should not be the ones who created them. For this reason, other people with the required expertise should be designated to purify the lesson.

#### 3.1.5 Closing

The closing phase can be the last moment to collect LL. The Ballistic 2.0 model supports project managers by integrating LL processes with the shared context by team members and Web 2.0 service models. This is the time to create an environment to perform the four types of *ba* using both individual and collective interactions. Closing is also the moment to include the last LL with “Resolved” status. Then, these LL should be purified and receive the status “Finished”.

### 3.2 Validating the Ballistic 2.0 model with focus group

Focus groups have been used to evaluate both the use of Web 2.0 technologies in organizations [33] and LL models in projects [34]. We set up a two-hour qualitative exploratory focus group in order to validate the Ballistic 2.0 model. Since Bloor et al. [35] suggest a focus group with six to eight participants; we recruited seven people who work in project settings to participate in the focus group. Since the success of a focus group session depends a lot on the dynamics between the group members [35], we established some criteria to select participants. The criteria were: 1) Participants should work in project settings; 2) Participants should have different professional backgrounds; 3) The group should have a balance of senior and junior professionals; 4) As far as possible, the group should be composed of

professionals from distinct business sectors. We established these criteria to allow participants to contribute with different perspectives as well as to ensure that the generalness of the Ballistic 2.0 model would be applicable in all types of projects settings. Another reason for creating these criteria was to avoid a biased discussion.

The group was composed of one architect from a small company in the real estate market; an IT systems manager from a large multinational chain of fashion clothing stores; one graphic designer in a small-size cooperative; an IT consultant from a large telecommunications organization; a project manager from a large company specialized in quality compliance in project settings; a project manager from a large-size insurance organization; and a project manager from a large company in the public sector. Obviously, due to the group's heterogeneity, the moderator had to be able to conduct the session in a way that all participants could share their opinions constructively, as recommended by Bloor et al. [35].

The audio of this focus group was recorded so that we could analyze the content of the discussions. The participants received A3 blank worksheets and a printed version of the model depicted in Fig. 5. A whiteboard and pens were also available so they could draw and write their ideas during the session. The session was divided in two parts: in the first part, the moderator presented the Ballistic 2.0 model and the constructs on which it was grounded (the *ba*, Knowledge Management, the Web 2.0 Service Models, the LL processes and the five process groups of PMBoK). In the second part, participants were invited to discuss the model, share their opinions and propose changes. The group was very receptive to the model and discussed it exhaustively and enthusiastically. At the end of the session, we had two different versions of the model, qualitative data rich in details and interesting contributions provided by all participants.

#### 4. Analysis of the Results and Discussion

All participants understood the model and participated actively in the session. The four types of *ba* were among the most discussed issues. One participant commented that the intensity of each type of *ba* could vary according to the phase of the project "The need for formalization of knowledge in both Dialoguing *ba* and Exercising *ba* is more intense than in Originating *ba* and Systemizing *ba*". Another participant added: "The tools are to be used gradually, in accordance with the phases of the project". Regarding the design of the types of *ba* in the model, one participant suggested using different colors to represent the type of interaction of the different contexts of *ba*, facilitating the comprehension of the model: "As project members are not physically present in Systemizing *ba* and Exercising *ba*, you could apply a different color in this part of the model".

The adoption of Web 2.0 service models was highly criticized by the group members. Even though the participants understood the concepts of the service models well, they could not understand why some service models could apply to a specific *ba* type and others not: "It's difficult for me to understand why the exchanger and the aggregator (Web 2.0 service models) are null". For them, the three service models used in the Ballistic 2.0 model - aggregator, collaborator and exchanger - could apply to the types of *ba*. In fact, when we suggested exclusion of the Web 2.0 service models from the Ballistic 2.0 model, they all agreed. For the group, it was better to use Web 2.0 technologies alone because "there are many different Web 2.0 technologies that can be distributed within the four quadrants of the *Ba* (shared context), during the whole project cycle".

On the other hand, the use of Web 2.0 technologies received positive comments from participants. One participant said "Thinking about the agility of Web 2.0, I really like Wiki and blogs. They are dynamic and users can be notified through RSS feeds in case of any updates". One participant suggested the use of microblogging: "LL happens all the time and whenever the LL repository is updated, a message could be sent, via Twitter, to the project participants". Another participant suggested the use of short messages via WhatsApp. A third participant complemented this suggestion saying that she uses WhatsApp and SMS to communicate with her colleagues: "I attend to scale model meetings in which I have to decide what material should be applied... and I communicate with my teammates using SMS and WhatsApp. After this, we use e-mail to register the decision or the lesson learned".

All participants agreed with the participant who suggested that the “same tools be distributed in the four quadrants (Web 2.0 Service models)”. Another participant added: “Depending on the phase of project, you cannot restrict the type of *ba* to just one type of tool or one service model”. As the participants reached a consensus on this issue, we opt to simplify the Ballistic 2.0 model, removing the Web 2.0 service models. Fig. 6 presents the new version of the model, which is grounded in Web 2.0 technologies instead of service models. Web 2.0 technologies are represented in the center of the four types of *Ba*. This new model design seeks to represent the suggestions proposed by participants. One participant commented on the representation of the LL processes and the types of *ba* “you could illustrate the core processes (types of *ba*) and the support processes (LL processes)”.

One factor that the participants strongly stressed was the need to represent the different intensities with which the *ba* shared context and the Web 2.0 technologies can be applied in the Ballistic 2.0 model. In their opinion, it is critical to consider that their application may vary depending on the project phase (or process group) “... in the initiation phase, we tend to communicate less. In the execution and monitoring phases, the level of communication is higher, and as we near the end of the project, the tendency is to communicate less as well (as in the initiation phase)”. A participant affirmed: “Web 2.0 tools will be progressively used according to the project phases”. Another participant added: “You could represent (the variance of intensity) by changing the size of the circles... you could draw circles of different sizes...”

Some participants suggested that the Ballistic 2.0 model be more generalist and not “tied to” PMBoK. They believed that the model should not be restricted to one specific methodology only. We declined this suggestion since the main purpose of the Ballistic 2.0 model is to fill a gap found in PMBoK regarding the implementation of LL [10;11].

Figures 6a and 6b outline the design of the model that resulted from the analysis of the focus group participants’ suggestions and comments. Figure 6a represents the four LL processes: collect, verify, disseminate and reuse, as well as the Web 2.0 technologies which support these processes.

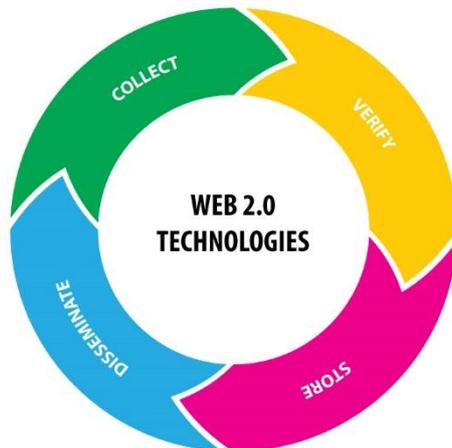


Fig. 6a. Layer-1 of the Ballistic 2.0 model validated with the focus group. Lessons learned (LL) processes and Web 2.0 technologies

In the new version, the model was divided into two layers. Layer-1, represented in Fig. 6a, illustrates the Ballistic LL processes, which contains the four LL processes adopted from the model of Weber et al. [10]: collect; store; verify; and disseminate. The LL processes are represented by a continuous cycle, which indicates that the LL processes should be repeated as much as necessary. In the center of the cycle, we placed the Web 2.0 technologies which should support all LL processes, as suggested by the focus group participants. During the focus group session, the moderator asked participants to describe examples of Web 2.0 tools that could be used in the Ballistic model. One participant suggested, “you should define one tool in the initiating phase of the project... later, you could include other tools”. Other participants cited blogs, wikis, mashups, WhatsApp and Twitter as suitable tools to engage LL in project settings with

dispersed teams. Their perspective is in tune with that of Gholami and Murugesan [31], who affirm that blogs, wikis, mashups and other Web 2.0 technologies can be used to improve team efficiency in global projects, as well as that of Auinger, Nedbal and Hochmeier [47], who found that wikis are suitable for sharing knowledge and record the project and blogs are adequate for communication and innovation. It is worth noting that the participants frequently mentioned the use of WhatsApp to generate LL. They mentioned the increasing use of WhatsApp in their companies: “WhatsApp is a very organic tool. Although we have not adopted WhatsApp as a corporate tool, we use WhatsApp more than Skype”.

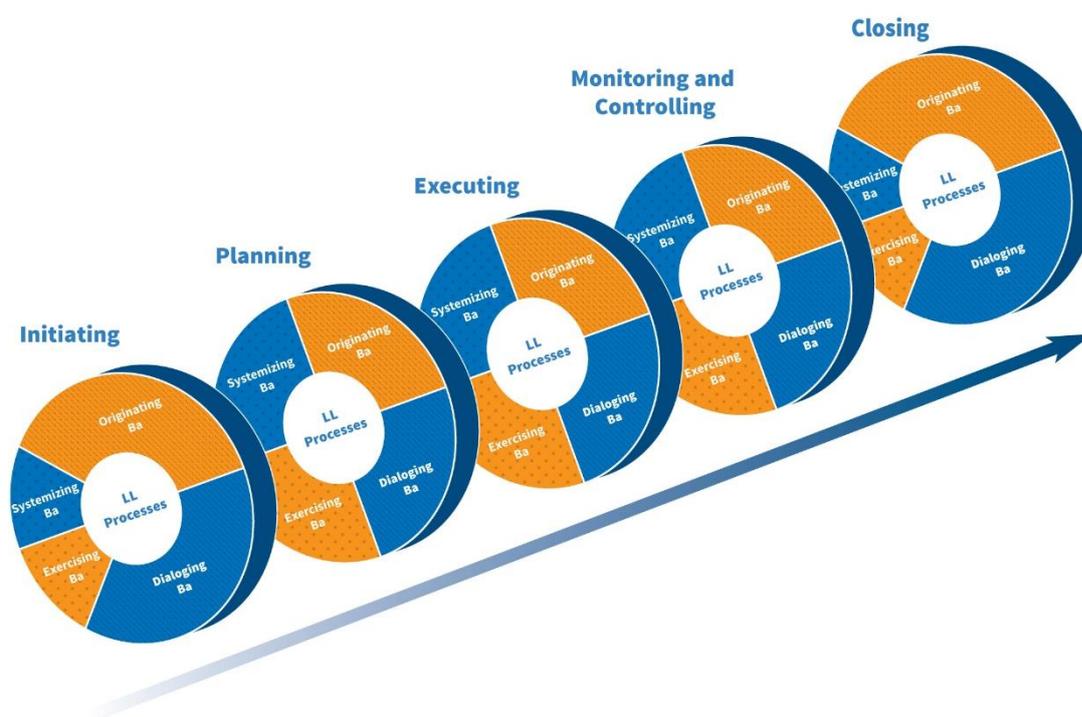


Fig. 6b. Layer-2 of the Ballistic 2.0 model validated with the focus group

In Fig. 6b, Layer-2 presents the combination of the Ballistic LL processes, the four types of *ba* and the five project phases. The four types of *ba* - originating, dialoguing, exercising, systemizing - are represented in the five circles, one circle for each of the five project phases - initiating, planning, executing, monitoring and controlling, closing. In order to represent the intensity with which each *ba* is used, we divided the circle into slices of different sizes. For instance, the slices representing the exercising and the systemizing *ba* are smaller than the ones representing the originating and the dialoguing *ba*. This representation indicates that the use of the exercising and the systemizing *ba* is less intense than the use of the other two types of *ba*. As mentioned above, according to the focus group members, the intensity with which the *ba* are used varies in accordance with the project phase. As commented by the focus group members, the dialoguing *ba* and the originating *ba* tend to occur more often than other types of *ba* in the Initiating and Closing phases of the projects. On the other hand, in the planning, execution and controlling phases, the four types of *ba* can be equally used to share LL within project team members. As suggested by one of the participants, we used the same texture to represent the systemizing *ba* and the exercising *ba*, to indicate that they consist of virtual interactions. Likewise, the originating and the dialoguing *ba* are represented by the same texture to indicate face-to-face interaction. We also used different colors to distinguish the *ba* in which there is individual or group interaction (orange for individual interaction

and blue for group interaction). The Ballistic LL processes are in the center of each circle to indicate that LL processes take place in the four *ba* contexts. The Ballistic model goes through the whole project cycle, as indicated by the arrow in the bottom of Figure 6b. Project evaluation should happen in all phases of project life cycle [36] and “the main message is to break a paradigm of managing LL only at the end of projects... LL occur all the time and we can use different means to manage them, and use applications such as WhatsApp and Twitter...”

## 5. Theoretical and practical implications

### 5.1 Theoretical implications

The theoretical contribution of this paper lies in its originality, which can be characterized as incremental according to the definition proposed by Corley and Gioia [37]. Ballistic 2.0 was built based on the existing theoretical underpinnings from knowledge management and lessons learned research fields. The Ballistic model adds to the extant literature by integrating concepts from different fields to try to improve LL in project management. Corley and Gioia [37] also suggest that researchers describe the scientific and practical utility of a research explicitly. Ballistic 2.0 is scientifically useful as it addresses the relationships between knowledge management, LL processes and project management phases.

Ballistic 2.0 also emphasizes the importance of human interaction in knowledge creation. As people perform their activities, they create their own knowledge. But communication interferences can prevent people from sharing their knowledge with others [46]. Therefore, LL processes should facilitate human interaction and knowledge sharing as much as possible. Moreover, it also shows how LL management can be supported by Web 2.0 technologies.

### 5.2 Practical implications

It is time to stop making the old mistakes of performing the management of LL only at the end or after the project. Based on Web 2.0 technologies, Ballistic 2.0 supports explicit and implicit knowledge sharing in all phases of project management life cycle. Moreover, all LL processes included in Ballistic 2.0 can be applied in all phases of project management life cycle.

As there are no more reasons to neglect the insertion of Web 2.0 in Project Management activities, practitioners should start to apply modern technologies such as Twitter and WhatsApp to support the management of LL. Users should be guided to use hashtags to facilitate search and dissemination in Twitter. Additionally, Ballistic 2.0 can be used by practitioners to deal with common problems in project settings, such as loosely defined questions and free flow templates [38]. The Ballistic 2.0 model provides alternatives to solve these problems, such as using labels in wiki pages or using web-based documents to structure answers to asked questions. Finally, the Ballistic 2.0 model gives project managers alternatives to foster knowledge creation [25] and to create an environment for high-performance project teams [48].

## 6. Conclusion

This paper addresses one of the most complex issues in contemporary project management practice by introducing a model to manage LL in PMBoK process groups. The Ballistic 2.0 model intends to fill a gap in literature, which is the lack of a theoretical model on LL. This model is not only supported by existing literature, but also improves consolidated LL processes as it adds Web 2.0 technologies. Therefore, Ballistic 2.0 is in tune with Project Management 2.0, encouraging project managers to introduce emergent technologies in their routine.

One limitation of this research is that the Ballistic 2.0 model needs to be refined and assessed in empirical research. To do this, it is necessary to implement the model in organizations and to analyze the results of its use in practice. For future works, we intend to conduct case studies to validate the model qualitatively as well as doing research on management of LL in other PMMs.

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