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EXPERIENCE REPORT

Information and Communication Technology tools to support the Knowledge Management process
an analysis of BU / UFSC tools from the perspective of the GC @ BU framework

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ABSTRACT
Introduction: Although technologies are not the fundamental aspect of Knowledge Management, it is known that they play a very important role. Objective: This article presents the tools of information and communication technologies that support Knowledge Management in the University Library of the Universidade Federal de Santa Catarina. Method: The analysis was performed based on the implementation of the GC@BU Framework, in its network and technology infrastructure module, in which it was possible to perceive the range of available tools and the functionality of each one of them. Results: The tools that support the Knowledge Management cycle processes are presented in each of the phases: capture/creation; sharing/dissemination; acquisition/application, in addition to the diagnosis and suggestions for improvements identified in the application of GC@BU. Conclusion: The study highlights that the tools, in the great majority, serve several Knowledge Management processes and that their employability hardly fits in only one of the phases of the Knowledge Management cycle.

KEYWORDS
Academic libraries. Knowledge management. Information and communication technologies.

Ferramentas de Tecnologia da Informação e Comunicação como suporte ao processo de Gestão do Conhecimento
uma análise das ferramentas da BU/UFSC à luz do framework GC@BU

RESUMO
Introdução: Apesar das tecnologias não serem o aspecto fundamental da Gestão do Conhecimento, sabe-se que elas desempenham papel de grande importância. Objetivo: Neste artigo apresenta-se as ferramentas de tecnologias de informação e comunicação que apoiam a Gestão do Conhecimento na Biblioteca Universitária da Universidade Federal de Santa Catarina. Método: A análise foi realizada a partir da implementação do Framework GC@BU, no seu módulo de infraestrutura de redes e tecnologia, em que foi possível perceber a gama de ferramentas disponíveis e a funcionalidade de cada uma delas. Resultados: Aponta-se as ferramentas que apoiam os processos do ciclo de Gestão do Conhecimento em cada uma das fases: captura/criação; compartilhamento/disseminação; aquisição/aplicação, além do diagnóstico e sugestões de melhorias identificadas na aplicação do GC@BU. Conclusão: O estudo destaca que as ferramentas, em grande maioria, servem a vários processos de Gestão do Conhecimento e que dificilmente sua empregabilidade se encaixa em somente uma das fases do ciclo de Gestão do Conhecimento.

PALAVRAS-CHAVE
Bibliotecas universitárias. Gestão do conhecimento. Tecnologias deiInformação e comunicação.

JITA: DD. Academic libraries.

1 INTRODUCTION

The Knowledge Management (GC) has occupied a central role in the University Library of the Federal University of Santa Catarina (BU/UFSC) since 2015, when it began the implementation of the Knowledge Management Framework in University Libraries: GC@BU (BEM, 2015a).

The BU/UFSC, with more than 50 years, has an administrative centralization composed of the Direction, Advisory Board, Secretariat of Planning and Administration, Information Dissemination, Collection Development and Treatment of Information and Technology, Digital Content and Innovation. It has a Central Library, ten Sector Libraries and two Reading Rooms distributed in four cities in the state of Santa Catarina (UNIVERSIDADE FEDERAL DE SANTA CATARINA, 2021a).

In 2015, the Rector, at the request of the BU/UFSC Directorate, established the Knowledge Management committee, composed of servers representing the different sectors and BU/UFSC libraries, to implement GC practices and projects supported by GC@BU (UNIVERSIDADE FEDERAL DE SANTA CATARINA, 2015).

Since then, the BU/UFSC has focused on improving its services through assessments and consequent evolution in a cycle of Planning, Development, Checking and Action (PDCA), provided by means of the GC@BU Framework and its articulation with the other BU committees and services, which ends up being made possible through biweekly meetings and regular monitoring of the Strategic Planning actions, in addition to a participatory management and an engaged team.

This article presents the application of the GC@BU and its developments focusing on Information and Communication Technologies (TIC). The contributions of TIC in GC are presented in Section 2, followed by the directions of the GC@BU Framework at BU/UFSC (Section 3), and in Section 4, the TIC tools, gathered by the BU/UFSC's GC committee when analyzing the "Network and Technology Infrastructure" element contained in the "Knowledge/Learning Spaces" module of the GC@BU Framework, in contrast with the GC phases they serve.

The proposal was to make a reflection from the TIC used by BU/UFSC - through a survey with the Superintendence of Electronic Governance and Information and Communication Technologies (SETIC) of the UFSC - in contrast with the cycle of Knowledge Management Dalkir (2011) that recognizes the following phases: Capture and Creation of Knowledge, Sharing and Dissemination of Knowledge, and Use and Application of Knowledge. Identifying through analysis of the tools, through experiences based on their use and in their descriptions, which phases of the GC cycle they most contributed to. Besides presenting the analysis of the verification criteria of the "Network and technology infrastructure" element of the GC@BU Framework, performed by the GC committee during the meetings. Although the article has brought the diagnosis and action, it should be noted that this analysis consists of reading the criteria (Appendix A), interpretation, diagnosis of how it is applied in BU/UFSC and evaluation (good, fair and poor), if necessary, actions are also listed with deadline and responsible, in order to improve the evaluation of the criterion. These data are recorded on a spreadsheet and stored in an internal shared folder.

2 THE CONTRIBUTIONS OF INFORMATION AND COMMUNICATION TECHNOLOGIES TO KNOWLEDGE MANAGEMENT

According to Garcia-Alvarez (2013), TIC refers to the study, design, development, implementation and management of computer-based information systems. This facilitates access to sources of information and internal knowledge in the organization. Therefore, the use of TIC allows organizations to be more competitive, developing greater flexibility and dynamism, essential characteristics to compete in the current business environment.

It is known that GC is not directly associated with technology. This is why it differs essentially from Information Management, because its input is knowledge, and this is found mainly in people. However, as in all areas, TIC also plays an essential role in GC.

For Rossetti and Morales (2007, p. 133):

> The main role of IT in GC is to support knowledge management, to extend the reach and accelerate the speed of knowledge transfer. It is important to note that IT plays an infrastructure role, because GC also involves human and managerial aspects. Its function is to identify and/or develop and deploy technologies and information systems that support business communication and the exchange of ideas and experiences.

Acoorsi (2014) points out that TIC has been driven to all knowledge processes in the 20th century and, although GC does not depend on technologies, it is streamlined by it, collaborating significantly considering that time is a scarce resource. It is important that people, especially managers understand the value of TIC and how it can contribute to the GC cycle.

> IT is an instrument that facilitates the rapid mobility of knowledge within organizations. A strategic factor for competitiveness and survival in companies. It is necessary, however, to be cautious so as not to make the mistake of judging that IT, in itself, is the solution for the success of organizations (ROSSETTI; MORALES, 2007, p. 133).

The human being is fundamental both in the processes of knowledge and in the correct application of TIC so that they do not become time-consuming or lose their value. The author adds that "[...] adapting the theory to different realities and articulating a unification of this management model to the appropriate technology for a conscious use is, besides instigating, a fundamental challenge [...]" (ACOORSI, 2014, p. 15).

The applications are diverse, Garcia-Alvarez (2013) did a study with the purpose of analyzing the relationship between TIC and GC, for that he suggested the following classification of the tools:

a. information search and retrieval tools - TIC found in databases/bases, also used to access more informal knowledge flows, such as e-mail;
b. information filtering and personalization tools - information obtained in the search and retrieval processes that reach users in a systematic way, established according to their needs, and in an interactive way;
c. information storage technologies - these tools include, among others, database management systems and data warehouses;
d. information analysis tools - these types of tools manage functions such as data mining (datamining), text mining (text mining) or simulation, among others;
e. communication systems - these technologies allow the analysis of the company's functional structure, including, among others, knowledge maps or corporate portals

f. e-learning and e-commerce systems - e-learning technologies are based on a set of methods, technologies, applications and services designed to facilitate learning that occurs through web technologies; and
g. business management systems - this type of technology includes Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM), among others.

Added to this, Garcia-Alvarez (2013) presents a diagram (Figure 1) that shows the effects of TICs on knowledge processes.

Figure 1. Effect of TIC on Knowledge processes

Source: Translated from Garcia-Alvarez (2013, p. 330).

One can see that in the Socialization stage, when tacit knowledge is converted into tacit, "information filtering and standardization tools" are used, as well as "management and communication systems". In the Combination stage, in which the integration of explicit knowledge occurs, the "information search and retrieval tools" are more evident, as well as the "information filtering and standardization tools". In Internalization, characterized by transforming explicit knowledge into tacit knowledge, the tools most associated are three types: "information analysis", "knowledge systems" and "learning tools. In the last phase of the cycle, which transforms tacit knowledge into explicit knowledge, exteriorization, the most used tools are "information search and retrieval".

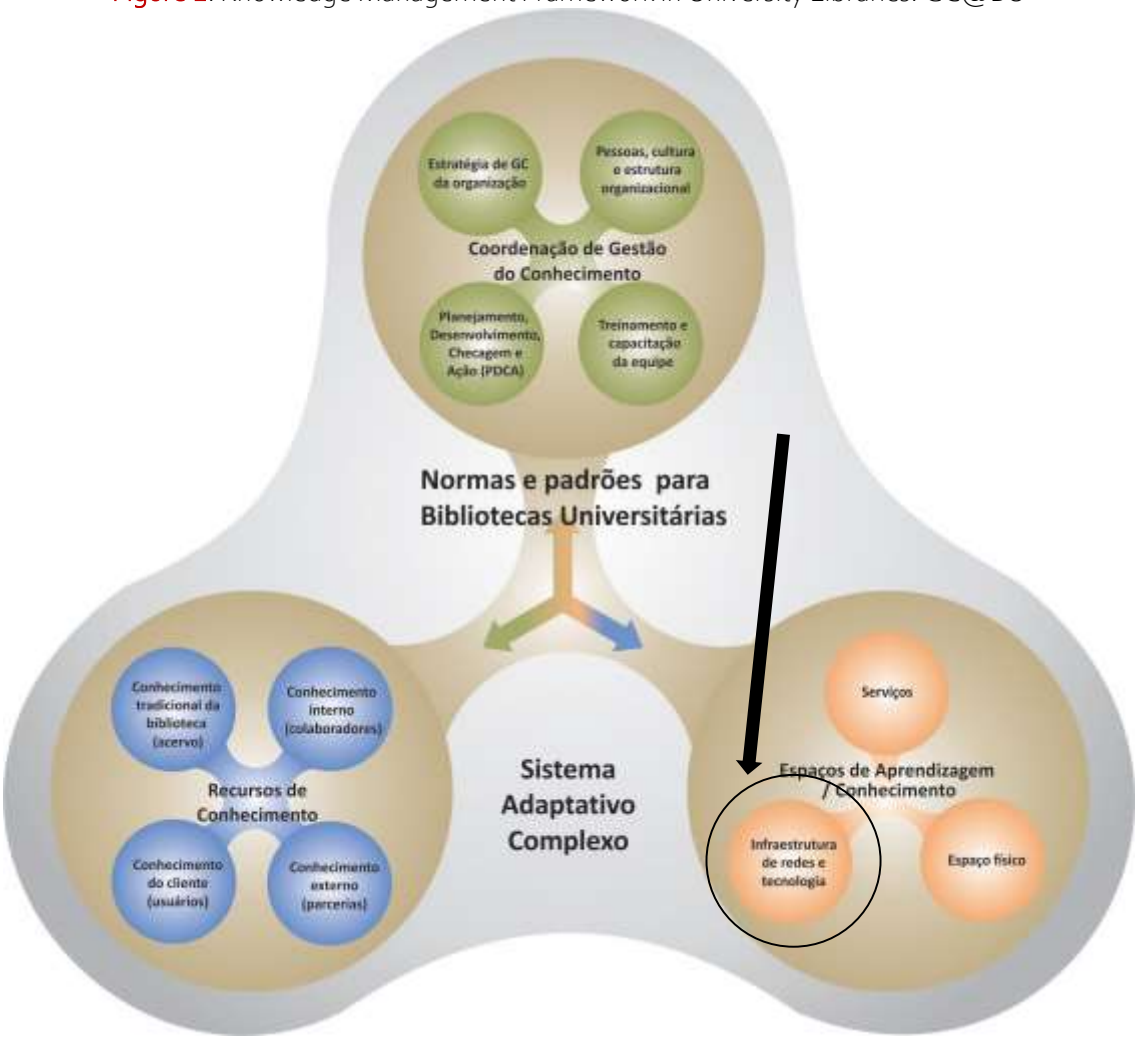
It is worth pointing out that the technological solutions must adapt to the variety of knowledge to be managed. Bettiol, Di Maria and Micelli (2020) argue that more collaborative, complex and open works require collaborative tools, repositories, search solutions, data capture and analysis, and for more routine and individual workflows one can count on applications that automate decision making.

It is clear that TIC plays a fundamental role in GC processes. Knowing them and knowing what they are used for is fundamental to make good use of them and enable GC in all its cycles.

3 GC@BU FRAMEWORK DIRECTIONS

The GC@BU Framework (Figure 2) is composed of three modules: Knowledge Management Coordination, Knowledge Resources and Knowledge/Learning Spaces. Its implementation at BU/UFSC took place in its entirety, but this article focuses only on one of its elements, network and technology infrastructure, which is contained in the Knowledge/Learning Spaces Module.

Figure 2. Knowledge Management Framework in University Libraries: GC@BU



Source: Adapted from Bem (2015a, p. 204).

The Learning/Knowledge Spaces Module contains three elements: Services; Network and Technology Infrastructure; and, Physical Space. According to Bem (2015a, p. 257):

> [...] it is necessary that the organization aligns its network and technology infrastructure to the fulfillment of its guidelines, so that it becomes essential to the fulfillment of the proposal of the 'Learning/Knowledge Spaces Module' which is an environment for building and sharing knowledge.

In this sense, the BU/UFSC, when working on the verification criteria of the GC@BU, paid attention to the fact of the importance of technologies and began to observe how they were part of the GC cycle. These verification criteria were analyzed in the committee meetings held on August 17 and September 9, 2020.

By analyzing each GC@BU verification criterion, the committee members made a general diagnosis, for all of BU/UFSC, and established actions, if necessary, with a deadline, the person responsible, and their status, considering that these actions are monitored over time, and are included in the BU/UFSC Strategic Planning.

There is a committee website (UNIVERSIDADE FEDERAL DE SANTA CATARINA, 2021c), which contains more information about the GC@BU Framework and its applications at BU/UFSC, committee publications and mind maps developed.

In the Network Infrastructure and Technology element, the committee performed the diagnosis (based on the verification criteria in Appendix A) and proposed some actions. The diagnosis and improvement actions are jointly described below:

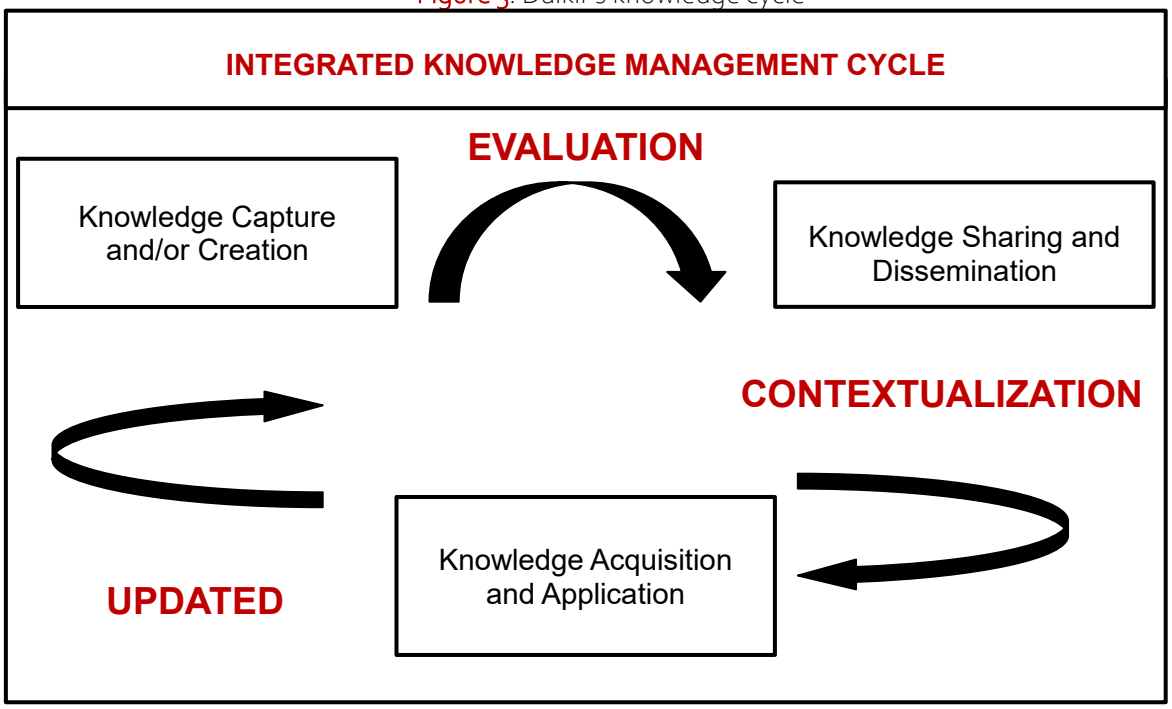
a. adequate infrastructure for Internet use - although considered good in all libraries, around 2015 the wireless Internet network was doubled in the Central Library. However, it was pointed out that it needs to facilitate visitors' access to wireless Internet;
b. good signal quality and data transfer capacity - are good throughout UFSC;
c. online collaboration environments - BU/UFSC has interaction environments (YouTube, Facebook, Instagram, Twitter), instant messaging through the Ebsco Discovery Service (EDS) chat, Cinema Mundo and Reading Club, among others. Internally, there is also the community of practice, Rocket.Chat (individual and groups), web conferencing, Only Office (calendar, shared documents). It is believed that it is possible to make better use of Moodle, and BU/UFSC is already developing a project to this end;
d. tools to anchor the development of new knowledge - it has integrated research via EDS, the Database page updated, manages the UFSC Periodicals Portal, Institutional Repository and is working on the development of a data Repository. It has identified a deficiency of e-books in Portuguese language and the need to advance in the availability of the Data Repository that is being worked on by the committee of Research Support and Research Data Management at BU/UFSC;
e. identifies and knows its needs and particularities in relation to TIC - although BU/UFSC performs constant analysis and has created a committee on Information Technology and Communication in Libraries, it needs to better plan and structure its needs, in addition to expanding the Technology, Digital Content and Innovation team
f. TIC project together and compatible with its structure and with the CG model - BU/UFSC has a good TIC structure, makes use of them and presents new demands whenever necessary, but does not have decision-making power regarding the resources made available by the UFSC. As mentioned, it has its own sector and committees for this, but reinforced the importance of working aligned, especially on the issue of UFSC Governance actions;
g. TIC tools that support GC processes and in which phase the tool will be used - the tools are listed on the website on the "Internal Systems" page, but BU/UFSC identified the need to perform a mapping to envision all the tools and their respective phases, which will be detailed in the next topic;
h. TIC infrastructure for robust and reliable virtual environments - BU/UFSC is aware of what is available, however it is a specific UFSC department that provides this infrastructure;

i. TIC infrastructure updated with advances in teaching and learning technologies - is attentive to know the needs of users and provide services, if necessary, but as pointed out earlier, there is a specific department to provide the infrastructure;
j. technological infrastructure that supports different information formats and resource discovery - makes available information content via Virtual Private Network (VPN), integrated search by the ESD, dissemination of information on the site, availability of computers for use in the library and assistive technology equipment, including for home use. However, it was identified that the loan of technology is a little deficient and it would need better and more modern equipment;
k. professionals responsible for the continuous improvement associated with the maintenance and expansion of the TIC infrastructure - given the reduced number of the Technology, Digital Content and Innovation team at BU/UFSC we are unable to make continuous improvements and expand the infrastructure considerably;
l. help desk team/service to help users with TIC - BU/UFSC helps, with the knowledge it possesses, with VPN registration, IdUFSC, digital signature, file submission to the repository, the use of Word for academic work, including tutorials, and, as already mentioned, has a specific department, which is attended to via the Call Portal and tutorials/frequent questions.

4 THE BU/UFSC'S TIC TOOLS

The GC@BU Framework is used by BU/UFSC as a management tool for the implementation of GC. In the context of GC@BU the knowledge cycle adopted is from Dalkir (2011), according to Figure 3.

Figure 3. Dalkir's knowledge cycle



Source: translated from Dalkir (2011, p. 54).

The phase of knowledge capture and/or creation refers to the identification and subsequent codification of existing (internal) knowledge, the so-called know how, it is the creation of new knowledge and know how, which did not previously exist in the institution (DALKIR, 2011).

The sharing/dissemination of knowledge is the process that justifies the previous phases (capture and acquisition), because it is in sharing that knowledge becomes endowed with contexts and one can make use of various tools to meet the needs of reaching the inventoried knowledge (DALKIR, 2011). It is the moment when knowledge "finds" those who need it.

Knowledge acquisition/application is the phase of the GC cycle, adopted by Dalkir (2011), in which users help validate the knowledge and signal when it becomes outdated or is no longer applicable. This is the step of defining the scope of the content and how to generalize/institutionalize best practices and lessons learned. This step is associated with organizational learning, when knowledge becomes incorporated into the organization's routines/processes/documents.

Chart 1 presents a list of the tools that are available at the UFSC and are used by the BU in its activities. The third column relates the tool to the GC cycle phase(s) it supports.

Chart 1. TIC tools associated with the GC cycle

TOOL	DESCRIPTION	CYCLE PHASE 1: Capture and Create 2: Share and Disseminate 3: Acquisition and Application
Pergamum http://150.162.1.90:8080/pergamumweb/home_geral/index.jsp#	Collection management, loans, and other library services.	1, 2 and 3
Only Office http://docs.bu.ufsc.br/	Office Suite. It is an open source tool that allows the "coupling" of several grouped tools, calendar, project management, document creation, education, and sharing.	1, 2 and 3
Rocket Chat - Instant Messaging https://chat.ufsc.br	It allows communication via chat between members of the UFSC community.	2 and 3
Shared Folders	It allows users to share files with each other through a shared folder on their computers.	2 and 3
UFSC Repository http://repositorio.ufsc.br/	It allows the storage, organization and publication of digital collections such as magazines, articles, presentations, programs, images, books, videos, etc.	1, 2 and 3
Web Conference https://servicosti.sistemas.ufsc.br/publico/detalhes.xhtml?servico=162	A communication and collaboration service that promotes virtual meetings between two or more participants.	2
E-mail - Electronic Mail	Provides UFSC's servers (faculty and technical/administrative), students,	2 and 3

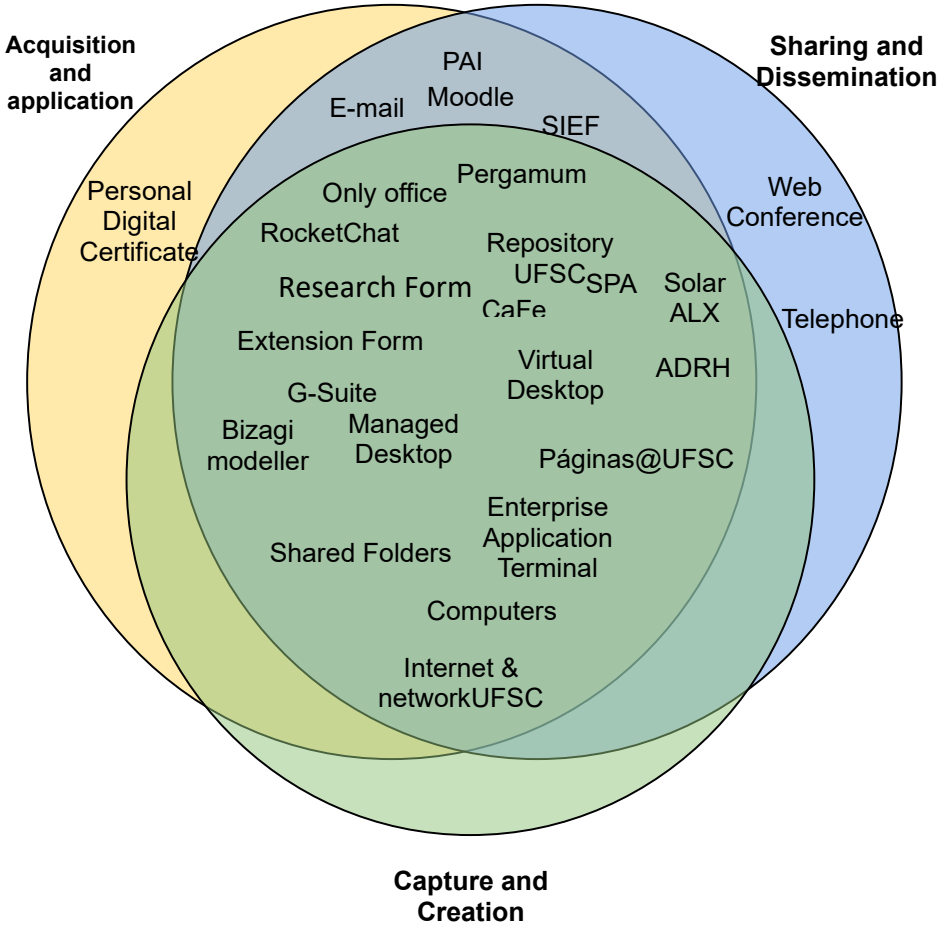
https://webmail.ufsc.br/?_task=mail&_mbox=INBOX	departments, junior companies, etc. with institutional e-mail accounts.	
Telephone https://servicosti.sistemas.ufsc.br/publico/detalhes.xhtml?servico=163	Voice communication service based on twisted pair (conventional) and VoIP technologies.	2
Survey form https://servicosti.sistemas.ufsc.br/publico/detalhes.xhtml?servico=132	It makes available for consultation, registration, and management the research projects developed at UFSC.	1, 2 and 3
Extension Form https://servicosti.sistemas.ufsc.br/publico/detalhes.xhtml?servico=131	It makes available for consultation, registration, and management the extension projects developed at UFSC.	1, 2 and 3
ADRH - People Management https://servicosti.sistemas.ufsc.br/publico/detalhes.xhtml?servico=134	System to manage the administrative procedures related to the UFSC's human resources.	1, 2 and 3
Personal Digital Certificate (P1) ICP-Edu – eduID https://servicosti.sistemas.ufsc.br/publico/detalhes.xhtml?servico=227	Certificate for signing documents and e-mails, issued by ICPEdu (RNP). The certificate is recognized for internal procedures at UFSC or between federal institutions that adhere to ICP-EDU.	3
Computers	The Computers service provides the user with support for computer configuration, maintenance and specification.	1, 2 and 3
Managed Desktop https://servicosti.sistemas.ufsc.br/publico/detalhes.xhtml?servico=225	Centralized computer management service, where settings and installed applications are managed directly by SETIC, facilitating the use and increasing the security of computers.	1, 2 and 3
Corporate Application Terminal https://servicosti.sistemas.ufsc.br/publico/detalhes.xhtml?servico=152	Provides a shared virtual server infrastructure where several people can, at the same time, use several administrative systems made available by UFSC (CAGR, ADRH, MATL, etc.).	1, 2 and 3
Internet & networkUFSC	Provision of wired and wireless data network infrastructure.	1, 2 and 3
Virtual Private Network (VPN) for networkUFSC	It allows you to connect to the UFSC network from any network connection with Internet access.	1, 2 and 3
CaFe - Federated Authentication Service https://servicosti.sistemas.ufsc.br/publico/detalhes.xhtml?servico=129	Federated Application Authentication Service, for content distribution in Federated Academic Communities.	1, 2 and 3

Google G-Suite	G-Suite for Education enables active servers and students to have an institutional account to access some services.	1, 2 and 3
Moodle https://servicosti.sistemas.ufsc.br/publico/detalhes.xhtml?servico=167	Platform for online teaching.	1 and 2
Institutional Attendance Portal (PAI) https://servicosti.sistemas.ufsc.br/publico/detalhes.xhtml?servico=228	It provides service portals for the UFSC units.	2 and 3
SPA - Solar https://servicosti.sistemas.ufsc.br/publico/detalhes.xhtml?servico=139	System for managing Administrative Requests and Processes.	1, 2 and 3
ALX Solar - SPA https://solar.egestao.ufsc.br/solar/	System for managing administrative procedures related to the UFSC's warehouse.	1, 2 and 3
Integrated Physical Spaces System (SIEF) https://servicosti.sistemas.ufsc.br/publico/detalhes.xhtml?servico=174	System that allows the management of the physical spaces available at the UFSC campuses.	2 and 3
Bizagi modeler https://www.bizagi.com/pt/plataforma/modeler	Software for process mapping.	1, 2 and 3
Virtual Desktop - Software Terminal https://servicosti.sistemas.ufsc.br/publico/detalhes.xhtml?servico=232	The Virtual Desktop is a service in which users can use software made available by UFSC without having to install it on their computers, including Corporate Applications and software from various areas (mathematics, imaging, office, etc.).	1, 2 and 3
Páginas@UFSC https://servicosti.sistemas.ufsc.br/publico/detalhes.xhtml?servico=121	Institutional Web Content Management System (CMS).	1, 2 and 3

Source: Prepared by the authors (2021), based on Universidade Federal de Santa Catarina (2021b).

Most of the tools made available by the UFSC serve to support more than one phase of the GC cycle, and many times, it is difficult even to establish to which phases the tools are associated. However, as most of the tools are management tools (collection, administrative processes, human resources, physical spaces, extension actions, research actions), the relationship ends up occurring with the three phases (Figure 4).

Figure 4 - List of TIC tools associated with the GC cycle



Source: Developed by the authors (2021).

Figure 4 presents the three major phases of the Management cycle and the tools that serve them, showing that there is an intersection between them. One can consider that when a management system is used, it goes through the registration of knowledge, because the information is registered in it so that it can be managed. On the other hand, it also becomes a source of information, considering that, when one needs certain knowledge, one knows where to find it, while it is also a learning and knowledge updating tool, since the information inserted into the system can be constantly checked, verified, and updated. This way, we can see that the tools will rarely serve an isolated area, even because the phases are continuous and hardly an activity/function begins and ends in a single phase, showing that the GC processes are cyclical.

The TIC are fundamental in all phases of the GC cycle and their potential is essential for GC. According to Mariano and Carreira (2010), the extraction and storage functions of technologies are fundamental for knowledge dissemination. However, as TIC is only a support, it must deal with other elements associated with the human factor.

5 CONCLUSIONS

The debate that the team promotes during the interpretation of each criterion, the diagnosis aimed at application at BU/UFSC, the evaluation of each criterion in the context of

the library, as well as listing actions that provide improvement of each criterion at BU/UFSC, when necessary, are important for the strengthening of CG.

The sharing of the BU/UFSC experience with the application of the GC@BU Framework ends up being a reference for other information units to absorb the good practices and also seek excellence both in the development of their activities and in the products and services offered.

Although some criteria of the element Network Infrastructure and Technology are still under development, such as the use of Moodle by BU/UFSC, facilitate wireless Internet access for visitors, among others, there are projects and referrals made for effectiveness and improvement of these issues. And, as stated in the analysis of some of these criteria, the team is aware of the TIC infrastructure available and is also attentive to meet the needs of users.

As exposed above, it is possible to notice the range of available tools that serve several GC processes, which have different functionalities, fitting, many times, in more than one phase of the GC cycle.

It is inferred that, although the tools are a support, they are fundamental in the process of capturing and/or creating knowledge, sharing/dissemination of knowledge, acquisition/application of knowledge, especially for the ease of access, agility in the retrieval and scope in the dissemination that it provides, if the knowledge is properly managed.

With all the tools described, BU/UFSC had the opportunity to realize the importance of TIC support in the development of GC actions and to deepen the GC projects on several fronts of daily activities, besides standardizing the use of some tools that had similar functions and ended up dispersing the team's efforts and the knowledge recorded.

CRediT

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ANNEX A - Verification Criteria for the Network Infrastructure & Technology element of the GC@BU Framew

CHECK CRITERIA (The University Library...)	Relation with...	Level	Dead line	Resp.
1. Has an adequate infrastructure for wired and wireless internet use				
2. It has good signal quality and sufficient data transfer capacity for downloading and sending files.				
3. Provides users and collaborators with online collaboration environments such as social networks, blogs, affinity groups, communities of practice, instant messaging, wikis, and others.	Spaces			
4. Provides users with databases, digital libraries, repositories, etc. In order to anchor the development of new knowledge.				
5. Identifies and knows your needs and particularities in relation to ICT (analyzing existing tools and those in use).				
6. Establishes an ICT project together and compatible with its structure and the KM model, not forgetting the "interface" with the university.				
7. Define the ICT tools (databases/knowledge, network analysis, workflow tools, web 2.0 tools, etc.) that will support the KM processes and in which phase (knowledge capture and/or creation, sharing/dissemination, acquisition/application) the tool will be used.	MRC			
8. Has ICT infrastructure in place to provide robust and reliable virtual environments needed for study and research.				
9. It has an ICT infrastructure that enables it to keep up with advances in teaching and learning technologies.				
10. Has a technological infrastructure that supports different information formats and resource discovery, including for the user to access from home.	Traditional knowledge			
11. It has professionals responsible for the continuous improvement associated with the maintenance and expansion of the ICT infrastructure continuously participating in trainings.				
12. Has a help desk team/service to help users with ICTs.	Services			

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