

SUPPLEMENTARY MATERIAL

Title: Protocol for Identifying and Retaining Critical Knowledge in a Public Health Administration

Authors: Núria Arimany-Serrat¹, Maria Antentas-Peraile¹ and Elisenda Tarrats-Pons^{1,*}

Material and Methods

Phase 1 (Phase 1A and Phase 1B)

The items used to score Phase 1A and Phase 1B are as follows.

The procedure for determining the **Expected Date of Retirement** [29] utilizes the following score, which is critical at 3 points and above:

Supplementary Table S1. Nearest Proximate Retirement Date Scoring for Phase 1A

Data on Expected Date of Retirement	Score
Exit from the organisation in the same year	5 points
Exit from the organisation three years ahead	4 points
Organisational exit in the next four years	3 points
Organisational exit in the next five years	2 points
Organisational exit within six or more years	1 point
Total score	

Respecting **Continuity Risk in the Workplace** [10], the score for each item is critical for the following 3 points onwards:

Supplementary Table S2. Workplace Continuity Score for Phase 1B

Workplace Continuity Risk	Score
High risk of leaving the job, due to resignation, serious illness, etc.	5 points
Young (less than 45 years old), restless, eager to acquire new work experience, has knowledge of interest in other offers.	4 points
Experienced worker who may find the job monotonous or who needs to travel 4 or more times a year for work purposes, with 5 or more years of experience.	3 points
Risk of gradual exit due to high levels of frustration.	2 points
Having completed their professional career in the job.	
Over 40 years old with a history of job rotation (three or more).	1 point

Total score

The **Characteristics and of Knowledge and Level of Difficulty** [29] can be calculated using the following score system, which is critical from 4 points onwards:

Supplementary Table S3. Scoring Knowledge Characteristics and Difficulty for Phase 1A and Phase 2B

Characteristics and Knowledge and level of Difficulty	Score
Expert, reliable and unipersonal knowledge. Not documented. Requires 5 years of learning. No substitute available.	5 points
Critical knowledge and skills (some documented). Some people have this knowledge. Requires an apprenticeship of 2-4 years.	4 points
Important knowledge and skills that are systematised. Substitutes available. 1- or 2-year apprenticeship required.	3 points
Process-based knowledge and skills. Clearly identified and documented. Requires an apprenticeship of less than 1 year.	2 points
Common knowledge and skills. Many skilled people with this knowledge. Little training required.	1 point
Total Score	

The **category of the workplace** can be calculated using the following score, which is critical from 3 points onwards.

Supplementary Table S4. Workplace Category Score (CLT) for Phase 1A and Phase 1B

Workplace Category Score (CLT)						
Years of Experience (YE)	Group A1 (2 points)	Group A2 (1 point)	Group B1 (2 points)	Group C1 (1 point)	Group C2 (1 point)	Group E (1 point)
Civil servant (3 points)	6 points	3 points	6 points	6 points	3 points	3 points
Interim (2 points)	4 points	2 points	4 points	4 points	2 points	2 points
Temporary or vacant point (1)	2 points	1 point	2 points	2 points	1 point	1 point

Technological competences (according to STARA competences) [14] are considered critical with a score of 3 or more for Phase 1A and 4 or more for Phase 1B (using the average of each scoring item).

Supplementary Table S5. Scoring of Technological Competences for Phase 1A and Phase 1B

Technological Competences	Score (Likert Scale)
The worker knows how to create digital content in different formats and in different applications. What specific ones do they use in their workplace? Do they use AI?	1-5 points
The person can correctly edit and handle documents, representations and SSP-specific databases.	1-5 points
The person knows how to produce different graphics and multimedia material for everyday tasks. Do they use AI?	1-5 points
The person shares and can explain how the applications/BDDs used by team members work.	1-5 points
Total: (Total score/Total number of items)	

Regarding **Sustainability-related Knowledge**, one scoring item is chosen for each main concept and a critical score of 3.5 or higher (using the average of each scoring item) is considered as a critical score.

Supplementary Table S6. Sustainability-related Knowledge Scores for Phase 1A and Phase 2B

Sustainability-Related Knowledge	Score (Likert Scale)
Is the employee aware of their actions in relation to environmental impacts?	1-5 points
Is the employee able to promote and advocate for sustainable initiatives to colleagues in the organisation?	1-5 points
Does the employee manage water, energy and waste inherent to the workplace correctly?	1-5 points
Is the employee committed to and respectful of new generations?	1-5 points
Total: (Total score/Total number of items)	

Phase 2 (Phase 2A and Phase 2B)

Phase 2A

With respect to **Continuing Education (CTE)** and congresses/workshops scores the score for each item is critical from 3 points onwards.

Supplementary Table S7. Continuing Education (CTE) and congresses/workshops scores

CTE and Congresses/Workshops	Score
CTE and 0 Congresses/Workshops	0 points
CTE and 1 Congresses/Workshops	1 point
CTE and 2 Congresses/Workshops	2 points
CTE and 3 Congresses/Workshops	3 puntos
CTE and 4 or more Congresses/Workshops	4 or more points
Total score	

Regarding **Workplace-Related documents**, the score for each item is critical from 3 points onwards.

Supplementary Table S8. Scoring of Workplace-Related Documents

Workplace-Related Documents	Score
0 documents	0 points
1 document	1 point
2 documents	2 points
3 documents	3 points
4 or more documents	4 points
Total score	

Regarding **Contact with peers and others**, the score for each item is critical from 3 points onwards.

Supplementary Table S9. Scoring of contact with peers/others

Contacts with Peers and Others	Score
0 peers	0 points
1 peer	1 point
2 peers	2 points
3 peers	3 points
4 or more peers	4 points
Total score	

Regarding the **No. of Critical Incidents (CI)**, the score for each item is critical from 3 points onwards.

Supplementary Table S10. Critical Incident Scoring (CISC)

No. Of Critical Incidents (CI)	Score
0 CI	0 points
1 CI	1 point
2 CI	2 points
3 CI	3 points
4 or more CI	4 points
Total score	

Phase 2B

The following procedures shall be followed to identify Critical Knowledge:

1. Structured interview

Supplementary Table S11. Questions to identify the different types of knowledge

Questions to Identify Human Knowledge (HK)
<ol style="list-style-type: none"> Unexpected problems in your workplace: How do you solve them? Usefulness of your knowledge related to our thinking: Which worker(s) would benefit from your knowledge? Difficulty of knowledge: What knowledge related to your critical thinking skills is most difficult to replace? Importance of your knowledge: What knowledge related to your skills does the organisation need five years down the line? Transfer of your knowledge: How is this knowledge stored in the organisation (documents, online repositories, email, one drive, etc.)?
Questions to Identify Technological Knowledge (TK)
<ol style="list-style-type: none"> New Technological and Digital Tools in the Workplace: What are the tools that the administration will need in the coming years? Technological Knowledge and Applicability: What instructions do you utilize to use computer programmes? Where are they located (in your mind, stored on a computer, on paper, etc.)? What knowledge do you use that is not documented? Problems with Electronic Devices and Programmes. When you have problems with a technological device, who do you contact, or do you solve it on your own? Importance of Your Technological Skills: Which technological and digital skills may be obsolete when you leave your job? Transfer: What skills would you transfer if you left your job?

Questions to Identify Relational and Leadership Knowledge (RLK)
1. Importance: What leadership skills do you have that another colleague of yours does not have? What about relationships with professionals in senior management positions?
2. Internal and External Professional Contacts: Who do you approach to resolve situations in your job? List these contacts (names, surnames, and e-mails).
3. Communication in the Work Team: What skills do you use and do you think that other people in the organisation also have these skills?
4. Project and Team Leadership: What actions do you use to motivate and guide the team?
5. Difficulty: What leadership and relationship skills do you have that may become obsolete when you leave the job?
Questions to Identify Operational Knowledge (OK)
1. Most Important Skills to Perform Your Tasks: Are they protocolised?
2. Critical Points in the Workplace: What are the key points to ensure that everything runs smoothly?
3. Lack of Knowledge: Do you lack the technical knowledge to perform tasks? Who can provide it?
4. Difficulty: What skills related to the functioning of your job do you have currently that will be obsolete when you leave?
5. New Skills and Long-term Continuity: What are the latest skills you have acquired related to performing your tasks that the organisation needs for the future?

1. Conducting Knowledge Mapping

Supplementary Table S12. Roadmap for Knowledge Mapping.

Type of knowledge	Nature	Tasks to which it applies	Location
Human Knowledge (HK)			
Technological Knowledge (TK)			
Relational and Leadership Knowledge (RLK)			
Operational Knowledge (OK)			

An outline is presented below to aid in the understanding of the mapping:

- **Type of knowledge:**
In the knowledge-type column, the name of the detected knowledge must be inserted.
- **Nature of knowledge:**
 - **Implicit:** It is automatic, it is specific to the person's mind, and it is not documented or recorded.
 - **Explicit:** It is a type of knowledge that is standardised, written down, and logged.
- **Tasks to which it applies:** Reflect on the tasks for which this knowledge is necessary.
- **Location of the knowledge:** Investigate whether it is knowledge that is only in the person's mind, whether it is unique and exclusive to the person, whether it is documented or written within a computer, computer system, or manual, or shared on a OneDrive, etc.

The **risk formula** applied to each identified knowledge type has the following scoring system:

Supplementary Table S13. Risk Formula Score.

Knowledge Risk Formula	
IMPORTANCE	Critical score ≥ 3 points
How important is the knowledge for the tasks that are and will be carried out in the administration?	Score
It is needed to carry out many of the current and future tasks; every day this knowledge is applied.	4 points
It is needed twice a week to perform some of these tasks.	3 points
It is needed monthly to perform tasks.	2 points
It is almost never required.	1 point
DIFFICULTY	Critical score ≥ 2 points
How many years does it take to acquire this knowledge?	Score
4 or more years	4 points
3 years	3 points

2 years	2 points
1 year or less	1 point
IMPLICATION	Critical score ≥ 3 points
Does the knowledge relate to the needs that are emerging in society or the needs of citizens?	Score
Yes, they are very much related and aligned with the new needs related to the environment and new technologies.	4 points
Yes, they are quite related to the new needs related to the environment and new technologies.	3 points
Yes, although they should not be applied too much in order to be able to manage the needs of society.	2 points
No, they do not have too much, only in some aspects they have some kind of relationship.	1 point
AVAILABLE STAFF	Critical score ≤ 2 points
How many workers in the administration have the skills needed to be able to fill the job?	Score
Half of the workers	4 points
A quarter of the workers	3 points
3 or 4 workers	2 points
None or almost none	1 point
Total score	

Results

Baby-Boomer-Generation Worker

Supplementary Table S14. Personal data of a Baby-Boomer-Generation worker.

Name	----
Date of birth	----
Expected date of retirement	5 years (2029)
Reasons for leaving the workplace	<input checked="" type="checkbox"/> Retirement <input type="checkbox"/> Voluntary resignation <input type="checkbox"/> Health <input type="checkbox"/> Rotation to another workplace (within the same organisation) <input type="checkbox"/> Not leaving
Date of departure from the workplace	It is not known exactly

Supplementary Table S15. Workplace characteristics of a Baby-Boomer-Generation worker.

Category workplace	A1, Senior Management, Deputy Director General of ASPCAT of Central Catalonia (CC).
Type of contract	Civil servant, from a position of trust to political office (voluntary access).
Academic qualifications	Graduate in veterinary medicine. Diploma in Public Health. ESADA Master's Degree in Public Administration Management.
Years worked in this workplace	As A1 category 30 years ago, as deputy director 12-14 years ago.
General duties	Tasks related to the health authority: management of the people of the CC. Implementation and execution of public policies throughout the territory of the CC. Ensuring that the public health law is complied with in the territory.
Specific duties	Risk management in the field of health and safety. Epidemiological surveillance of the CC health region. Development of public policies to promote health.

Supplementary Table S16. A Baby-Boomer-Generation Worker's Critical Knowledge Sheet.

Type of knowledge	Nature	Tasks to which it applies	Location
Human knowledge (HK)			
Team leadership (HK 1)	Implicit	Human resource management for implementing public health programmes.	Inherent to the person's personality.
Current issues (HK 2)	Implicit	Resource and budget management for public health policy actions.	In the mind, not documented in a shared file.
Technology knowledge (TK)			
Document sharing (TK 1)		Access to important documents for the tasks of the CC Secretariat.	Explicit Documented and uploaded in a shared space on the internet.
Use of GenCat Programs (SIAPS, etc.) (TK 2)	Implicit/Explicit	Task development and policy notification.	In the mind from practice. Not documented, but can ask colleagues.
Relational and leadership skills (RLS)			

Links with other departments (RLS 1)	Implicit/Explicit public policies.	Relationship with key individuals in other departments for managing	Contacts personally known, but others in the organisation may also know them.
Information dissemination (RLS 2)	Implicit/Explicit other important factors.	Awareness of problems and solutions, necessary resources, and	Documented and shared in an accessible OneNote for service heads and the CC Secretariat.
Operational knowledge (OK)			
Strategic management (OK 1)	Implicit	Implementation and execution of public health policies.	In the mind.
Anticipatory planning (OK 2)	Implicit	Organisation of resources in the face of public health emergencies.	In the mind.
Job competences (OK 3)	Implicit	Quick and assured decision-making, knowledge of key institutions.	In the mind, not explained at the time.
Emergency resolution (OK 4)	Implicit	Action in response to epidemiological outbreaks or zoonosis.	In the mind, not documented anywhere.
Epidemiological Data Analysis (OK 5)	Implicit	Taking measures in critical public health situations.	In the mind, not documented anywhere.
Occupational Health (OK 6)	Implicit/Explicit	Ensuring compliance with regulations in various establishments.	Regulations are published, but application requires implicit knowledge for interpretation.

Millennial-Generation Worker

Supplementary Table S17. Personal data of a Millennial-generation worker.

Name	-----
Date of birth	-----
Expected date of retirement	Not applicable

Reasons for leaving the workplace	<input type="checkbox"/> Retirement <input type="checkbox"/> Voluntary resignation <input type="checkbox"/> Health <input type="checkbox"/> Rotation to another workplace (within the same organisation) <input checked="" type="checkbox"/> Not leaving
Day of departure from the workplace	Not applicable

Supplementary Table S18. Workplace characteristics of a Millennial-Generation worker

Category A2.	
Category of place of work	
Type of contract	Civil Servant.
Academic qualifications	Diploma in Public Management and Degree in Law from the University of Barcelona (UB). Administration from the University of Barcelona (UB)
Years worked in the workplace	6.5 years in the Public Health Department. 14.5 years in the Department of Education.
General duties	Responsible for personnel management in Central Catalonia (administrative staff, administrative assistants, and public health technicians). Coordination of territorial and administrative support. Management of personnel: registrations and deregistration's with social security. Management of technological incidents and organisational maintenance.
Specific duties	Resolve technological incidents, prioritising veterinarians in slaughterhouses. Manage printers and ensure their proper connectivity between locations. Select workers for replacements, especially veterinarians in slaughterhouses. Manage employees' personal matters both in person and via Teams. Coordinate the flow of vehicles, supervising MOTs and contracts. Manage registrations, appointments, and terminations of staff, with an emphasis on veterinarians in slaughterhouses. Select and interview administrative and technical staff in public health.

Supplementary Table S19. A Millennial-Generation Worker's Critical Knowledge Sheet

Type of knowledge	Nature	Tasks to which it applies	Location
Human knowledge (HK)			
Writing Personal Notes (HK 1)	Implicit and Individual	Resolution of queries regarding regulations and management of incidents with Social Security.	Manually documented in a personal folder.
Personnel Management (HK 2)	Implicit and Individual	Facilitates communication and resolution of conflicts objectively.	Inherent to the personality.
Technology knowledge (TK)			
Use of HR Programs (TK 1)	Implicit and Social	Advanced management of SIPICIP and ATRI.	Not documented, accessible to all.
Application of Social Security (TK 2)	Implicit and Individual	Exclusive management of contractual registrations and deregistration's.	Not documented, managed solely by him.
Access Management (TK 3)	Implicit and Individual	Management of appointments.	Not documented, accessible only by him.
Relational and leadership skills (RLS)			
Availability of Phone Contacts (RLS 1)	Explicit and Social	Resolution of incidents and continuous advice.	Documented in his personal folder.
Relationship with the IT Specialist (RLS 2)	Implicit and Social	Resolution of technological incidents without resorting to general services.	Not documented, depends on his relationship with the IT specialist.
Contact with the Head of Service (RLS 3)	Implicit and Social	Monthly meetings to resolve matters with the head of service.	Not documented, knowledge shared between them.
Operational knowledge (OK)			
Management of Unconventional Contracts (OK 1)	Implicit and Individual	Management of exceptional absences, especially veterinarians in slaughterhouses.	Not documented, personal knowledge.
Updating Documentation (OK 2)	Explicit and Social	Updating welcome protocols and occupational risk prevention.	Documented, updated with other colleagues.
Functioning of the Intranet (OK 3)	Explicit and Social	Consultation of regulations and documents to resolve queries.	Accessible and documented for all.