INITIAL IDENTIFICATION AND PRELIMINARY ASSESSMENT (PRE-MAPPING) OF POTENTIAL RISKS

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RISK ANALYSIS AND MANAGEMENT OF MANUAL REPETITIVE TASKS.
Handbook for applying the OCRA system for preventing biomechanical overload in simple and complex manual jobs.

1.ISO/TR 12295: key enters and quick assessment

ISO recently published a Technical Report, ISO/TR 12295 *"Ergonomics — Application document for ISO standards on manual handling (ISO 11228-1, ISO 11228-2 and ISO 11228-3) and working postures (ISO 11226)"*, the main section of which concerns the identification of risk via *key enters* (i.e. the field of application of different standards) and *quick assessments* (ISO, 2014).

For ISO, a technical report is a sort of guideline representing the "state of the art" in a specific area, and provides users with detailed information. That being said, it is also a reliable and useful tool for initially identifying risk, in this case related to repetitive manual tasks.

Before going into a broader approach towards identifying and pre-assessing potential health risks, it is first necessary to consider what ISO/TR 12295 says about the risk of biomechanical overload.

1.1 Key enters

"Key enters" are used to detect the existence of an occupational hazard (problem), in this case, the risk of biomechanical overload and WMSDs), and decide whether further analyses and assessments are required (HAZARD IDENTIFICATION).

Key enters define the field of application of the four sections of the relevant ISO standards.

Table 1 lists the key enters for ISO/TR 12295.

Below is an in-depth analysis of one particular aspect of the standard, relating to repetitive manual work.

According to the key enters for the application of ISO 11228-3, a task is classified as repetitive when:

- the task features repeated work cycles, or
- the same work actions are repeated for more than 50% of the time.

Based on these definitions, when there are one or more repetitive tasks involving the upper limbs for 1 hour or more in the shift, the assessment must be pursued further by means of the *quick assessment*.

It should be noted that the only reason for indicating the presence of a repetitive task is to established that it must be assessed; it does not suggest that there is necessarily any risk. The existence of risk will be established only after the next stage of the evaluation. Conversely, if there are no repetitive tasks, then no further assessments are required.

The same rationale applies to the other aspects dealt with in ISO/TR 12295 (lifting and carrying loads; pushing and pulling; static and/or awkward working postures).

1.2 The quick assessment

The *quick assessment* consists in rapidly checking for potential risk conditions (in this case for WMSDs), by asking simple qualitative and quantitative questions. The *quick assessment* is essentially designed to identify three possible conditions or outcomes:

- acceptable (green): no further actions are required;
- critical (purple): the work or process must be immediately redesigned;
- a more detailed analysis is required: a proper risk assessment needs to be carried out using specific analytical tools (as suggested by the series standards).

1 *Application of ISO 11228-1*		
Is there any manual lifting/lowering or carrying of an object weighing 3 kg or more?	NO	YES
if NO, then this standard is not relevant; go to the next "Key Questions" regarding the other standards		
If YES then go to step 2: "Quick Assessment"		
2 *Application of ISO 11228-2*		
Is there any two-handed whole-body pushing or pulling of loads?	NO	YES
if NO, then this standard is not relevant; go to the next "Key Questions" regarding the other standards		
If YES then go to step 2: "Quick Assessment"		
3 *Application of ISO 11228-3*		
Are there one or more repetitive tasks involving the upper limbs with a total duration of 1 hour or more per shift?	NO	YES
Where the definition of "repetitive task" is:		
a task characterized by repeated work cycles		
or		
tasks during which the same working actions are repeated for more than 50% of the cycle time.		
If NO, then this standard is not relevant; go to the next "Key Questions" regarding the other standards		
If YES then go to step 2: "Quick Assessment"		
4 *Application of ISO 11226*		
Are there any static or awkward working postures of the HEAD/NECK, TRUNK and/or UPPER AND LOWER LIMBS held for more than 4 consecutive seconds and repeated for a significant part of the working time?	NO	YES
For example:		
- HEAD/NECK *(neck bent back/forward/sideways, twisted)*	NO	YES
- TRUNK *(trunk bent forward/sideways/, bent back with no support, twisted)*	NO	YES
- UPPER LIMBS *(hand(s) at or above the head, elbow(s) at or above shoulder height, elbow/hand(s) behind the body, hand(s) turned with palms completely up or down, extreme elbow flexion-extension, wrist bent forward/back/sideways)*	NO	YES
*- **LOWER LIMBS** (squatting or kneeling)held for more than 4 consecutive seconds and repeated for a significant part of the working time*	NO	YES
Of NO, then this standard is not relevant **If YES** then go to step 2: "Quick Assessment"		

Table 1 – ISO/TR 12295: key enters for the application of ISO 11226 and ISO 11228 (parts 1-2-3)

It is worth remembering that when conditions are found to be *acceptable* or *critical*, respectively, it is not always necessary to conduct a more in-depth analysis of the exposure level (level 3), especially in the case of critical conditions. Efforts should be directed towards reducing the detected risk rather than on often complex and sometimes useless investigations into the situation.

On the other hand, as happens in the majority of cases, if neither of these two "extreme" conditions are clearly detected, it is essential to assess risk using a simplified or more detailed approach, and with traditional assessment methods (as will be described in later chapters). This assessment may result in risk being classified as green, yellow, red or purple, with all the relevant consequences.

Here, only the recommendations featured in ISO/TR 12295 will be reported with regard to the topic of this book, i.e. repetitive tasks and standard ISO 11228-3. Other aspects will be mentioned and included in an overview of the pre-mapping tool described in the next paragraph.

Table 2 lists the conditions that must all be present **simultaneously** to classify a repetitive manual task as acceptable (green).

The rapid assessment of 'acceptable' referred to a repetitive task, has been drawn from standard ISO 11228-3 (ISO, 2007) and especially from EN 1005-5 (step 1) (CEN, 2007).If a repetitive task is assessed as acceptable using the *quick assessment* procedure, this would be equivalent to classifying it as acceptable using the detailed methods indicated by the relevant standards.

Conversely, **Table 3** lists situations which, **even if they occur alone**, determine a *critical* condition.

To make a quick assessment of "definitely critical" conditions, it is possible to use the definitions and criteria included in the methods recommended by the standards (starting with the OCRA method), which indicate one or more highly risky elements. These include actions performed with extremely high frequency using the upper limbs or the need for almost peak force to be used. When a repetitive manual task is found to be critical, even for just one of the situations listed in **Table 3**, the recommendation is to opt for a rapid and

substantial corrective action (i.e. risk reduction), without necessarily carrying out further analyses. However, more in-depth investigations might be undertaken at a later date, to monitor the potential effectiveness of the corrective measures.

Are either upper limbs working for less than 50% of the total duration of the repetitive task(s)?	NO	YES
Are both elbows held below shoulder level for almost 90% of the total duration of the repetitive task(s)? NO YES	NO	YES
Is moderate force (perceived effort max 3 or 4 on the CR-10 Borg scale) exerted by the operator for no more than 1 hour for the duration of the repetitive task(s)?	NO	YES
Absence of force peaks (perceived effort 5 or more on the CR-10 Borg scale)?	NO	YES
Presence of breaks (including meal break) lasting at least 8 minutes every 2 hours?	NO	YES
Are the repetitive task(s) performed for less than 8 hours a day?	NO	YES
-If all of the answers to these questions are "YES", then the task is in the Green area (ACCEPTABLE) and it is not necessary to continue the risk evaluation. *-If the answer to at least one of the questions is "NO", then evaluate the task(s) by ISO 11228-3.*		

Table 2 – ISO/TR 12295: Quick assessment for repetitive manual tasks: acceptability criteria (GREEN area)

If even only one of the situations listed below is present, risk should be considered as CRITICAL and the task must be redesigned URGENTLY		
Are the technical actions performed by a single limb so fast that they cannot be counted by simple direct observation?	NO	YES
Are one or both arms operating with the elbow at shoulder height for half or more of the total repetitive working time?	NO	YES
Is a "pinch" grip (or any kind of grasp using the fingertips) used for more than 80% of the repetitive working time?	NO	YES
Is peak force applied (perceived effort 5 or more on the CR-10 Borg scale) for 10% or more of the total repetitive working time?	NO	YES
Is there no more than one break (including the meal break) in a shift of 6-8 hours?	NO	YES
Does the total repetitive working time exceed 8 hours within the shift?	NO	YES
If the answer to at least one of the questions is "YES", then a critical condition is present. *If a critical condition is present, then apply ISO 11228-3 to identify urgent corrective actions.*		

Table 3 – ISO/TR 12295: Quick assessment for repetitive manual tasks: criteria for identifying CRITICAL CONDITIONS.

2. Pre-mapping of danger and discomfort

2.1 Foreword

As stated previously, one of the latest developments being pursued by the World Health Organization (WHO) and other international organizations (ILO, ISO), in relation to preventing work-related diseases and disorders, concerns the creation of toolkits.

The main aim is to rapidly but accurately identify the presence of possible sources of risk, using instruments that can easily be used by accident prevention officers, occupational physicians, business owners, workers, trade union representatives and security services.

However, this objective also reflects the criteria set forth in ISO/TR 12295 with respect to the risk of biomechanical overload, as mentioned above.

Against this backdrop, the "problem" of WMSDs must be considered together with other occupational "hazards" (be they physical, chemical, or other), for the more general purposes of prevention.

The aim here is to suggest a methodology and some simple tools for bringing together various parties to undertake a preliminary *mapping of discomfort/danger* (i.e. to identify *risk sources in the work cycle*) in the work place, especially in small and very small businesses.

The tool does not pretend to replace the standard risk evaluation process, but to support such a process in order to identify hazardous situations in the work place, based on which to single out emerging problems that need to be submitted to a full risk assessment (in the appropriate order of priority).

As well, the tool can be used by employers and/or trade union representatives to more readily identify situations that may also call for the involvement of an occupational health expert to be present during the assessment.

The tool is primarily designed to be used by employers and work safety officers, but it may also be useful for:

-medical staff conducting periodical inspections and drafting health surveillance protocols;
-work safety officers periodically monitoring hazardous situations in the work place;
-supervisory bodies (labour inspectors) conducting inspections in the workplace, needing to rapidly detect potentially dangerous situations requiring specific preventive interventions.

The procedure presented here demands a cooperative approach towards assessing and managing risk, as it also entails interviews with workers.

In accordance with the recommendations of the WHO (WHO, 2010), three main criteria underpin the methodology:

- **globality:** a global approach towards assessing the worker's discomfort, due to either the task or the work place;
- **simplicity:** the methodology consists in an easy to use model for collecting data.
- **priority-setting:** the results obtained automatically via dedicated software and depicted clearly in bar graphs will not only help to identify problems but also offer a scale of priorities for conducting subsequent assessments.

2.2 The pre-mapping model

The operations involves two levels of intervention.

Level one entails a rapid and general identification of possible risk inducers via the use of specific *key enters*. This preliminary level ensures that all users (regardless of their skills and education) can simply and generally observe the workplace. The first level is broken down into several "boxes" relating to the main types of risks: *handling loads, repetitive movements of the upper limbs, postures, noise, microclimate, chemicals, organization of work, etc*..

Level two entails quickly identifying acceptable risk (indicated, using the traditional traffic light method, as *green*) or very high risk, (*critical*, or *purple*) using the *quick assessment* procedure.

If the situation is *code green* (green light) the risk assessment process could even stop here because it means that there is no meaningful occupational risk.

If a *critical code* (purple light) is detected, then there is definitely a significant occupational risk and immediate corrective actions will be required.

If the *quick assessment* finds that the risk level at the work station is neither acceptable (green light) nor critical (purple light), and therefore the situation is intermediate (potentially code yellow or red), then the risk assessment will have to be carried out using the analytical methods suggested by ISO or the accredited literature.

The methodology consists in an easy to use computer-based model for collecting data (Excel spreadsheet): the en-PREMAPPING-**ERGOCHECK** software can be downloaded free of charge in Italian or English from www.epmresearch.org.

The methodology calls for the active participation of all those involved in work place health and safety.

The model provides a general preliminary overview of all the main risk factors that may be present, regardless of the size of the manufacturing facility, and is underpinned by the basic tenets of ergonomics entailing a global interpretation of the worker's discomfort deriving from the task or the work place.

The main highlights of the model will be described later.

2.3 First level pre-mapping (Key enters)

*a) Details concerning the place of employment (**Figure 1**)*

Once the facility has been described, the pre-mapping form is completed for individual workers or groups of workers (i.e. homogeneous groups), who perform the same job or tasks in the shift. The term 'job' is used

to describe a set of tasks performed in a typical shift or longer time frame. A separate pre-mapping form must be used for each homogeneous group of workers.

A-COMPANY: DATA AND TASKS CONSIDERED				
Company name		Manufacturing sector		
Department		Nr. of employees	Males	
			Females	
Address				
Other details				
Short description of work				

Figure 1 - Description of the work place and definition of homogeneous group

*b) Key enters for identifying priorities related to the risk of biomechanical overload (**Figure 2**).*

The various biomechanical risks are then identified in terms of *presence or absence*, using the same key enters as those proposed in ISO/TR 12295. The key enters are actually very simple questions with YES/NO answers that reveal:

-whether a potential source of risk (such as lifting loads) in a specific task, does not require further analysis (i.e. no loads are manually lifted because the object weighs less than 3 kg);
-or alternatively, if the assessment must be continued (for instance, because the load lifted manually is equal to or heavier than 3 kg).

These key enters allow anyone analysing occupational risk exposure to quickly and unequivocally know whether or not further assessments are required.

Figure 2 (showing the Excel spreadsheet) indicates the corresponding key enters for repetitive movements, lifting loads, moving loads and pushing and pulling loads.

With regard to biomechanical overload due to awkward postures of the spine and lower limbs, in addition to using the key enters provided by ISO 11226 (for static postures only and in reality with no key-enter criteria) (ISO, 2000), other simple discomfort detection criteria have been used (and can be found in a specific folder of the Excel file), taken and re-assembled from numerous ergonomics checklists and/or questionnaires and/or manuals that are readily available in the literature. These "items" have been converted into simple closed-ended questions (**Figure 3**). The form relating to postures is completed, with the help of the attached pictures, by indicating with a cross the main postures adopted by the worker when performing the task (among those listed) and then entering their duration in percentage terms, adding up to a sum total of 100%.

While for repetitive movements, manual load handling and postures, once the presence of risk has been determined, the process calls for completing the specific *quick-assessment* forms (i.e. the second stage in the assessment process), for all subsequent physical and organizational risk indicators the questions are more in-depth, albeit simple, in order to begin prioritizing evaluations and preventive actions.

Going back to **Figure 3,** after completing the form, the software will generate the appropriate color below the light: *green* (no postural problems for the back or lower limbs), *yellow* (slight discomfort), *red* (discomfort present calling for further investigations), *purple* (critical discomfort present requiring urgent investigation). It was a deliberate decision to avoid assigning a score to these initial indicators, and rather to use colors to depict either the absence of the problem or the presence of the problem and the need to deal with its more or less urgently (color-coded priorities).

B-BIOMECHANICAL OVERLOAD			
B1	**BIOMECHANICAL OVERLOAD OF UPPER LIMBS DURING REPETITIVE TASKS**		
	PRESENCE OF REPETITIVE TASK: the task is organized in cycles, regardless of duration, or the task is characterized by similar working gestures for over 50% of the time. The term does not indicate the presence of risk.	YES NO	
B2	**BIOMECHANICAL OVERLOAD DUE TO MANUAL HANDLING - LIFTING**		
	PRESENCE OF OBJECTS WEIGHTING MORE THAN (OR EQUAL TO) 3 KG TO BE MANUALLY LIFTED (if the weight is less, no need to continue the investigation).	YES NO	
B3	**BIOMECHANICAL OVERLOAD DUE TO MANUAL HANDLING - CARRYING**		
	PRESENCE OF OBJECTS HEAVIER THAN 3 KG TO BE MANUALLY CARRIED (if the loads are lighter, no need to continue the investigation).	YES NO	
B4	**BIOMECHANICAL OVERLOAD DUE TO MANUAL PUSHING AND/OR PULLING**		
	IS THERE WHOLE-BODY PUSHING OR PULLING OF LOADS?	YES NO	
B5	**BIOMECHANICAL OVERLOAD DUE TO AWKWARD POSTURES - TRUNK AND LOWER LIMBS**		
	Are there static or awkward working postures of the HEAD/NECK, TRUNK and/or UPPER AND LOWER LIMBS held for more than 4 consecutive seconds and repeated for a significant part of the working time? **In practice, generally speaking there are no awkward postures (SIGN NO) if the worker:** **-** *is sitting with his/her back well supported, with adequate space for the legs and can stand up (change position) at least every hour;* *-is standing with the trunk erect (no deep bending or twisting) but can walk around or sit down at least every hour (with the back well supported and adequate space for the legs).*	YES NO	
	For example		
	HEAD/NECK (neck bent back/forward/sideways, twisted)	YES	
	TRUNK (trunk bent forward/sideways/, bent back with no support, twisted)	YES	
	UPPER LIMBS (hand(s) at or above the head, elbow(s) at or above the shoulders, elbow/hand(s) behind the body, hand(s) turned with palms completely up or down, extreme elbow flexion-extension, wrist bent forward/back/sideways)	YES	
	LOWER LIMBS (squatting or kneeling) for more than 4 consecutive seconds and repeated for a significant part of the working time	YES	

Figure 2 - Key enters for setting assessment priorities in relation to biomechanical overload due to repetitive movements of the upper limbs and manual load handling

Figure 4 shows an example of how the Excel software changes the color of the traffic light. In this instance, the homogeneous group spends 40% of the time standing, 10% with the spine in extreme flexion, and 50% seated with the back slightly bent. The column to the right of the traffic light (under the heading PUNT.), indicates the scores assigned to each posture, ranging from 0 to 4 (although the software masks them): 0 = almost ideal postures, 4 to 8 = more tiring postures. These scores should not be regarded as "predictors of the likelihood of disease": all they do is "arrange" the level of biomechanical overload from lower to higher. The next column (under the heading PUNT. POND.) weights the scores based on the duration of the postures in percentages. The weighted cumulative score is equal to 2.7. Having established that the *maximum score* is 4, it can be assumed that the posture shown here corresponds to 68% of the *maximum score* (2.7/4*100). The significance of this percentage will be referred to later, when it is used as a final brief descriptive term for each of the various risk indicators. For scores above 0% but below 25%, the color will be *yellow;* for scores between 25% and 99% the color will be *red*; for scores of 100% the color will be *purple*, which is always used for the highest possible score, and therefore indicates a critical condition.

Similar masked scores are also used for all the other risk inducers present in the pre-mapping form, and therefore will no longer be specified.

TRUNK POSTURE		
Standing or squating posture (not seated)		
Nearly always upright		
Frequent moderate flexions		
Frequent torsions		
Frequent major flexions		
Seated posture		
Works leaning on the back		
Works in upright position but there is no backrest		
Works mostly bent forward		
Frequent trunk torsions		
Note:	described time of trunk posture:	
LOWER LIMBS POSTURE		
Standing or squating posture (not seated)		
Standing posture with possibility of walking around		
Standing fixed posture		
Kneeled or squatted legs		
Seated posture		
Leg space is suffcient		
Leg space is insufficient or very limited		
Leg space is non existing		
Note:	described time of lower limbs posture:	
USE OF LOWER LIMBS		
No acting pedals		
Use of lower limbs for acting pedals		
Note:	described time of use of lower limbs:	100%

Figure 3 - Simplified "indicators" for analysing awkward postures of the spine and lower limbs

*c) Key enters for identifying indoor lighting problems (**Figure 5**).*

As for all the other sections of the pre-mapping form, these questions are also closed-ended and refer to the visual effort required to perform the work in relation to the lighting both at the work station and in the work place in general

TRUNK POSTURE				
Standing or squating posture (not seated)				
Nearly always upright		40%	1	
Frequent moderate flexions			2	
Frequent torsions			3	
Frequent major flexions		10%	4	0,8
Seated posture				
Works leaning on the back			0	
Works in upright position but there is no backrest			2	
Works mostly bent forward		50%	3	1,5
Frequent trunk torsions			4	
Note:	described time of trunk posture:	2,3		

Figure 4 – "Masked" scores listing discomfort from low to high, so as to obtain color-coded priorities.

C-KEY-QUESTIONS FOR IDENTIFYING LIGHTING PROBLEMS		
General lighting: judgment of visual effort required at work		
SUFFICIENT		
POOR :	FOR SEVERAL HOURS A DAY	
	ALL DAY LONG	
EXCESSIVE:	FOR SEVERAL HOURS A DAY	
	ALL DAY LONG	
ARTIFICIAL LIGHTING: NEEDED BUT UNAVAILABLE		
Localized lighting. judgment of visual effort required at work		
SUFFICIENT		
POOR :	FOR SEVERAL HOURS A DAY	
	ALL DAY LONG	
EXCESSIVE:	FOR SEVERAL HOURS A DAY	
	ALL DAY LONG	
NEEDED BUT UNAVAILABLE		
Kind of surfaces: judgment of visual effort required at work		
SURFACES OF WORK TOPS	OPAQUE	
	BRIGHT AND SHINY	
SURFACES OF OBJECTS BEING PROCESSED	OPAQUE	
	BRIGHT AND SHINY	

Figure 5 - Key enters for identifying indoor lighting problems

It is advisable to obtain answers to these questions by interviewing the members of a homogeneous group; each one should be asked to express their judgment regarding the type of lighting, i.e. whether it is *sufficient*, *poor*, or *excessive*, also in relation to the time frame, in other words: *for a few hours a day or all day*. The workers are also asked about the surfaces of their work benches, i.e., whether they are opaque or shiny.

*d) Key enters for identifying problems relating to outdoor work/UV radiation (***Figure 6***).*

With regard to detecting the possible existence of a problem, all that is considered here is the time spent working out of doors.

D-KEY-QUESTIONS FOR IDENTIFYING PROBLEMS RELATING TO OUTDOOR WORK/UV RADIATION	
Exposure to UV radiation and/or weather related factors	
OCCASIONAL OUTSIDE WORK	
OUTSIDE WORK FOR A SIGNIFICANT PART OF THE YEAR (1/3)	
OUTSIDE WORK FOR MORE THAN HALF THE YEAR (2/3)	
OUTSIDE WORK NEARLY ALL YEAR LONG (3/3)	

Figure 6 – Key enters for identifying problems relating to outdoor work/UV radiation.

e) Key enters for identifying problems relating to noise **(Figure 7).**

Here, workers are asked whether or not the task *involves* or *does not involve* verbal communications with co-workers or other people (for work related reasons). In either case, additional information is acquired by asking the following simple questions which provide an indirect indication of the noise level:

-the noise is slightly bothersome, but it is possible to talk with co-workers (or with the interviewer if there are no co-workers);
-the noise is bothersome, and it is difficult to talk with co-workers (or with the interviewer if there are no co-workers);
-the noise is very loud, and it is impossible to talk with co-workers (or with the interviewer if there are no co-workers).

E-KEY-QUESTIONS FOR IDENTIFYING PROBLEMS RELATING TO NOISE	
The task requires verbal communications with co-workers	
THE NOISE IS NOT BOTHERSOME	
THE NOISE IS SLIGHTLY BOTHERSOME, BUT IT IS POSSIBLE TO TALK WITH CO-WORKERS	
THE NOISE IS MADDENING (BOTHERSOME), IT IS DIFFICULT TO TALK WITH CO-WORKERS	
THE NOISE IS VERY LOUD, IT IS IMPOSSIBLE TO TALK WITH CO-WORKERS	
The task does not require verbal communications with co-workers	
THE NOISE IS NOT BOTHERSOME	
THE NOISE IS SLIGHTLY BOTHERSOME, BUT IT IS POSSIBLE TO TALK WITH CO-WORKERS	
THE NOISE IS MADDENING (BOTHERSOME), IT IS DIFFICULT TO TALK WITH CO-WORKERS	
THE NOISE IS VERY LOUD, IT IS IMPOSSIBLE TO TALK WITH CO-WORKERS	

Figure 7 – Key enters for identifying problems relating to noise

e) Key enters for identifying problems relating to noise **(Figure 8)**.

The key questions are extremely simple: *does it feel hot, does it feel cold*; plus a description of the duration: *only in summer, only in winter, all year long.*

The workers are also asked if the work is prevalently out of doors (e.g. farming, building construction), involving exposure to the elements.

F-KEY-QUESTIONS FOR IDENTIFYING PROBLEMS RELATING TO THE MICROCLIMATE		
QUITE GOOD ALL YEAR LONG		
IT IS HOT:	ONLY IN SUMMER	
	ALL YEAR LONG	
IT IS COLD:	ONLY IN WINTER	
	ALL YEAR LONG	
working out of doors with exposure to the elements		
ONLY IN SUMMER		
ONLY IN WINTER		
ALL YEAR LONG		

Figure 8 – Key enters for identifying problems relating to weather and micro-climate

*g) Key enters for identifying problems relating to tools/equipment (***Figure 9***).*

In this section, workers report on the most frequent "intrinsic" problems with a tool or piece of equipment, or with the way they are used. Problems are indicated by placing an X in the corresponding box.

*h) Key enters for identifying problems relating to exposure to vibrations (***Figure 10***).*

A distinction is made between vibrations caused by the use of tools (pneumatic screwdrivers, grinders, cutters, pneumatic drills, etc. for at least 1/3 of the time) or by driving vehicles (whole-body vibrations for a large percentage of the time).

*i) Key enters for identifying problems relating to the use of machinery or machine parts (***Figure 11**).

As in the section on tools, in this section workers report on the most frequent "intrinsic" problems with machinery or parts of machines, or with the way they are used. Problems are indicated by placing an X in the corresponding box.

G-KEY-QUESTIONS FOR IDENTIFYING PROBLEMS RELATING TO THE USE OF TOOLS/EQUIPMENT	
ADEQUATE AND IN GOOD CONDITION (SATISFACTORY MAINTENANCE)	
HEAVY	
NOISY	
REQUIRES USE OF FORCE	
NOT WORKING EFFICIENTLY	
CUMBERSOME AND/OR HARD TO GRASP	
NOT FIT FOR SPECIFIC USE AND/OR TECHNOLOGICALLY BACKWARD	
THE EQUIPMENT RAPIDLY OVERHEATS	
REQUIRES EXCESSIVE ATTENTION	
MAY PRODUCE LESIONS (CUTS, ABRASIONS, BLISTERS, BURNS, ETC.)	
REQUIRES USE OF BODY PARTS AS EQUIPMENT, WITH CONSEQUENT LESIONS (CALLUSES, RASHES, CUTS, ETC.)	

Figure 9 - Key enters for identifying problems relating to the use of tools/equipment

H-KEY-QUESTIONS FOR IDENTIFYING PROBLEMS RELATING TO VIBRATION	
NO EXPOSURE TO VIBRATION	
the task involves the use of vibrating tools	
OCCASIONAL USE	
USE OF PNEUMATIC SCREWDRIVERS FOR AT LEAST 1/3 OF TIME	
USE OF GRINDERS/CUTTERS/POLISHERS FOR AT LEAST 1/3 OF TIME	
USE OF JACK HAMMERS FOR AT LEAST 1/3 OF TIME	
the task involves driving a vehicle	
OCCASIONAL DRIVING	
ALMOST ALWAYS DRIVING A CAR, MOTORCYCLE, VAN	
ALMOST ALWAYS DRIVING A TRUCK, BUS	
ALMOST ALWAYS DRIVING A TRACTOR, AGRICULTURAL VEHICLE, SCRAPER, DIGGER	

Figure 10 - Key enters for identifying problems relating to exposure to vibration (hand-arm or whole-body)

I-KEY-QUESTIONS FOR IDENTIFYING PROBLEMS RELATING TO MACHINERY	
ADEQUATE AND IN GOOD CONDITION (SATISFACTORY MAINTENANCE)	
REQUIRES USE OF FORCE	
REQUIRES LIFTING HEAVY COMPONENTS	
NOISY	
NOT WORKING EFFICIENTLY	
NOT FIT FOR SPECIFIC USE AND/OR TECHNOLOGICALLY BACKWARD	
REQUIRES EXCESSIVE ATTENTION	
LIMITED SPACE AROUND MACHINERY	
MAY PRODUCE LESIONS (CUTS, ABRASION, BLISTERS, BURNS, ETC.)	

Figure 11 - Key enters for identifying problems relating to the use of machinery or parts of machines

*l) Key enters for identifying problems relating to pollutants (chemical risk, biological risk) and other specific risk factors (***Figure 12***).*

The key questions for this important section may seem excessively simple. The questions, however, are designed to detect the presence and quantity of any pollutants. It should be stressed that if the presence of a pollutant is detected, another questionnaire needs to be completed in addition to this one, to collect preliminary data concerning the possibility that the pollutant might become a risk inducer (see the paragraph on *quick assessments*).

This tool neither represents nor replaces official Risk Assessment Documents. Any report of workplace hazards associated with exposure to chemicals is an alarm signal that must be followed by an in-depth evaluation based on the standards originating from the technical and scientific knowledge existing at the time.

L-KEY-QUESTIONS FOR IDENTIFICATION OF PROBLEMS ASSOCIATED WITH POLLUTANTS, AND BIOLOGICAL OR OTHER SPECIAL AGENTS			
NO POLLUTANTS AND BIOLOGICAL OR OTHER SPECIAL AGENTS ARE PRESENT			
DUST: type		PRESENT	
		HIGHLY PRESENT	
FUMES: type		PRESENT	
		HIGHLY PRESENT	
UNPLEASANT ODORS: type		PRESENT	
		HIGHLY PRESENT	
CHEMICALS: type		PRESENT	
		HIGHLY PRESENT	
OTHERS: type		PRESENT	
		HIGHLY PRESENT	

Figure 12 - Key enters for identifying problems relating to pollutants (chemical risk, biological risk) and other special risk factors

*m) Key enters for identifying organizational problems (***Figure 13***).*

Shift type and duration and forced working rate are the main factors that can potentially cause organizational problems.

M-KEY-QUESTIONS FOR IDENTIFING ORGANIZATIONAL PROBLEMS		
Shift work		
SHIFT WORK	ONLY ONE DAILY SHIFT	
	SEVERAL DAILY SHIFTS	
	ONLY NIGHT SHIFT	
	SEVERAL SHIFTS ALSO AT NIGHT	
Work rate		
WORK RATE	FREE	
	IMPOSED BY MACHINERY	
Duration		
SHIFT DURATION	NO MORE THAN 8 HOURS PER SHIFT	
	MORE THAN 8 HOURS PER SHIFT	

Figure 13 - Key enters for identifying several organizational problems (shift work; work rate imposed by machinery, shift duration)

*n) Key enters for identifying potential risk inducers (***Figure 14***).*

With regard to this important and very challenging aspect, the decision was taken to deal with the issue by simply suggesting a limited list of possible stressors. The items on the list should therefore not be used as actual key enters, but only as descriptions of situations to be monitored. Unlike in the previous situations, no numbers are used in order to classify risk and set priorities using the traffic light system. There are in fact no simple recommendations in the literature that would serve this purpose. The authors will wait until such time as enough experience has been acquired, following a broader enforcement of work-related stress assessment requirements, to implement the system.

N-KEY ENTERS FOR IDENTIFYING GENERIC POTENTIAL STRESSORS	
NIGHT SHIFT	
WORK RATE IMPOSED BY MACHINERY	
WORK SHIFT LONGER THAN 8 HOURS	
UNCOMFORTABLE WORK ENVIRONMENT DUE TO NON-ERGONOMIC WORK PLACE, LIGHTING, MICRO-CLIMATE, NOISE, VIBRATION, ETC..)	
PROLONGED CONTACT WITH THE PUBLIC	
CONTACT WITH PEOPLE IN PAIN	
WORK AT HIGH RISK OF ACCIDENT OR INJURY	
WORK AT HIGH RISK OF PHYSICAL VIOLENCE OR PSYCHOLOGICAL ABUSE	
PIECE WORK OR HIGHLY PERFORMANCE-CONTINGENT PAY	
JOB WITH HIGH RESPONSIBILITY FOR OTHERS	
JOB WITH HIGH RESPONSIBILITY FOR PRODUCTIVITY	
USE OF SOCIALLY UN-INTEGRATED WORKFORCE	
OTHER:	
OTHER:	
OTHER:	
NOTES:	

Figure 14 - Key enters for identifying potential stressors

2.4 Second level pre-mapping (Quick assessment)

Once the potential risk inducers (absent/present) have been identified using the key enters, it is possible to quickly assess the presence of *acceptable* or *critical* risk using simple evaluation methods such as the *Quick assessment*.

This procedure consists in checking whether or not certain essential assumptions and requirements are met, without calculations or equations, and generation three potential scenarios:

- ***critical*** *(purple light)*
- ***acceptable*** *(green light)*
- ***neither critical nor acceptable****:* this scenario calls for the use of one of the traditional risk assessment methods listed in the reference standards (level three).

After applying the procedure, if all the acceptability criteria have been met and no critical codes emerge, the condition is defined as *acceptable*, and no further assessments are required.

If conditions are *critical*, since the information has already been collected evidencing the existence of serious potential risk, it is advisable to begin immediate remedial and correction actions, based on the reference standards for *risk reduction.* However, at times it is still worth conducting a more detailed evaluation according to the calculations or equations provided by the standards dealing with biomechanical load (ISO and CEN).

If conditions are *neither critical* nor *acceptable* (as in a large percentage of cases), it will be necessary to use the classic "third level" risk assessment procedures and methods, which in turn may determine the presence of acceptable risk (green), or borderline risk (yellow), or risk that is present but slight/medium (red) or intense (purple).

In the proposed pre-mapping model, the second level analysis (*quick assessment*) refers only to biomechanical overload due to manual load handling, in which the EPM Research Unit has decades of experience. The criteria suggested by ISO/TR 12295 were found to be of great help, and as such have been used.

With regard to physical risk (noise, vibration, micro-climate, etc.), reference should be made to the excellent evaluation techniques that can be found in the literature. Going forward, other expert groups may eventually come up with genuine quick assessment techniques.

A detailed, descriptive questionnaire is provided only as regards the indicators for chemical risk, which, after the key enters level, allows for a more detailed analysis of hazardous situations in order to define how urgently the assessment process needs to be pursued.

The *quick assessment* questionnaires relative to repetitive movements, manual load handling and chemical risk are described below.

Quick assessment of repetitive tasks

Once key enters have established that the work entails repetitive tasks, the relevant form is completed.

The first part of the questionnaire refers to certain organizational aspects (**Figure 3.15**): shift duration, number and actual duration of breaks, and duration of non-repetitive tasks. The purpose of this section is to determine how long the worker spends performing repetitive tasks during the shift, in other words, the *net duration of repetitive work.*

The second part (**Figure 16a,** as well as **Table 2** in this chapter) proposes a number of pre-defined scenarios which, when present simultaneously, allow the risk associated with repetitive work performed by a homogeneous group of workers to be defined as acceptable (*green* code).

The third part (**Figure 16b**, but also **Table 3** in this chapter) proposes more pre-defined scenarios in which, if even only one of the replies is positive, it can be stated that the repetitive work performed by a homogeneous group of workers entails critical high-risk conditions (*purple* code).

In short, the quick assessment form for investigating repetitive work will lead to one of the following three conclusions:

- the repetitive work is *acceptable* in terms of risk because the scenarios reported in the *code green* section have all been checked;
- the repetitive work is definitely *at risk* if even only one of the replies in the *critical code* section is positive. In this case, remedial action must be taken urgently especially with regard to the critical result. A risk assessment should also be conducted using the classic evaluation tools (OCRA checklist, or the even more precise OCRA Index);
- repetitive work *could be at risk* because there are one or more positive replies in the scenarios listed in the *code green* section. A risk assessment must be performed using the classic evaluation tools (OCRA checklist or, for level four, the more precise OCRA Index); the situation is potentially a code *yellow* or *red*;

In actual fact, when conditions are neither acceptable nor critical, a simple scheme is recommended (**Figure 17**), which leads to a rough preliminary estimate of the OCRA checklist score range that might be expected with a more detailed analysis. As previously seen for the key enters, the results of this quick assessment do not generate a visible score, but rather color scales indicating the level of risk and priorities for the corrective action plan.

In order to define the intervals of these color scales, potential OCRA checklist values have been calculated for each scenario, so that when the questionnaires are compiled, the system generates a kind of *pre-index* (not visible to the compiler), where *green* (less than 7.5) means acceptable risk, *yellow* (7.5-11) means potential risk, to be assessed but not high priority, *red* (11.1-22.5) means risk probably present and to be assessed, and *purple* (more than 22.5) means risk definitely present and assessment urgently required. The maximum value for the concealed *pre-index* is 25, and the percentage of biomechanical load is calculated with respect to this value: this ratio will later be used to briefly define the extent of to which the upper limbs are engaged with respect to other risk factors.

SUMMARY OF NET DURATION OF REPETITIVE WORK ON A TYPICAL DAY			
TOTAL average shift duration (in minutes)		Total repetitive working time (in minutes)	0
DESCRIPTION OF NON-REPETITIVE WORK, DURATION AND TIMING OF BREAKS - TOTAL DURATION			
	Fetching supplies		
	Cleaning		
	Other		
Total duration of non-repetitive work per shift (in minutes)		0	
Total duration of breaks (average) per shift (in minutes) including meal break only if included in the shift duration			
Number of breaks (including meal break) lasting at least 8 min			

Figure 15 - Quick assessment of risk due to repetitive movements: organizational data

ACCEPTABLE CONDITIONS *If all underreported conditions are fulfilled and all replies are **"YES"**, the risk level is acceptable for repetitive work and it is not necessary to continue the risk evaluation* ***NB. Reply by placing an X in the appropriate white box***				
Do either upper limbs work for less than 50% of the total duration of the repetitive task(s)?	No		**Yes**	
Are both elbows held below shoulder height for at least 90% of the total duration of the repetitive task(s)?	No		**Yes**	
Is no or moderate force (perceived effort max 3 or 4 on the CR-10 Borg scale) exerted by the operator for no more than 1 hour throughout the duration of the repetitive task(s) and are there no force peaks (perceived effort 5 or more on CR-10 Borg scale)?	No		**Yes**	
Are there breaks (including meal break) lasting at least 8 minutes every 2 hours and are repetitive tasks performed for less than 8 hours a day?	No		**Yes**	

Figure 16a - Quick assessment of risk due to repetitive movements: pre-defined scenarios for determining acceptable risk (code green)

CRITICAL CONDITIONS If even only one of the situations listed below is present, risk should be considered as CRITICAL and the task must be redesigned URGENTLY **NB: Reply by placing an X in the appropriate white box**				
Are technical actions of a single limb so fast that they cannot be counted by simple direct observation?	**No**		**Yes**	
Are one or both arms operating with the elbow at shoulder height for half or more of the total repetitive working time?	**No**		**Yes**	
Is a “pinch” grip (or any kind of grasps using the fingers tips) used for more than 80% of the repetitive working time?	**No**		**Yes**	
Is peak force applied (perceived effort 5 or more on the CR-10 Borg scale) for 10% or more of the total repetitive working time?	**No**		**Yes**	
Is there is no more than one break (including meal break) in a shift of 6-8 hours or does the total repetitive working time exceed 8 hours within a shift?	**No**		**Yes**	

Figure 16b - Quick assessment of risk due to repetitive movements: pre-defined scenarios for determining the presence of high risk conditions (*critical code, purple)*

FREQUENCY						
How is the frequency of technical actions with dominant hand?						
Slow (no more than 1 action every 2 seconds)		No			Yes	
Medium (no more than 1 action per second) or holding an object by hands most of time		No			Yes	x
High (more than 1 action per second): difficult to count the actions		No			Yes	
PACE						
Is the pace mainly determined by the machine?		No			Yes	x
AWKWARD POSTURES						
Shoulder	Are arms operating with the elbow at shoulder height from one third to half of the total repetitive working time?	No			Yes	
Hand	A "pinch" (or all kinds of grasps using the fingers tips) is used from half to 80% of the repetitive working time?	No			Yes	
Wrist	Are extreme wrist deviation (flexion, extension or lateral deviations) present for quite all the time?	No			Yes	
Elbow	Are extreme forearm movements (elbow flexion-extension or rotations) present for quite all the time?	No			Yes	
LACK OF VARIATION						
Are the same actions and gestures repeated for most of time? Or the cycle time is very short (less than 8 sec.)?		No			Yes	
USE OF FORCE						
Are peaks of force (perceived effort = 5 or more in CR-10 Borg scale) applied for 1% to 9 % of the time?		No			Yes	
Is a moderate force (perceived effort = max 3 or 4 on CR-10 Borg scale) exerted by the operator?		No			Yes	

Figure 17 – Quick assessment of repetitive movements under conditions that are neither acceptable nor critical

b) Quick assessment of manual load lifting

Once it has been established, using key enters, that the work includes manual load lifting, the relevant quick assessment form is compiled.

The first part of the questionnaire gathers information concerning certain aspects of the environment and objects that the worker lifts or carries, which might represent an added risk in load handling work, and must be taken into due account in the assessment, as indicated in Annex XXXIII to Italian Legislative Decree nr. 81/08 (**Figure 18**).

ADDITIONAL ORGANIZATIONAL AND ENVIROMENTAL RISK FACTORS TO BE CONSIDERED				
Is the working environment unfavorable for manual lifting and carrying?				
Are there extreme (low or high) temperatures?	No		Yes	
Is there a slippery, uneven, unstable floor?	No		Yes	
Is there insufficient space for lifting and carrying?	No		Yes	
Are the objects unsuitable for manual lifting and carrying?				
Does the size of the object reduces the operator's view and hinder movement?	No		Yes	
Is the center of gravity of the load unstable (e.g. liquids, loose items inside a container)?	No		Yes	
Does the object have sharp edges, surfaces or protrusions?	No		Yes	
Are the contact surfaces too cold or too hot?	No		Yes	
Is the manual lifting or carrying task performed for more than 8 hours a day?	No		Yes	

Figure 18 - Quick assessment of manual load lifting and carrying risk: preliminary evaluation of certain unfavorable characteristics of the work organization, environment and load

The second part of the questionnaire (Figure 19) suggests another set of pre-defined scenarios. If even only one of the replies is positive, it means that the lifting task entails critical conditions and high risk (critical code, purple light).

These are the scenarios for which the revised NIOSH lifting equation suggests using the multiplier "Ø" for calculating the recommended weight. In other words, in the presence of these situations, the recommended weight is equal to Ø kg, i.e. under these conditions, load lifting is unadvisable). Scenarios include situations where the load is held more than 63 cm away from the body, the height of the hands at beginning/end of lift is over 175 cm, and so forth.

Moreover, conditions are defined as critical when a single worker has to manually lift weights in excess of the maximum lifting limits (Figure 3.19) recommended, for specific gender and age, by the technical standards ISO 11228-1 and EN1005-2 (ISO, 2003; CEN, 2003).

CRITICAL CONDITIONS If even only one of the conditions listed below is present, risk should be considered as HIGH and the task must be redesigned immediately.						
Task lay-out and frequency						
VERTICAL LOCATION	The hand location at the beginning/end of the lift is higher than 175 cm or lower than 0cm	No			**Yes**	
VERTICAL DISPLACEMENT	The vertical distance between the origin and the destination of the lifted object is more than 175cm	No			**Yes**	
HORIZONTAL DISTANCE	The horizontal distance between the body and the load is greater than a full arm's length	No			**Yes**	
ASYMMETRY	Extreme body twisting without moving the feet	No			**Yes**	
FREQUENCY	equal to or above 15 times/min for SHORT DURATION (MAX 60 min)	No			**Yes**	
	equal to or above 12 times/min for MEDIUM DURATION (MAX 120 min)	No			**Yes**	
	equal to or above 8 times/min for LONG DURATION (OVER 120 min)	No			**Yes**	
Presence of loads exceeding the following limits						
men (18-45 years)	**25 KG**	No			**Yes**	
women (18-45 years)	**20 KG**	No			**Yes**	
men (<18 or >45 years)	**20 KG**	No			**Yes**	
women (<18 or >45 years)	**15 KG**	No			**Yes**	

Figure 19 - Quick assessment of manual load lifting risk: pre-defined scenarios for determining the presence of high risk conditions: *critical code* (purple light)

The third part (**Figure 20**) suggests several more pre-defined scenarios. If even only one of the replies is positive, it means that the lifting work performed by the homogeneous group entails acceptable risk (*code green*).

These scenarios refer to the manual lifting of loads weighing up to 10 kg, under virtually "ideal" lifting frequency and workplace set-up conditions.

In short, the quick assessment form for investigating tasks involving the manual load lifting will, as in the case of repetitive movements, lead to one of the following three conclusions:

- the manual load lifting work is *acceptable* in terms of risk because the situations reported in the *code green* section have all been checked; repetitive work could be at risk because there are one or more positive replies in the scenarios listed in the code green section. A risk assessment should be conducted using the classic evaluation tools (Revised NIOSH lifting equation);
- the manual lifting work is *definitely at risk* if even only one of the replies in scenarios for the *critical code* section is positive. Upgrades or remedial action must be undertaken urgently with regard to the conditions defined as critical, to be followed by a risk assessment using one of the classic evaluation tools (Revised NIOSH lifting equation).

In order to complete the analysis of lifting tasks through the use of *code greens* and *critical codes*, other scenarios have been added to more comprehensively describe the handling of the various weights (**Figure 21**). As in the case of repetitive movements, with this additional information it will be possible to more

accurately determine the color scale score and the biomechanical effort of the spine with respect to the pre-defined maximum scores.

ACCEPTABLE CONDITIONS						
If all underreported conditions are fulfilled and replies are all "**Yes**" (using both hands for lifting) for all weight categories present, the risk level is acceptable for manual lifting loads. However, it is advisable to check for additional risk factors (see above). **NB.** ***Reply by placing an X in the appropriate white box***						
Do loads weigh between 3 and 5 kg?		No			**Yes**	
between 3 and 5 kg	Asymmetry (e.g. body rotation, trunk twisting) is absent	No			**Yes**	
	Load is kept close to the body	No			**Yes**	
	Load vertical displacement is between hips and shoulders	No			**Yes**	
	Maximum frequency: less than 5 lifts per minute	No			**Yes**	
Do loads weigh between 5 kg and 10 kg?		No			**Yes**	
between 5 and 10 kg	Asymmetry (e.g. body rotation, trunk twisting) is absent	No			**Yes**	
	Load is kept close to the body	No			**Yes**	
	Load vertical displacement is between hips and shoulders	No			**Yes**	
	Maximum frequency: less than 5 lifts per minute	No			**Yes**	
Do loads exceed 10 kg?		No			**Yes**	

Figure 20 - Quick assessment of manual load lifting risk: pre-defined scenarios for determining the presence of acceptable risk: *code green.*

CHARACTERISTICS AND FREQUENCY OF LOAD RANGES (OVER 10 KG)						
Do loads weigh between 10 and 15 kg?		No			Yes	
between 10.5 and 15 kg	Asymmetry (e.g. body rotation, trunk twisting) is absent	**No**			Yes	
	Load is kept close to the body	**No**			Yes	
	Load vertical displacement is between hips and shoulders	**No**			Yes	
	Maximum frequency: less than 1 lift every 5 minutes	**No**			Yes	
Do loads weight between 15 and 25 kg?		No			Yes	
between 15 and 25 kg	Asymmetry (e.g. body rotation, trunk twisting) is absent	**No**			Yes	
	Load is kept close to the body	**No**			Yes	
	Load vertical displacement is between hips and shoulders	**No**			Yes	
	Maximum frequency: less than 1 lift every 5 minutes	**No**			Yes	

Figure 21 - Quick assessment of manual load lifting risk: pre-defined scenarios for descriptive completion of lifting conditions.

As seen previously for the key enters, the results of this quick assessment do not generate a visible score, but rather color scales indicating the level of risk and priorities for the corrective action plan.

If even only one of the scenarios on the *critical code* list is positive, the color scale moves towards *purple*. Having pre-defined the *maximum value* (taking into account problems relating to the environment, load characteristics, work place layout and organizational set-up), the percentage of biomechanical effort is calculated with respect to this threshold. As for all risk inducers, this ratio is used to briefly define the degree of involvement of the spine in manual load lifting tasks. For scores between 0% and 10%, the color green will appear*;* for scores up to 50% the color yellow will appear; for scores between 50% and 99% the color will be red; for scores of 100% the color will be purple, which is always used to indicate the highest possible score, and therefore indicates a critical condition.

*c) Quick assessment of manual load carrying tasks (***Figure 22***).*

For the initial quick assessment, the calculation of the *cumulative mass* (as per ISO 11228-1) has been used, i.e. the total weight of all the loads carried in a shift. The *cumulative mass carried* is compared with the *cumulative mass tolerable for 8 hours, one hour* and *one minute*: if the weight of the mass carried is higher than that of the mass tolerated, then the situation would be deemed as critical (*critical code*, purple light). The *cumulative tolerated mass* varies based on the distance over which the load is carried, from 10,000 kg for 8 hours to 6,000 kg for distances of over 10 m. To estimate the *cumulative mass carried*, the number of objects, weight (at least by category) and distance carried must be entered into the proposed questionnaire: the calculation will be made automatically. The ratio of the cumulative mass carried to the cumulative tolerated mass is calculated but is "concealed" by the system.

Nr. of objects exceeding 3 kg carried in a shift	Weight of objects carried	Cumulative mass (kg)	Max. distance	
		0		
		0		
		0		
		0		
Cumulative Mass (total load carried) =		**0**		

Recommended Cumulative Mass (total load in kg carried during specific period					
Is the cumulative mass carried per HOUR spent carrying loads heavier than this limit (kg)?	**750**	No		Yes	
Is the cumulative mass carried per MINUTE spent carrying loads heavier than this limit (kg)?	**15**	No		Yes	

Are unfavourable environmental conditions present, or are lifting from/to low levels present, (e.g. below knee height), or are the arms lifted above the shoulders? *In these cases the recommended limits for cumulative mass for carrying should be substantially reduced (at least by one-third).*	No		Yes	

Figure 22 - Quick assessment (critical condition) of manual load carrying risk: calculation of cumulative mass.

d) Quick assessment of load pushing and/or pulling

Figure 23 lists the conditions to be examined first of all to define the manual pushing or pulling of transpallets as acceptable. These conditions could in fact represent an additional risk in load handling work, and must be taken into due consideration in the evaluation.

Figure 24 describes the conditions for assessing manual pushing and pulling tasks as acceptable. The conditions in **Figure 24** must all be met (together with the previous ones in Figure 23) to conclude that the situation is *code green*.

The perceived effort (ascertained by interviewing workers using the CR-10 Borg scale):					
ADDITIONAL ORGANISATIONAL AND ENVIROMENTAL RISK FACTORS TO BE CONSIDERED					
Is the working environment unfavorable for pushing or pulling?					
Are floor surfaces slippery, unstable, uneven, sloping, fissured, cracked or broken?	No			**Yes**	
Are paths restricted or constrained?	No			**Yes**	
Are temperatures in the working environment high?	No			**Yes**	
Is the object unsuitable for pushing or pulling?					
Does the object (or trolley, transpallet, etc.) limit the vision of the operator or hinder movement?	No			**Yes**	
Is the object unstable?	No			**Yes**	
Does the object (or trolley, transpallet, etc.) have hazardous features, sharp surfaces, projections etc. that may injure the operator?	No			**Yes**	
Are the wheels or casters worn, broken or not properly maintained?	No			**Yes**	
Are the wheels or casters unsuitable for the working conditions?	No			**Yes**	

Figure 3.23 - Quick assessment of manual pushing or pulling risk: preliminary evaluation of certain unfavorable characteristics of the work organization, environment and objects carried.

ACCEPTABLE CONDITIONS If all underreported conditions are fulfilled and all replies are "**YES**", the risk level is acceptable for pushing/pulling tasks. However, it is advisable to check for additional risk factors (see above). **NB. Reply by placing an X in the appropriate white box**					
The perceived effort (ascertained by interviewing workers using the CR-10 Borg scale) shows the presence, during pushing-pulling tasks, of up to SLIGHT force exertion (score 2 or less on the Borg CR-10 scale)?	No			**Yes**	
Does the task involving manual pushing or pulling for up to 8 hours a day?	No			**Yes**	
Is pushing-pulling force applied to the object between hip and mid-chest height?.	No			**Yes**	
Is the pushing-pulling action performed with an upright trunk (not twisted or bent)?	No			**Yes**	
Are the hands held between shoulder width and in front of the body?	No			**Yes**	

Figure 24 - Quick assessment of manual pushing or pulling risk: pre-defined scenarios for determining the presence of acceptable risk conditions: *code green.*

Figure 25 shows a series of conditions where, if even only one of the replies is positive, the manual pulling or pushing task can be defined as critical, regardless of which complex assessment method is used as recommended in ISO 11228-2 (ISO, 2007) and ISO/TR 12295 - Annex B).

It should be noted that the quick assessment of manual pushing and pulling involves the use of the Borg scale (version CR-10) to estimate the important parameter of intensity of effort (or force).

When the level on the Borg scale is equal to or less than one (slight force), the conditions may be acceptable, whilst if the level is equal to or more than 8, the conditions are definitely critical. For intermediate levels (between 3 and 7), the percentage of effort is classified based on a set of percentage ranges.

This new shared but simpler approach was introduced to avoid having to perform measurements using a dynamometer during manual pushing or pulling actions.

CRITICAL CONDITIONS if even only one of the situations listed below is present, risk should be considered as high and the task must be redesigned immediately					
Does the perceived effort on the CR-10 Borg scale (obtained by interviewing the workers), indicate the presence of high peaks of force (i.e. a score of 8 or more on the Borg CR-10 scale)?	No			**Yes**	
Is the pushing-pulling action performed with the trunk significantly bent or twisted?	No			**Yes**	
Is the pushing-pulling action performed in a jerky manner or in an uncontrolled way?	No			**Yes**	
Are the hands held either beyond shoulder width or not in front of the body?	No			**Yes**	
Are the hands held higher than 150 cm or lower than 60 cm?	No			**Yes**	
Does the pushing-pulling action also feature vertical force components (“partial lifting”)?	No			**Yes**	
Does the manual pushing-pulling task last for more than 8 hours a day?	No			**Yes**	

Figure 25 - Quick assessment of manual pushing or pulling risk: pre-defined scenarios for determining the presence of high risk conditions: *Critical code* (purple light)

e) Description and initial inspection of chemical pollutants

Figure 3.26 presents a descriptive diagram for describing potential chemical pollutants: it suggests beginning by looking at the "technical specifications” on the label, indicated with letters or pictograms.

Once the presence of the chemical has been recognized and classified (qualitative data), the description is completed with the relevant quantitative data (**Figure 27**). The type of exposure may be: closed-cycle, controlled-cycle or involving direct handling. The frequency of exposure will be reported as *sporadic*, short but daily, *high and daily*.

With regard to the “concealed scores”, descriptive scores are attributed from the highest risk products to the lowest risk products. The scores are also adjusted to the quantitative degree of exposure.

It should be noted that as per the original approach, the questionnaire aims to measure exposure to chemicals or particulates by essential elements.

2.5 Summary results of pre-mapping

The results of the pre-mapping exercises carried out via key enters and quick assessments can also be summarized graphically to more comprehensively define the "PRE-MAP" and corrective action priorities. The software described previously and duly programmed, generates this summary automatically.

Figure 28 shows an example of a summary of the results obtained from "pre-mapping" a group of stonemasons who work serpentine, a stone typical of northern Italy's Valtellina region, which is a costly cladding and roofing material.

The homogeneous group is comprised of five workers who all perform the same tasks in the shift. They do not work in a mine but in a small, old-fashioned workshop; the blocks of stone (weighing from 25 to 50 kg) are left outside the workshop after being extracted from the mine.

	QUALI- QUANTITATIVE IDENTIFICATION OF PRESENT CHEMICAL AGENTS OR AGENTS GENERATED IN PROCESSING																		
	HEALTH RISKS FROM ACUTE EXPOSURE						HEALTH RISKS FROM CHRONICAL EXPOSURE					RISKS FOR SAFETY							
	EXTREMELY HIGH	HIGH		MEDIUM	LOW	SENSITIZATION RISK	EXTREMELY HIGH	HIGH	MEDIUM	LOW	SENZITIZATION RISK	EXTREMELY HIGH			HIGH		MEDIUM	LOW	
	VERY TOXIC	TOXIC	CORROSIVE	HARMFUL	IRRITATING	SENSITIZING	CANCEROGENIC; MUTAGENIC; REPRODUCTIVE CYCLE RISK; TERATOGENIC	CANCEROGENIC; MUTAGENIC; REPRODUCTIVE CYCLE RISK; TERATOGENIC; TOXIC	TOXIC	IRRITATING	SENSITIZING	EXPLOSION	EXTREMELY INFLAMABLE	COMBUSTIVE	EASILY INFLAMABLE	EXPLOSION	INFLAMABLE	HIGH INFLAMABILITY POINT (I.E >70°)
	H300 H310 H330	H301 H311 H331	H314 H318	H302 H312 H332	H315 H319 H335	H317 H334	H340 H350 H360	H341 H351 H361 H370 H372	H371 H373	H315 H319 H335 OR WITHOUT "H" LABEL	H317 H334	H200 H201 H202 H203 H240 H241	H220 H222 H224 H241 H242 H251 H252	H250	H225 H228	H204	H223 H226 (IN CERTAIN CONDITIONS)	NO LABEL
ACIDS																			
BASES																			
FUELS																			
ORGANIC COMPOUNDS																			
DUSTS																			
GAS FUMES																			
PLASTIC MATERIALS																			
METALLOIDS AND METALS																			
ODIXANTS																			
PESTICIDES																			
SOLVENTS								x											

Figure 26 – Descriptive diagram of potential pollutants

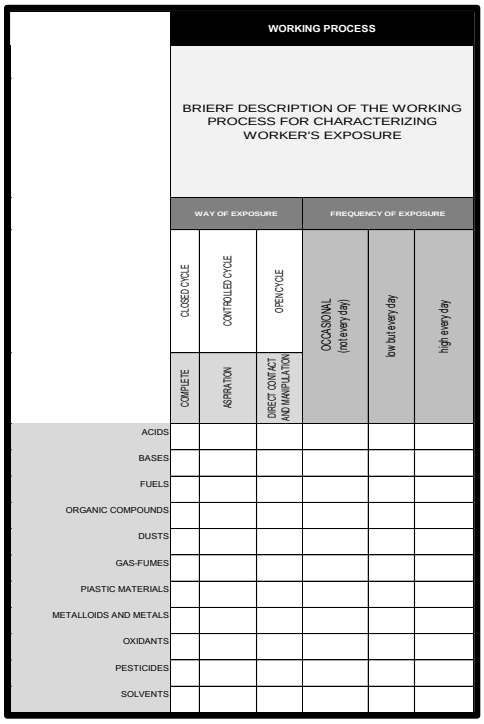

Figure 27 – Descriptive diagram of potential pollutants: descriptive quantification of exposure

Manual transpallets are used to transport the blocks into the workshop where the workers use manual tools, especially sledgehammers and chisels, to produce luxurious tiles (serpentine is a very valuable stone). The larger blocks are broken down into smaller ones, weighing between 10 and 20-25 kg, which are generally handled manually. To reduce the blocks into tiles, the cuts have to follow the natural crystallization of the stone. This is a job that requires great skill and expertise. The stone is a silicate and in the quarry, serpentine may be found close to asbestos veins. In the above example, a homogeneous group of workers performs several tasks, from transporting stone with transpallets, to carrying them manually, and cutting the stone (**Figure 29**). However, just one pre-mapping form must be compiled: the questionnaire is not for the entire company or for a single task, but should be used to describe a complete task performed by a specific homogeneous group of workers. The work is repetitive and features high risk conditions (critical code), since it entails the use of peak force. Manually lifted loads may weigh more than 25 kg (critical code). There are also problems associated with pushing and pulling manual transpallets, given the uneven ground outside the workshop. Noise and the micro-climate are generally also a problem; the tools are obsolete and could cause accidents or injuries. There is silica dust (and possibly also asbestos), although manual sledgehammers are used to split the stone rather than grinders. The workshop has no dust aspirators.

Figure 28 shows the final summary results generated automatically by the software, depicting histograms for all possible risks.

The height of each histogram derives from the percentages resulting from the equation:

$$(PI_i/PM_i)*100$$

where

PI i = intrinsic score for the risk inducer deriving from the sum of the scores attributed to the individual parameters describing it and emerging from the analysis.

PMi = pre-defined maximum inducer score

As already stated in the paragraph on methods, these are merely descriptive scores, to be used to "rank" events from the best to the worst. The scores do not reflect an analysis or assessment of risk: they are simply descriptive scales designed to help not only identify problems but also set priorities for the analyses and evaluations that will have to be undertaken to adopt immediate measures to reduce risk, especially for conditions defined as "critical".

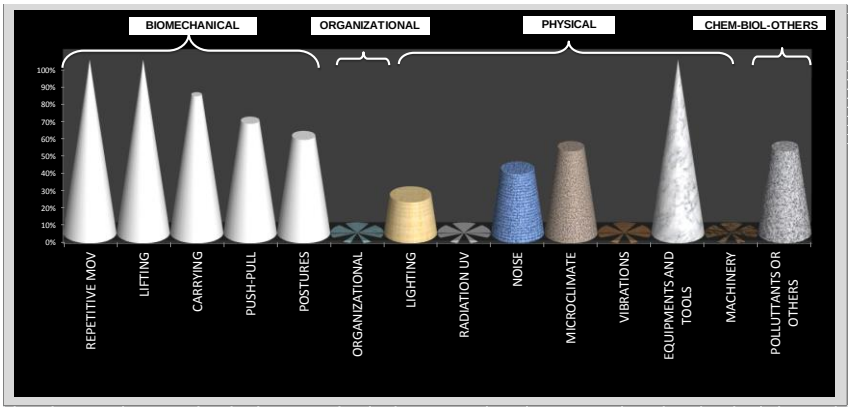

Figure 28 – Final summary results depicted as histograms for all potential risks: example of a homogeneous group of stonemasons splitting serpentine rock (silicate) in a workshop.

Figure 3.29 – Splitting serpentine rock

2.6 Examples of pre-mapping results

This paragraph shows examples of preliminary results obtained by applying the proposed model in just a few of the innumerable small businesses covered by the investigation.

Additional analyses and details can be found in Volume 102, nr. 1, 2011, of *"La Medicina del Lavoro".*

Pasta makers: manual preparation of fresh tagliatelle

The work is performed for 3-4 hours a day in a chain of small fresh pasta-making stores. **Figure 30** shows a part of the activity, and **Figure 31** shows the summary results of the relative pre-mapping exercise.

Figure 30- Steps in the manual preparation of fresh tagliatelle

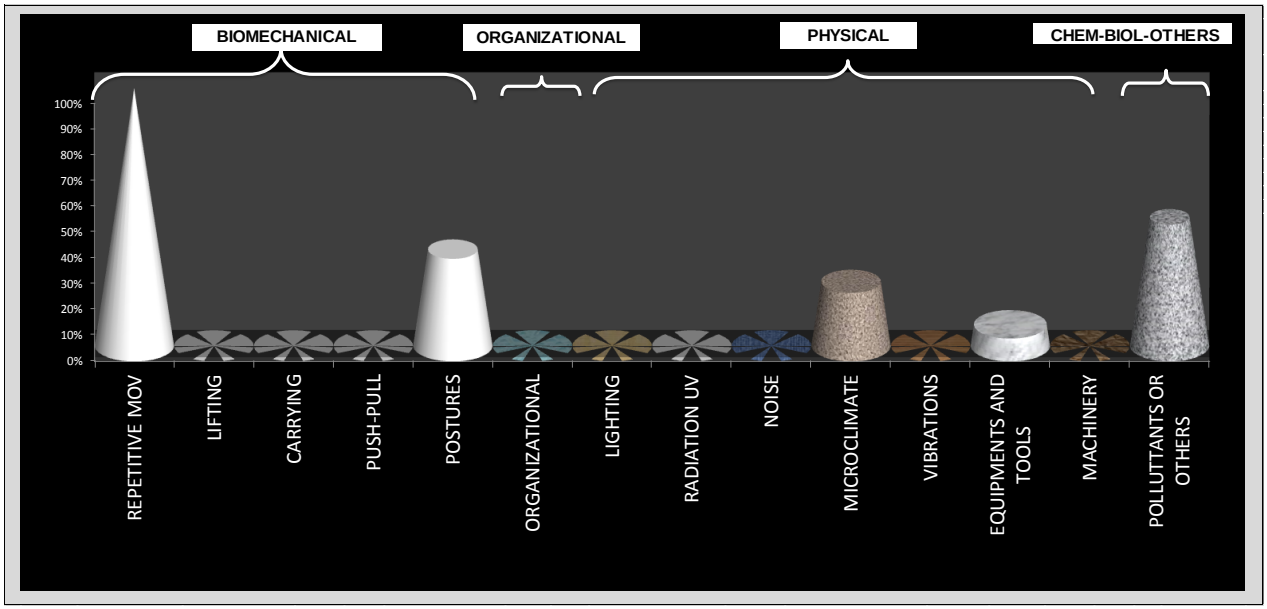

Figure 31- Results of pre-mapping applied to the manual preparation of fresh tagliatelle

Manufacturing of Parmigiano Reggiano cheese

This work is carried out by craftsmen even in the largest cheese making factories.

The most strenuous tasks involve lifting the curd mass, or "twins", from the vat, changing the cloth wraps and positioning the forms in brine (**Figure 32**). Before maturing, the forms weigh around 40 kg.

Figure 32 – Steps in the processing of Parmigiano Reggiano cheese

Figure 33 shows the results of pre-mapping applied to the manual processing of Parmigiano Reggiano cheese.

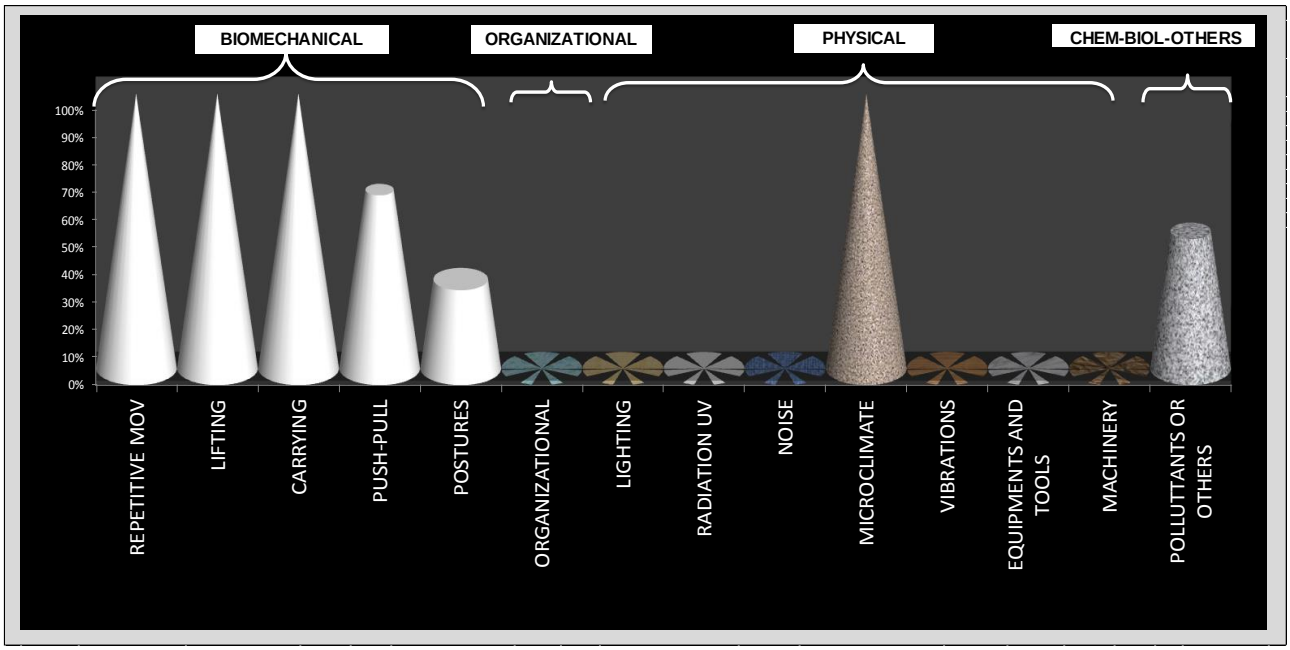

Figure 33 - Results of pre-mapping applied to the manual processing of Parmigiano Reggiano cheese.

Manual manufacture of piano accordions (mechanical parts)

The manufacturing process involves fitting mechanical parts to the lacquered wood frame of the piano accordion. The manual mechanical assembly work is meticulous and involves the use of small tools. Each worker performs a specific finishing task. The instruments (weighing between 5 and 10 kg) are carried manually from one work bench to the next (**Figure 34**).

Figure 34 – Steps in the mechanical assembly of hand-made piano accordions (Pigini, Castelfidardo)

Figure 3.35 shows the results of pre-mapping in the production of hand-crafted piano accordions.

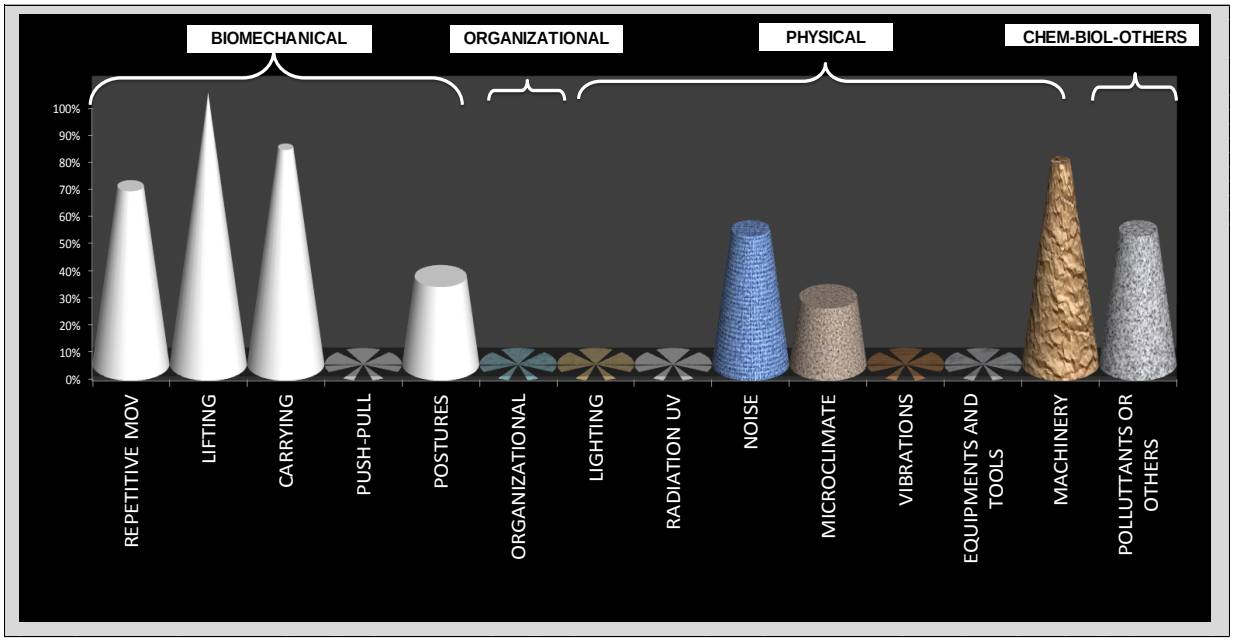

Figure 3.35 - Results of pre-mapping in the production of hand-crafted piano accordions.

Manually decorated stoneware

This work includes enamelling and painting.

Enameling involves using a set of tweezers to manually dip the kiln-fired ceramic parts into an enamel bath; to decorate, the operator is seated and uses a brush to paint each individual piece. The task must be performed confidently and precisely, since errors are not allowed (**Figure 36**).

Figure 36 – Enameling and decoration of artistic stoneware

Figure 37 shows the results of pre-mapping in the production of hand-decorated stoneware.

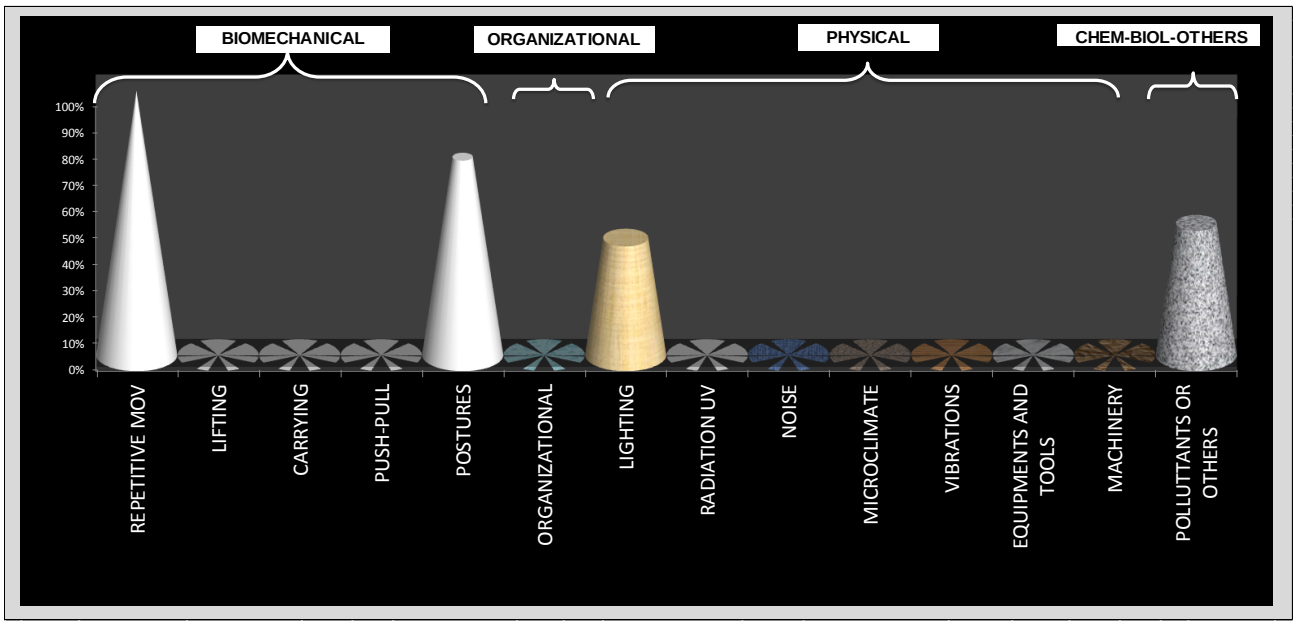

Figure 37 – Results of pre-mapping in the enameling and decoration of artistic stoneware.