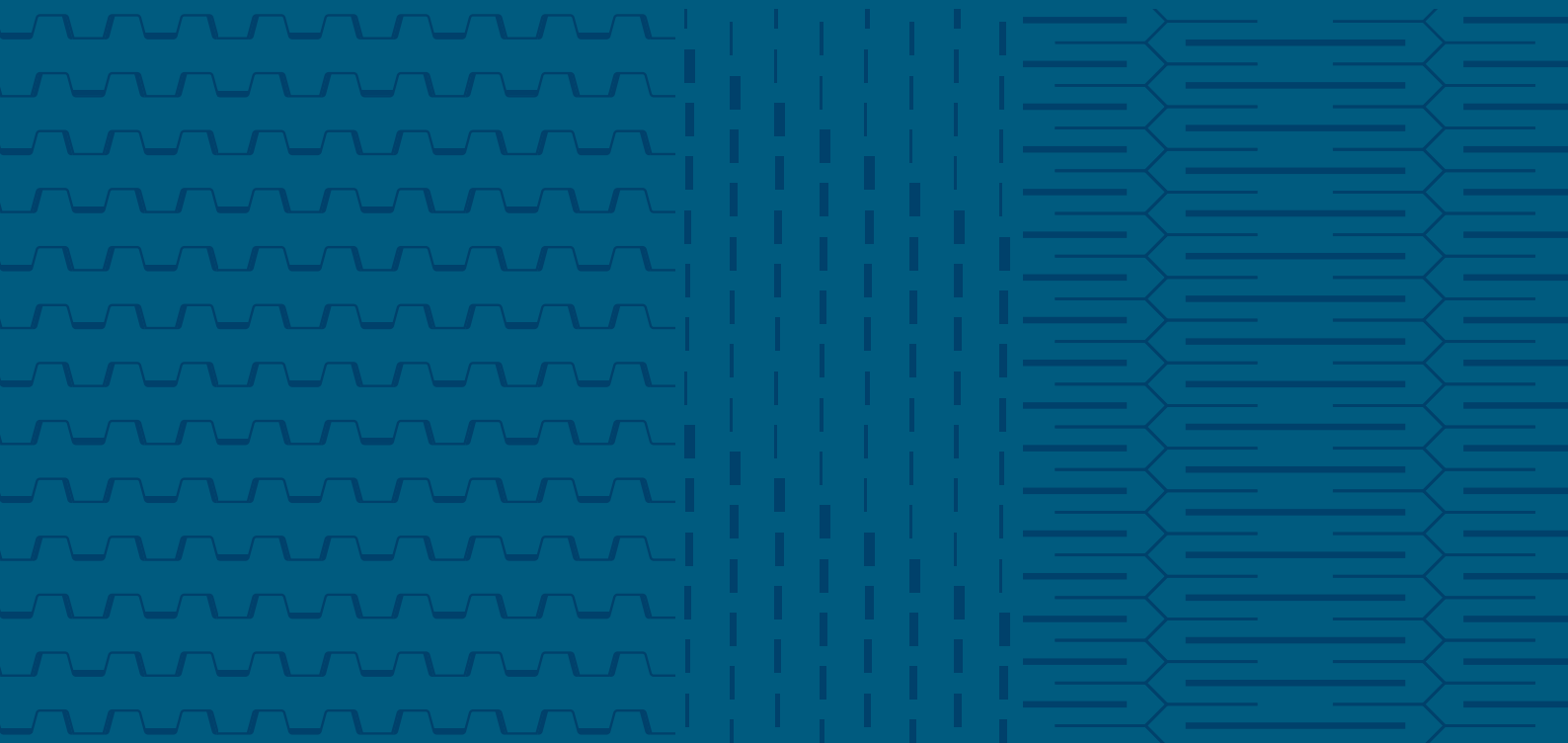
AMPC

AUSTRALIAN MEAT PROCESSOR CORPORATION

Evaluation and implementation of exoskeletons

Five step guideline



What is an exoskeleton and why might it be good for my business?

Exoskeletons are worn by a person to provide posture, movement and force assistance. They include things like a splint which can hold a joint in a particular position, a glove that can accentuate grip and holding forces, or structures to support the neck, lower back, shoulders, hips or knees.

There are even shoe technologies that deliver energy back to a person during movement. The types of tasks that exoskeletons could support in processor plants include those requiring:

1. Sustained and/or awkward postures
2. Repetitive movements that may be awkward or exceed a low range of joint movement, in particular movements of the hands/wrists, shoulders and back
3. Gripping tools or parts of a carcase or packaged products to process and handle them
4. Limited variation from physical demands.

Ergosante Hapo Front

Hilti Exo01/Ottobock Shoulder

How exoskeletons work

Exoskeletons don't usually provide the movement for a person, but instead assist and enhance the movements a person makes or helps them to sustain a posture.

The level of assistance provided depends on the design of its assistive mechanisms, how it is powered and the level of adjustment available and set by the wearer.

There are two main types of exoskeleton:

Active exoskeletons

have an external power source (usually batteries).

Passive exoskeletons

use levers, springs, elastic cords or rubber straps to absorb energy when the person moves the supported joints away from a neutral position. These passive devices either hold this tension to help maintain a posture within the range provided by the device, or they give this energy back though the device to assist the wearer to move.

Leg Exoskeleton — Active

Suit X Leg X

Neck Exoskeleton — Passive

Ottobock Paxeo Neck

Thumb Exoskeleton — Passive

Ottobock Paxeo Thumb

How do I choose the right exoskeleton tech for my business?

AMPC has developed a five-step process that can be used across the red meat processing industry for the identification, evaluation and possible implementation of exoskeletons.

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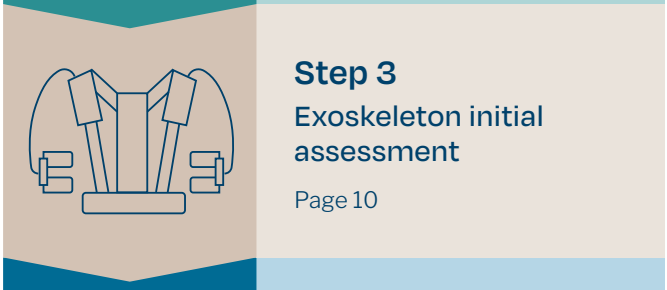

Step 3
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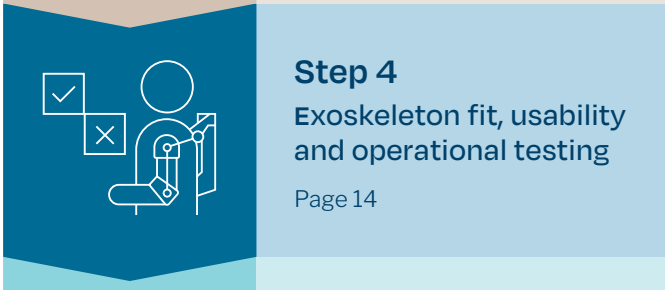

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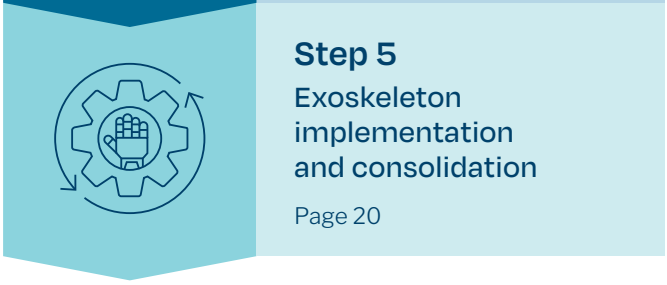

Step 5
Exoskeleton implementation and consolidation

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Need more help?

These guidelines should assist meat processors to consider and address the broad range of issues that may impact the implementation of exoskeleton devices. The functionality is just one of many factors to be considered. How easy a device is to put on, take off, clean and maintain, is also critical.

When introducing a new assistive device into the workplace, an ongoing process to monitor and review its performance over time is essential. This is because there is no or only limited long term case studies or experience of their use, available for reference. A good relationship with the manufacturer/distributor is vital to enable processors to provide feedback and for these providers to continue to learn about industry needs and keep processors up to date with advances.

To see the full report on AMPC's evaluation and implementation of exoskeletons, go to our website.

Step 1

Manufacturer/distributor evaluation

Given the novel nature and often unproven functionality and impact of devices, a thorough due diligence assessment of the manufacturers and/or distributors is essential to underpin investment in these technologies.

We recommend gathering the following information to enable informed decision making on the ability of a manufacturer/distributor to supply and support their device.

1 Manufacturer/distributor background

- ☐ Location and general information about the manufacturer/distributor.
- ☐ Current presence and experience within the exoskeleton industry.

2 Current and planned presence in Australia

- ☐ Which regions and countries do they currently operate within?
- ☐ Does the manufacturer/distributor currently supply devices into Australia?
  - If yes, describe their current distribution arrangements.
  - If no, are there plans to supply devices into Australia? If yes, describe the planned distribution arrangements, where they will be based and planned service model. If no, consider whether the use of the device is likely to be viable without manufacturer/distributor presence within Australia.
- ☐ For distributors:
  - Are they distributing this device in other regions or countries?
  - Do they have other devices or services that may be relevant to the meat processing industry? If so, provide details.

3 Device types and range

- ☐ What devices does the manufacturer/distributor currently offer in Australia?
- ☐ What body locations do these devices assist and how do they work?
- ☐ How long have the current versions of these devices been available?
- ☐ Are any upgrades or new models due in the near future?
- ☐ Are/will the devices and services provided into Australia be the same as those provided in other regions and countries? If no, what will be different and why?
- ☐ Are there other current or emerging devices that may fit within, and be of use to, the meat processing industry?
- ☐ What categories are the devices currently, or soon to be, available (active or passive/soft or rigid)?

4 Evidence to support fit and device functionality claims

- ☐ Can the manufacturer/distributor provide any evidence to support their claims of the functionality and effectiveness of their current or emerging devices?
  - If yes, provide these.
  - If no, are any studies or assessments planned?
- ☐ Can the manufacturer/distributor provide any evidence to demonstrate the quoted fit size and adjustment range to optimise comfort and functionality of their device(s) for wearers?
  - If yes, provide these.
  - If no, are any studies or assessments planned?
- ☐ Can the manufacturer/distributor provide information on how all components of their device(s) can be cleaned and washed after use, to the requirements of the meat processing industry?
- ☐ Can the manufacturer/distributor provide any other information about their device(s) to assist in their evaluation? If yes, provide this information.

5 Experience with the same or like industries

- ☐ Have or does the manufacturer/distributor provide these devices and support services into the same or similar industries in the regions and countries they are present?
  - If yes, can they provide the details of, and introduction to, other meat processors that are currently using their devices in any of these locations? What have been the successes and biggest challenges for processors using the device(s) provided?
- ☐ Are these customers still using these devices? If not, provide details as to why.
- ☐ What is the expected life of a device in the meat processing environment?
- ☐ What is the uptake and current use of their device(s) in other industries?

6 Supporting the evaluation, uptake, testing and implementation of their devices

- ☐ What approach do they take when first introducing one or more exoskeletons into a processing facility?
- ☐ Do they provide devices for testing and evaluation?
  - If yes, what are the conditions and details?
  - If no, are there any alternatives to purchasing a device that will enable it to be evaluated for possible use.
- ☐ Do they have guidelines, training, information and instruction to support the progressive uptake of their devices to enable employees to build up their familiarity and tolerance in using them? If yes, provide details.
- ☐ Can or do they provide assistance in matching device capability to the different jobs performed across the meat processing industry?

7 Determining how to best protect worn devices during use

- ☐ What methods would the manufacturer/distributor recommend to protect the device when used within meat processing environments?
- ☐ Does the manufacturer/distributor have experience in using these types of protection? If yes, provide details.
- ☐ Can they provide any examples of protective clothing (PPC), or equipment (PPE) used to protect their device(s)? If yes, provide details.
- ☐ Have any risk assessments been conducted to ensure that wearing of protective clothing or equipment does not introduce secondary hazards in meat processing environments? If yes, provide details. If no, the processor may need to conduct this risk assessment.

8 Providing post implementation support

- ☐ What measures does the manufacturer/distributor take to provide post-purchase and implementation support for their devices?
- ☐ Does the manufacturer/distributor maintain adequate stock to minimise downtime if a device breaks or becomes unusable? What timeframe can be expected to provide new devices or replacement parts?
- ☐ Are the devices covered by a warranty and what are the details of that coverage?

9 Cost competitiveness of devices

- ☐ What is the current price range to purchase these devices?
- ☐ Are there charges for service and support or are these included in the purchase price?
- ☐ Are pricing comparisons with competing like devices available?

Step 1 — Decision

Is further investment in working with the manufacturer/distributor to identify and test possible exoskeletons worthwhile?

YES
Proceed to Step 2

NO
Determine if supplier can overcome any concerns, or cease engagement

Step 2

Meat processing industry criteria

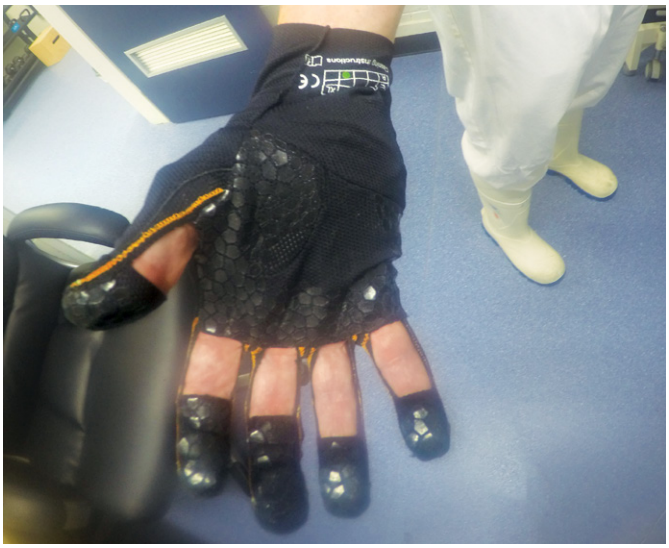
The following considerations should enable a meat processing facility to evaluate exoskeletons against inherent requirements of the industry.

These criteria are not exhaustive, and processors should add their own as they become apparent.

Note: AMPC has found that combinations of soft components and passive design are more likely to be useable within meat processing. However, the combination of soft and active has appeal, particularly where the device can also measure its function and provide data on its use.

1 Device name, details and type

- ☐ Device name
- ☐ Body locations assisted
- ☐ Description of claimed device activation
- ☐ Device category:
  - Soft (and flexible) or rigid
  - Active or passive activation power



Bioservo Ironhand

2 Device features and likely appeal to the meat processing industry

- ☐ What does the device do to assist the person wearing it (i.e. what are the assistance features and how do they work)?
- ☐ Is the assistance device likely to be too complicated for use in meat processing environments? Why?
- ☐ Are the device adjustment and assistance controls likely to be too awkward to use within the meat processing environment? Describe why (e.g. *difficult to activate small control levers with a gloved hand, PPC worn may cover control devices over the top, performance of repetitive and short work cycles with limited breaks may limit options to adjust the device fit or activation.*)
- ☐ Note the work areas and jobs most likely to be suited to the use of this device. For each meat processing job selected, confirm that the device assistance features align with the physical demands of the job. This may require an assessment of these physical demands.
  - Yards (outdoor)
  - Production areas (slaughter floor)
  - Offal processing
  - Skin processing
  - Chillers
  - Processing areas (boning and slicing)
  - Bagging and packing areas
  - Value added areas
  - Carton processing (load out)
  - Blast freezers
  - Loading transportation vehicles (cartons and carcases)
  - Facility maintenance
  - Facility and area cleaning
  - Other areas

3 Fit range to accommodate likely wearers

- ☐ Can the manufacturer/distributor provide details about their sizing range and any limitations of fit that may occur with people due to their body size (e.g. *height, girth, foot or hand size*)?
  - If this information is available, is this sizing range likely to fit a sufficient range of employees at the meat processor who are likely to wear this device?
  - If this information is not available, this device may not be suitable for further testing.

4 Device protection, cleaning and maintenance

- ☐ Will the device wearer need additional personal protective clothing (PPC) or equipment (PPE) to create a shield or barrier to reduce exposure to blood, water and other contaminants and the risk of cross contamination?
  - If yes, define the recommended PPC/PPE
  - If this is not available, the type of PPC/PPE likely to be most effective, how it works to protect the device and where it can be purchased.
- ☐ Describe how the device will be cleaned after use in the meat processing environment.
- ☐ Will this be satisfactory to clean all hard and soft components to the required standard on a daily basis?
  - If yes, the device may be suitable for use within a meat processing environment.
  - If no, this device may not be suitable for use in the areas that require this level of hygiene.
- ☐ Describe how the device will be maintained on a daily and periodic basis (include daily charging of batteries, or adjustment of settings to a defined level before the device is used).

5 Implications or limitations of use in meat processing environments

- ☐ Define the work environments where this device is likely to be used. Select all appropriate options.
  - Wet (direct exposure to water)
  - Humid/moist
  - Exposure to blood, fat and body tissue
  - Cool temperatures (2 to 8 degrees Celsius)
  - Extremely cold temperatures (< minus 20 degrees Celsius)
  - Extremely hot external environments (outdoor)
  - Exposure to dusty environments (outdoor)
- ☐ Has the device been used in these environmental extremes before? If yes, provide details of successes and any failures.
- ☐ Will the device consistently operate, be comfortable for wearers, and be durable in these environments?

6 Food safety and commercial risks

- ☐ Is there a risk of small components becoming free and dropping onto product during processing or into product containers and causing contamination?
- ☐ Are there any other features of the device(s) that may compromise produce and food safety?
- ☐ Provide a detailed assessment of the device to identify any potential risks of it being used in this environment.

7 Possible secondary hazards for users and others

- ☐ Will the wearing and use of this device and any required PPC/PPE in a meat processing facility create any secondary hazards or risks for:
  - The user
  - Others working near them
  - The job being performed
  - Those required to clean and maintain the device

  If yes to any of these, provide details of the hazard(s) and whether and how they can be eliminated or effectively controlled. If they cannot be eliminated or controlled, this device may not be suitable for further consideration or testing.

Step 2 — Decision

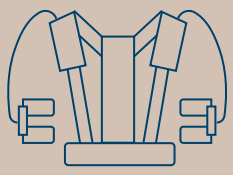
Based on the outcomes of the above assessments, is further investment in working with the manufacturer/distributor to identify and test possible exoskeletons worthwhile?

YES
Proceed to Step 3

NO
Determine if supplier can overcome any concerns, or cease engagement

Step 3

Exoskeleton initial assessment



The next step in the evaluation process focuses on whether the device can be comfortably fitted to the wide range of body sizes and shapes within the meat industry, what the device does to enhance a person's capability to perform manual red meat processing tasks and whether secondary hazards are likely to be present when wearing or handling the device.

The assessment criteria for Step 3 — initial evaluation of an exoskeleton identified as possibly being beneficial for the meat processing industry include:

1 Detailed understanding of the exoskeleton being considered

- ☐ Describe in detail the components of the device, relative to its fit and adjustment on the wearer as well as the features and functions of its components that anchor the device to the person's body and extend across it to provide assistance for postures and movements:
  - The components that hold the device on the wearer's body (e.g. straps, cuffs, pads etc).
  - How the device is prepared for fitment to the wearer, how it is put on by the wearer, adjusted for optimum fit and removed after use.
  - The components that provide assistance to the wearer (e.g. springs, tensioned straps or cords, cables or small motors/mechanical devices).
  - The assistance provided by the device, how the assistance components work, the ranges of movement over which they operate and how the level(s) of assistance can be adjusted to increase or lower their impact.
- ☐ Confirm whether the assistance device is likely to be too complicated for use in meat processing environments. Describe why.
- ☐ Confirm whether the device adjustment and assistance controls are likely to be too awkward to use within the meat processing environment. Describe why — e.g. difficult to activate small control levers with a gloved hand, PPC worn may cover control devices over the top, performance of repetitive and short work cycles with limited breaks may limit options to adjust the device fit or activation.
- ☐ Confirm that any powered devices have a quick shut off feature that is readily accessible and usable for the wearer and co-workers or supervisors working near them.

2 Evidence to support device functionality claims

- ☐ Can the manufacturer/distributor provide any evidence or information to support their claims of the functionality and effectiveness of their current or emerging devices?
  - If yes, it should be provided.
  - If no, what is the basis of their claims and are any studies or assessments planned?
- ☐ Gather any additional information to help in the evaluation of their device.
- ☐ Gather information about other meat processors that have used or are currently using this device. If available, include information plus contact details.

3 Confirm meat processing jobs targeted and expected outcomes for use of the device

- ☐ Confirm the jobs that appear to be most suitable for testing the device, within the nominated work areas.
  - Yards (outdoor)
  - Production areas (slaughter floor)
  - Offal processing
  - Skin processing
  - Chillers
  - Processing areas (boning and slicing)
  - Bagging and packing areas
  - Value added areas
  - Carton processing (load out)
  - Blast freezers
  - Loading transportation vehicles (cartons and carcases)
  - Facility maintenance
  - Facility and area cleaning
  - Other areas
- ☐ Has an assessment of the physical demands of these jobs been conducted to define the postures, movements, force used and their duration and frequency to confirm that the device may be a suitable match?

- ☐ Do the device assistance features align with the physical demands of the targeted jobs?
  - If yes, describe the jobs most likely to be suited to use of this device.
  - If no, describe why.
- ☐ Has a risk assessment of these jobs been conducted?
- ☐ Is use of this exoskeleton likely to be more suitable than design based (or other) improvements?
  - If yes, describe why an exoskeleton may be the most suitable short to medium option.
  - If no, describe what design improvements should be put in place instead.

4 Confirm fit range and anticipated comfort

- ☐ Can the device manufacturer/distributor provide details about their sizing range and limitations of fit? If this information is available, will this sizing range fit the employees at the meat processor who are likely to wear this device? If this information is not available, this device may not be suitable for further testing.
- ☐ Is there any bias toward or against gender with regard to fit and adjustment? Provide details.
- ☐ Is the device likely to fit a sufficient range of the anticipated population of users? If no, provide details.
- ☐ Do pads and straps appear to be a sufficient size to distribute load across the wearer's body? If no, provide details.
- ☐ Do any parts of the device appear to present a risk of placing excessive pressure on the wearer's body? If yes, provide details.
- ☐ Are there any unusual requirements to prepare the device for putting it on? If yes, describe them.
- ☐ Can the device be safely put on by the wearer without assistance? If no, explain why.
- ☐ Can the fit of the device be easily adjusted by the wearer once on, to fine tune its fit, without assistance? If no, explain why.
- ☐ Will the device be worn under or over existing PPC?
- ☐ If worn under the wearer's clothing and PPC, will this inhibit access to and operation of the device? If yes, describe these details and any strategies that might be used to overcome them.
- ☐ Will additional PPC need to be worn over the device to protect it? If yes, describe any additional PPC items and where they can be purchased if they are not already in use at the plant.
- ☐ Will wearing the device result in any compromise to existing PPC requirement? If yes, describe any strategies that might be used to overcome this.
- ☐ Can the device be safely removed by the wearer without assistance? If no, describe why.
- ☐ Are there any unusual requirements to prepare the device for removal or when removing it? If yes, describe them.

Ironhand glove (soft/active) and bodypack when fitted. Bioservo Ironhand

5 Device assistance function, how it is adjusted and the anticipated benefits

- ☐ Does the adjustment control appear to be easily accessed by the wearer? If no, why?
- ☐ Does the adjustment control appear to be easily operated used by the wearer? If no, why?
  - Is the wearer's PPC likely to reduce access to the controls and/or the ability of the wearer to manipulate them? If yes, describe why:
    - i. Describe the details and whether and how this can be overcome.
    - ii. Will this limit the ability of the wearer to be able to wear and use this device?
- ☐ Do the controls appear to provide sufficient feedback to the wearer of the adjustment(s) made? If no:
  - Describe the details and whether/how this can be overcome.
  - Will this limit the ability of the wearer to be able to wear and use this device?
- ☐ For active devices that use a battery or other power source:
  - What is the expected operational duration per battery?
  - Will the wearer be able to change the battery during their main break, rather than having to change it while working?
  - Is the method of changing the battery or batteries straightforward? If no, will this limit the ability of the wearer to be able to wear and use this device?

6 Device data gathering and analysis about its function and use

- ☐ Does the device provide data on its function and use? If yes, describe how data is gathered, the data that is collected and how this can be used in operational testing.
- ☐ Does the manufacturer provide data collation, analysis, storage and presentation features for this data? If yes, describe in detail, and how this can be used to assist operational testing.
- ☐ Can data about an individual be de-identified so it can be used to describe device utilisation but does not reveal the identity of the wearer. If yes, describe how this is done.
- ☐ How will these data be stored to maintain this confidentiality?
- ☐ Is employee consent required for the collection, storage and use of data that originates from the device that they will be wearing? If yes, describe in detail, including the parameters of this consent (i.e. any limitations as to how the data can be used).

7 Identify and assess any apparent hazards or risks

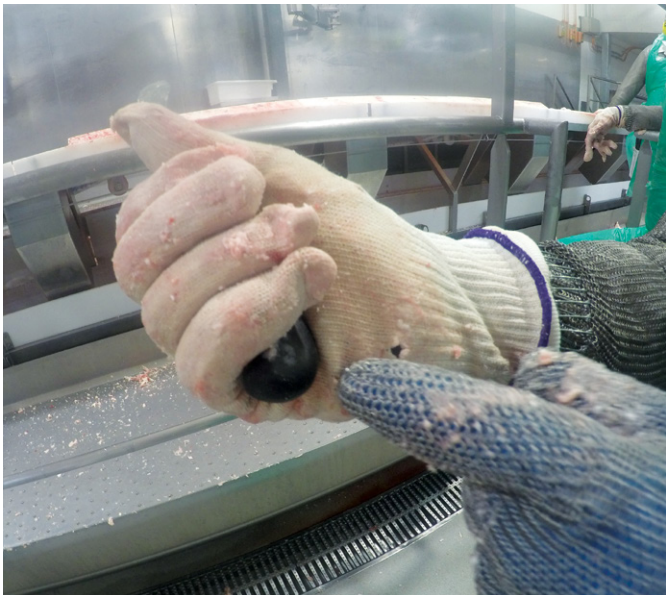
- ☐ Describe any possible hazards or risks related to the use of this device for the wearer and those working near them.
- ☐ Describe any possible hazards and risks related to the cleaning and maintenance of this device.

8 Confirm how the device will be protected during use

- ☐ Describe any methods the manufacturer/distributor has recommended to protect the device when used within meat processing environments.
- ☐ Does the manufacturer/distributor have experience in using these types of protection? If yes, provide details.
- ☐ Can they provide any examples of protective clothing or equipment used to protect their device(s)?
- ☐ What follow up is needed to ensure that adequate device protection will be available for operational testing.
- ☐ Have any risk assessments been conducted to ensure that wearing of protective clothing or equipment does not introduce secondary hazards in meat processing environments? If yes, provide details.

9 Confirm how the device will be cleaned after use

- ☐ Are any activities required to prepare the device for cleaning? If yes, describe these.
- ☐ Are there any special methods of cleaning the device, such as using a bag to contain it when placed into a washing machine? If yes, describe them.
- ☐ Describe in detail the process that will be used to clean the device, so it is ready for the operator on their next working day. For example:
  - Is the wearer required to prepare the device for cleaning?
  - Where will the device be deposited for cleaning?
  - How will the device be cleaned?
- ☐ Will the cleaners be required to reassemble the device after cleaning to ensure that it is ready for use?
  - If no, who will do this and where will it be done so the device is always read for next day use?
- ☐ Where will the device be placed so it is ready for use by the wearer on their next working day?



Ironhand glove when fitted and protected in a boning room. Bioservo Ironhand

10 Confirm how the device will be maintained

☐ Describe in detail the process that will need to be used to maintain the device on a daily, weekly and monthly basis. For example:

- For active devices, who is required to recharge any batteries, so they are fully charged for their next working day?
- Where will charging occur?
- Where will batteries be placed so they are ready for use by the wearer on their next working day?
- Is an additional supply of charged batteries required to ensure that power supply is always available? If yes, who will be responsible for this and where will they be charged and stored.
- What checking of the components of the device is required to ensure that it is safe to use?
- What will the process be to replace damaged or broken components?
- Will this prevent the device from being worn if repair is required?

Step 3 — Decision

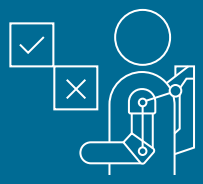
Based on the outcomes of the Step 3 assessment above, is the device being assessed suitable for further testing (Step 4)?

YES
Proceed to Step 4

NO
Determine if supplier can overcome any concerns, or cease engagement

Step 4

Exoskeleton fit, usability and operational testing



At this stage, one or more devices should be emerging as likely to be suited for use in the plant.

The next step is practical testing in the workplace to determine whether to proceed to full implementation. Manufacturers will often be able to supply a test unit, or AMPC may be able to assist.

1 Preparation for operational testing of the device

- ☐ Establish an exoskeleton evaluation project co-ordinator (if one hasn't already been chosen).
- ☐ Confirm the jobs for which testing of the exoskeleton will be conducted.
- ☐ Confirm the suitability of using an exoskeleton to reduce physical work demands for these jobs (via any previous assessment).
- ☐ Procure the required number of devices for testing.
- ☐ Establish the operational testing timeframe for the following sequence of activities:
  - Preparation
  - Familiarisation and training
  - Initial implementation
  - Ongoing testing
  - Data and feedback gathering
  - Testing evaluation
  - Determination of implementation of the device
- ☐ Identify the participant group who will wear the device for testing (select a representative cross section of employees who perform the targeted jobs, considering skill level and body size representation).
- ☐ Gather information about the device to support training and instruction that should include:
  - Assessment information obtained to date within this five step evaluation process.
  - Training support material from the manufacturer/distributor including: online, printed and video instructions. Develop any additional guidance information if required. For example, whether a "simple" one-page visual guide for donning, adjusting and using the device is to be made available for employees to follow when they first use the device.
- ☐ Confirm if the manufacture/distributor provides on-site training and support and, if so, organise a schedule and the resources for this training.
- ☐ Finalise the operational testing evaluation process and content. This should include:
  - Direct feedback from devices users at any time.
  - Standard feedback surveys for users and other stakeholders, such as supervisors, to complete at set periods within the testing schedule.
  - Quantified data where available. For example, data directly from the device being tested if available.
- ☐ Device protection:
  - Implement strategies for consistent protection of the exoskeleton during all phases of operational testing per the device protection considerations previously described.
  - In addition, also consider:
    i. If the device needs to be protected only during operational use.
    ii. Whether the whole device or only part(s) of it requires protection.
    iii. Will existing PPC be sufficient?
    iv. Will additional PPC or another type of barrier be required?
- ☐ Are there any risks present that may be associated with wearing this protective clothing? If yes, describe these, any risk elimination or mitigation strategies and how it will be safe for the employee to wear protective layers.
- ☐ Device cleaning:
  - Implement strategies for the consistent cleaning of the exoskeleton during all phases of operational testing, per the cleaning considerations previously described.
  - Also, define the specific method for cleaning all soft and rigid components of the device. For example, is a soft wash bag needed when washing soft components, can soft components be washed at high temperatures and what cleaning or disinfectant agent will be used to wipe down rigid components?

- ☐ Device maintenance:
  - Implement strategies for the timely and consistent maintenance of the exoskeleton during all phases of operational testing, per the maintenance considerations previously described.
  - In addition, also consider if the manufacturer specified a method of inspection for maintenance or described maintenance methods for specific components and/or functions and the timeframes for any of these checks. For example, checking wear and tear on cuffs, cables, levers or rigid components that bear highest levels of force.
  - Maintain a record of maintenance checks and any device defects or requirements for maintenance and repair during the testing and evaluation period.
- ☐ Describe the expected daily sequence of use for each device and employee who will wear it and ensure that each of these steps is organised and understood by all stakeholders to optimise the success of the testing process. For jobs performed within production and processing areas, this sequence is likely to include the following tasks and activities:
  - Collect the device from storage after cleaning
  - Don usual PPC/PPE
  - Don the exoskeleton before moving through the washroom unless the device is worn on the employees' hands, to ensure that their hands can be washed. Devices worn on the hands should be donned after the washroom
  - Adjust the device for fit
  - Set device so walking is not inhibited (back and lower limb devices)
  - Don additional device PPC if required (at the appropriate work location)
  - Walk to the washroom
  - Wash hands and boots
  - Walk to the knife preparation area
  - Prepare knives (or other work tools/equipment) for use
  - Don the device and relevant PPC once ready to move to the work area, if not donned before the washroom
  - Walk to the work area
  - Prepare to commence the job in the work area, if required
  - If not already turned on, activate the device assistance so it is ready to use when the job commences.
  - Commence work
  - If moving to another job within a rotation, change the setting according to any instructions
  - Cease work and walk to short breaks as needed, repeating device inhibition if needed, and hand washing and drying procedures. Determine if the device should be removed or remain worn during shorter smoko breaks
  - For the longer meal break, cease work and walk to break room as needed, repeating device inhibition if needed, and hand washing and drying procedures. Consider removing the device for the longer meal break. Note that during initial use of the device, while the duration of daily use is being built up, the wearer may need to take the device off at any of these breaks, until they eventually build up to whole of shift use, or any other defined period of maximum use per day.
  - Cease work at the end of the shift
  - Walk to the change room, repeating device inhibition if needed, and hand washing and drying procedures
  - Remove all PPC
  - Remove the device
  - Prepare the exoskeleton for cleaning per instructions. For example, remove soft or flexible components and place them in a soft bag for washing. Isolate rigid components that will be wiped to clean them
- ☐ Describe the wearer experience in using the device that day, using a brief survey. For example:
  - Was the device comfortable to wear? If no, describe any area(s) of discomfort and how this can be relieved.
  - Did the device work? If no, what can be done better? If yes, what were the perceived benefits?
  - Were there any issues that need to be addressed? What were they and how will they be addressed?
  - Is PPC coverage adequate? If no, what additional protection is required and how will it be organised?
  - Describe (rate) thermal comfort when wearing the device
  - Is the device too bulky when worn?
  - Is the assistance mechanism easily adjusted (up and down)?
- ☐ Deliver the device (components) for cleaning
- ☐ Device storage:
  - Before use — where and how the device is stored after cleaning, ready for use.
  - After use — where and how the device should be delivered after use so it can be cleaned. For example, where is the device reassembled and who will do this.

2 Familiarisation and training

- ☐ Inform participants that wearing the device during testing is voluntary.
- ☐ Provide familiarisation and training sessions to participants and stakeholders (e.g. supervisors).
- ☐ Emphasise the knowledge of the physical demands of the targeted jobs, the expected assistive capacity of the device to reduce these demands, the anticipated outcomes of this project and how it will be evaluated.
- ☐ Learn how to fit the device onto each participant:
  - Choose or set the size to match the size of the participant.
  - Prepare the device per the manufacturer or additional instructions.
  - Put the device on and adjust for optimal fit. This should achieve a high level of comfort and without localised pressure on the wearer's body through the expect range of postures and movements.
  - If it is not possible to achieve optimal fit of the device on a participant, determine why, inform the manufacturer/distributor and inform the participant that it will not be possible for them to continue with the testing. Recruit a replacement participant if required.
  - Record the donning and fit adjustment process for each participant so they can refer to it in future.
  - Each participant should practice preparing the device, putting it on and adjusting it for optimal fit until they can demonstrate competency in achieving a consistent high quality of fit of the device.
  - Removing the device and preparing it for cleaning should also be demonstrated and documented and each participant trained so they consistently remove it in the same, safe manner.
- ☐ Learn how to adjust the device during non-operational activities to avoid unnecessary restrictions. For example, with some devices, such as back exoskeletons, the anchoring around the wearer's thighs will restrict their ability to walk unrestricted. This will require the device settings to be adjusted to deactivate the assistance function and allow other movements, such as walking to be undertaken.
- ☐ Learn how to adjust the assistance function(s) of the device for each participant:
  - The assistance function(s) and settings should be clearly described.
  - Before putting on the device, instruct participants in the activation features of the device, what they do and how the settings are raised or lowered.
  - Put on the device with the assistance feature turned off, deactivated or set to its lowest level.
  - Once the device has been fitted for optimal comfort and "anchoring" on the wearers body, they should practice adjusting the control(s) to vary the setting levels up and down until they are competent.
  - If the device uses active power, the participant should learn and practice how to shut it off quickly so it can be promptly disabled if required.
  - The participant's immediate co-workers and supervisors may also need to learn how to quickly deactivate the device.
  - Practice the range of postures and movements typically used on the job(s) being tested and estimate the level of assistance that may be required. This should be conservative, and it is preferred that the testing at the job location starts with lower levels of assistance to enable the participant to adapt to wearing and using the device and to reduce inadvertent hazards or risks.
  - Use of the participant's work tools and equipment that are normally utilised should also be tested before moving to the operational area, as much as practicable.
  - Contact the manufacturer/distributor if any issues of concern arise to either develop a solution. If this is not possible cease use of the device to prevent exposure to any risks.

3 Initial implementation

- ☐ Establish the testing method and timeframe for the device and selected.
- ☐ The following approach to the initial implementation of the device in operational areas is recommended:
  - The participant should be able to cease wearing the device at any time and for any reason, without consequence to them. The detail of this circumstance should be recorded, in confidence, to understand any factors that should be considered for the safe and functional use of the device by other participants.
  - The participant should promptly report any hazards, risks, concerns or discomfort so the project co-ordinator can rectify the issue(s) or cease use of the device until any issues can be resolved.
  - Establish a graduated program for wearing the device to enable each participant to build up their level of use over a period of one to two weeks, or longer if required. For example, not more than two hours of consecutive wear for the first two to three days, increasing by a two-hour period with each increment until the participant feels comfortable wearing the device for a normal shift period, including any regular overtime. This graduated wearing of the device should rely on feedback from the participant and a slower rate of uptake should be used if required. A more rapid uptake should only occur if there is a clear indication that it is safe to do so, and that the participant approves.
  - The range of jobs to be performed, and the variations of these jobs as different products are processed, should be defined.
  - The level of activation of the device should only be increased once the participant is comfortable wearing the device and feels competent wearing it while performing all jobs.

- The level of activation of the device should be co-ordinated between the project co-ordinator and participant, and it should only be increased to levels that the participant approves of.
- The use of increased levels of assistance should be tested for 10 to 15 minutes before confirming that this level can be maintained.
- The participant should reduce the level of assistance provided by the device if needed at any time and for any reason.
- A record of changes in the level of assistance engaged and the impact on the participants performance of the job should be kept on a daily basis until a pattern of use that is considered to be useful and safe for the participant is established.
- Records on consistent assistance settings for specific jobs should also be conducted.

☐ Once participants are confident using the device and setting assistance levels, they should be encouraged to conservatively try different levels for different jobs or variations of the same job (e.g. when boning or slicing product that has been in the chiller for several days, a proportionally higher level of assistance may be helpful).

☐ A brief, standardised survey of participants' daily level of use of the device, jobs performed, activation levels used, device comfort, perceived usefulness and any observed hazards, risks or concerns should be recorded at the end of every shift. This record should be provided to the project co-ordinator at the end of every day to ensure information is available for review during and at the end of the testing period.

☐ Once the participant has established a consistent pattern of use and activation settings for the device they should perform the same jobs for a day, or part of a day, without wearing the device. Their observations of the differences in their level of effort to perform the jobs should be recorded as one way of assessing if the device provides any benefit.

☐ For any devices that collect data during use, configure the settings and the data to be collected, and how this will be downloaded, labelled, categorised, collated, analysed and reported as part of the device evaluation. Ensure that this data is captured and catalogued on daily basis.

☐ For highly complex assistive devices, such as the Bioservo Ironhand glove, additional pre-testing of the device is likely to be required to establish the best settings to use for different manual jobs.

4 Ongoing testing

- ☐ Ongoing testing should be conducted once the participant is able to wear the device for up to an entire shift and able to vary the settings according to preference for the range of jobs and tasks they perform.
- ☐ The duration of ongoing testing will need to be established by the processor. This type of testing is important to help decide whether the device should be implemented on a full-time basis. A minimum period of two to three weeks for ongoing testing for each participant is suggested.
- ☐ The same survey applied during initial testing should be recorded at the end of each week during the testing phase. Responses that identify the need for improvements should be promptly addressed and, if this is not possible, the participant should stop wearing the device.
- ☐ Any device-based data gathering, collation and analysis should continue during this phase.

5 Data and feedback

- ☐ During the initial testing phase, participants should complete a daily survey of comfort, device effectiveness and impact and general progress.
- ☐ During ongoing testing, this survey should be completed at the end of every week.
- ☐ At the end of each week during both phases, seek feedback from supervisors and other relevant stakeholders. Supervisor surveys should include questions about whether use of the device is disruptive, inconvenient or poses any threats to safety and whether use of the device contributes to overall productivity and yield. If there a perceived benefit in using the device, obtain details.
- ☐ Any data provided by the device should continue to be collected and downloaded on a daily basis. The analysis of this data should also occur as a parallel activity and the involvement with the manufacturer/distributor for this analysis is strongly encouraged.
- ☐ For each different job where the device is worn and tested, write down the daily sequence of activities to don, use, remove and clean the devices. This reference can be used to fast-track use of the device if it is implemented after the Step 4 operational testing phase.
- ☐ At the end of the evaluation process, develop a “tips and traps” reference sheet for new users of the device to help them fast track their learning about the safe and effective use of the device.

6 Testing evaluation

- ☐ All feedback and data should be collated and analysed to finalise the evaluation of the device.
- ☐ A range of general questions should also be considered in the overall evaluation of the use and testing of the exoskeleton device, such as:
  - Did the device do what the manufacturer/distributor said it would do?
  - Did the device performance fall below, match or exceed expectations of its impact on reducing physical work demands for employees?
  - Is the device suitable for use in this environment?
- ☐ Were there any issues or limitations regarding:
  - Fitting the device to employees?
  - Employees wearing the device for an entire shift and on a daily basis?
  - Controlling and using the activation of the assistance features of the device?
  - The type and level of assistance provided by the device.
  - How was the device protected, whether this is satisfactory or improvements are required?
  - How was the device cleaned, whether this is satisfactory or improvements are required?
  - How was maintenance of the device conducted, and was it satisfactory or are improvements required?
- ☐ Were any hazards identified in the use of the device?
  - If yes, describe them and note whether/how any associated risks were controlled.
  - If risks cannot be satisfactorily controlled after contact with the manufacturer/distributor, use of the device should cease or be restricted to avoid exposure to any risks.
- ☐ Is the device likely to be suitable in other areas and jobs within the processing facility? If yes, identify those areas and jobs and repeat Steps 3 and 4 to test and evaluate its likely usefulness and effectiveness in reducing physical work demands and enhancing efficiency.

Step 4 — Decision

Based on the outcomes of the Step 4 operational testing, is the device suitable for implementation (Step 5)?

YES
Proceed to Step 5

NO
Determine if supplier can overcome any concerns, or cease engagement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Step 5

Exoskeleton implementation and consolidation

The Step 5 implementation guidelines are based on utilising information and feedback from the previous assessment steps of this process for a given exoskeleton, to refine and consolidate the training, resources, strategies and monitoring mechanisms needed to support the broader, effective implementation of the device.

The key guideline categories to support the implementation of selected devices are:

1 Prepare for implementation

- ☐ Establish device implementation leaders within the target area(s).
- ☐ Confirm the jobs for which the exoskeleton will be used.
- ☐ Procure the required number of devices for implementation.
- ☐ Establish the implementation timeframe for the following sequence of activities:
  - Preparation.
  - Identify new device users.
  - Familiarisation and training for new device users.
  - Progressive implementation to build familiarity and experience.
  - Data and feedback gathering.
  - Ongoing support.
- ☐ Finalise training and instruction references. These should be based on references used during Step 4 and include any identified improvements.
- ☐ Develop a schedule for familiarisation and training for new device users. This should be delivered by local "experts" who have become very familiar with the device during the Stage 4 assessment. This training and instruction may also include the manufacturer/distributor or external provider depending on the complexity of the device set up and configuration and any data gathering capability.
- ☐ Finalise any ongoing feedback and data gathering mechanisms that will be used to track implementation progress. This should include:
  - Direct feedback from devices users at any time.
  - Standard feedback surveys (previously developed) for users and other stakeholders, such as supervisors, to complete at set periods within the implementation schedule.
  - Quantified data where this is provided by the device.
- ☐ Prepare device protection measures based on the outcome of the Step 4 assessment. This should include any risk mitigation strategies related to the user of device protection measures/PPC.
- ☐ Confirm the device cleaning measures and methods to ensure that the users and those cleaning them are fully aware of the flow of the devices through the cleaning process and their responsibilities relative to disassembly and re-assembly of the device and where it is stored for next day use.
- ☐ Confirm device maintenance measures, methods and frequency to ensure that preventative and reactive maintenance is conducted.
- ☐ Maintain a record of any device defects or requirements for maintenance and repair once the device has been implemented.
- ☐ Finalise and the expected daily sequence of use for each device and employee who will wear it according to the outcomes of the Step 4 assessment. This will vary for each job and should be used to help fast track the new participants' uptake of the device.
- ☐ Device storage:
  - Storage before use — specify where and how the device is stored after cleaning, ready for use.
  - Storage after use — describe where and how the device should be delivered after use so it can be cleaned including where is the device reassembled and who will do this.

2 Familiarisation and training

- ☐ Provide familiarisation and training sessions to new users and stakeholders (e.g. supervisors).
- ☐ Emphasise that knowledge of the physical demands of the targeted jobs, assistive capacity of the device in reducing physical demands of these jobs and outcomes of the Stage 4 assessment that have led to the broad implementation of the device.
- ☐ Train each new user how to prepare, don and fit the device to their body size, utilising those employees who have previously worn the device during the Step 4 evaluation.
- ☐ Teach each new user how to adjust the device during non-operational activities: For some devices, such as back exoskeletons, the anchoring around the wearer's thighs will restrict their ability to walk unrestricted. This will require the device settings to be adjusted to deactivate the assistance function. Once the wearer is ready to perform the job, the device needs to be reactivated.
- ☐ Teach each new user how to adjust the assistance function(s) of the device.
- ☐ New users should be provided "tips and traps" references developed during the Step 4 assessment.

3 Initial implementation for new users

- ☐ Commence the graduated use of the device in the targeted areas according to the schedule and approach determined during the Step 4 assessment.
- ☐ Ensure all new device users sign any consent forms for the collection, storage and use of data if required.
- ☐ A record of changes in the level of assistance engaged and the impact on the participant's performance of the job should be kept on a daily basis until a pattern of use that is considered to be useful and safe by the participant is established.
- ☐ Records on consistent assistance settings for specific jobs should also be maintained.
- ☐ Once the participants are confident in using the device and setting the assistance levels, they should be encouraged to utilise levels found to be appropriate within the Stage 4 evaluation process.
- ☐ Once the participant has established a consistent pattern of use and activation settings for the device, they should perform the same jobs for a day without wearing the device. Their observations of the differences in their level of effort exerted to perform the same jobs should be recorded as one way of assisting them to identify any benefit and impact on their physical exertion when perform this work.
- ☐ For any devices that collect data during use, configure the settings and the data to be collected, and determine how this will be downloaded, labelled, categorised, collated, analysed and reported as part of the device utilisation. Ensure that this data is captured and catalogued on daily basis.

4 Ongoing review of progress

- ☐ Ongoing implementation should be monitored via feedback from wearers and other stakeholders. If available, data from the device use should be used to monitor implementation progress and impact.
- ☐ The same survey applied during initial testing should be recorded at the end of the first month (nominal time period) of use for each new wearer of the device.
- ☐ Any feedback where improvements are identified should be responded to directly to assist the wearer. The manufacturer/distributor should also be contacted for any issues that require their involvement or for which they should be made aware.

5 Exoskeleton implementation and consolidation outcome

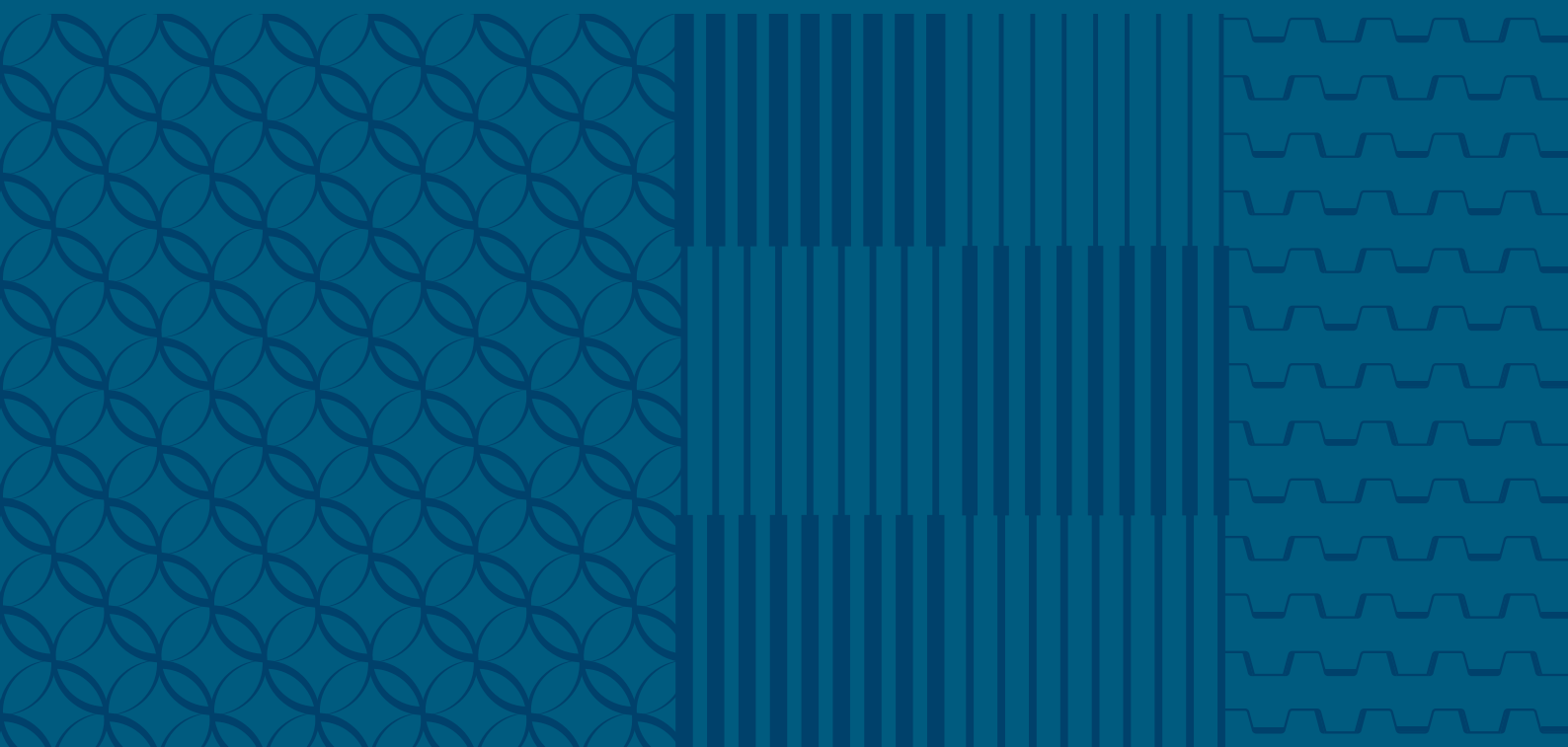
- ☐ Has the ongoing use of the device been successful? Describe why.
- ☐ Has the manufacturer/distributor provided the level of supported indicated at the outset of the project? Describe why.
- ☐ Should the device continued to be used in the current areas?
  - If yes, summarise the reasons why and include any additional conditions or strategies to support their ongoing use.
  - If no, describe why.
- ☐ Should use of this device be extended to other areas?
  - If yes, summarise the reasons why and any conditions or strategies needed to support implementation into these areas.
  - If no, describe why.
- ☐ Develop and implement further strategies based on the outcome of this review of broad scale implementation of the device.

Step 5 — Decision

Based on the outcomes of the Step 5 implementation and consolidation, is the device suitable?

YES
Consolidation

NO
Determine if supplier can overcome any concerns, or cease engagement



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