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RESTRAINING SYSTEMS
FOR BOVINE ANIMALS
SLAUGHTERED WITHOUT STUNNING
WELFARE AND SOCIO-ECONOMIC IMPLICATIONS
ACRONYM: BOREST

FINAL REPORT

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1. INTRODUCTION

An essential requirement for the slaughter of bovine animals with or without stunning is adequate restraint. The objective of the different systems is to restrain the animal in the pen so that stunning and slaughter can be performed effectively, safely, while minimising stress, distress and pain to the animals (Anil 2012).

Regulation (EC) No 1099/2009 allows the possibility to derogate from stunning animals in the case of religious slaughter (Jewish and Muslim methods of slaughter respectively Shechita and Dhabaha for the production of kosher and halal meat). Two main restraint systems are used for this purpose in European countries:

- Rotating restraint device where the bovine animals are slaughtered in dorsal (inverted) or lateral position
- Upright restraint device where animals are restrained in an upright position.

The 2004 report on the welfare aspects of animal stunning and killing methods, prepared by the European Food Safety Authority, concluded that there is a welfare advantage in restraining animals in upright position on the basis of studies comparing the two systems that was carried out at the beginning of the nineties. However, during the political debate that led to the adoption of Regulation (EC) No 1099/2009, some religious communities expressed concerns about compatibility of the upright position with their religious requirements. Furthermore, different stakeholders highlighted that the new designs of rotating restraint devices (including adjustable lateral and head restraint) that are currently in use in Europe, significantly differ from those used in the previous research studies. These newer devices have been suggested to provide advantages in terms of animal welfare and work safety. As a conclusion, Article 27 (2) of Regulation (EC) No 1099/2009 provides that: *“No later than 8 December 2012, the Commission shall submit to the European Parliament and the Council a report on systems restraining bovine animals by inversion or any unnatural position. This report shall be based on the results of a scientific study comparing these systems to the ones maintaining bovines in the upright position and shall take into account the animal welfare aspects as well as the socio-economic implications, including their acceptability by the religious communities and the safety of operators. (...)”*.

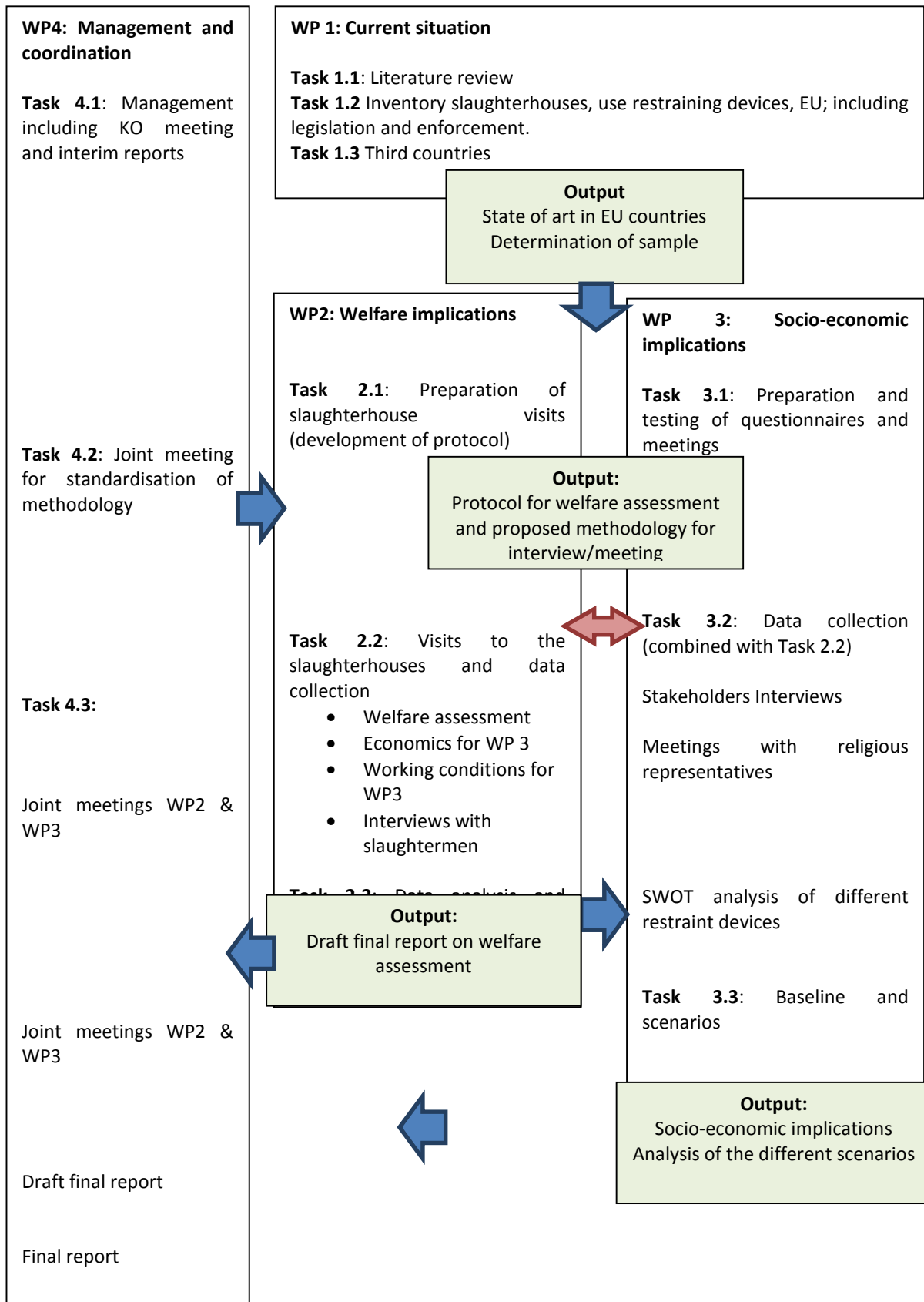
The general purpose of the present study was therefore to collect relevant information for the Commission to prepare the above mentioned report.

To achieve this objective, the study firstly examined the overall current situation regarding restraining practices for bovine animals slaughtered without stunning in Europe. A review of the scientific literature was conducted and detailed information about practices and equipment in slaughterhouses of six Member States (Belgium, France, Italy, The Netherlands, The United Kingdom and Spain) were collected.

The second part of the study aimed to assess animal welfare, taking into account the diversity of systems (upright vs. rotating) and variations in practices. This assessment was carried out in a sample of slaughterhouses of the selected Member States.

A third part of the study aimed to analyse the socio-economic implications of the use of the different restraint system. Based on data collected from the sampled slaughterhouses, costs and work safety aspects were analysed. Religious communities' opinions were collected through interviews and meetings. At the end, different scenarios of future European Union (EU) policies for implementing technical recommendations were proposed and analysed in comparison with the future situation without any EU policy change (baseline scenario).

Figure 1: Organization of the project



2. OVERVIEW OF THE METHODOLOGY

The objectives of the project and the different tasks that were carried out are listed in **figure 1**. The project was divided in four work packages.

Work package 1: Current situation

The first work package aimed to describe the current situation in terms of restraint devices and practices used for slaughtering bovine animals without stunning in the European Union and in some third countries. Data were collected through questionnaires sent to the competent authorities of the different Member States to provide an overview of the beef meat production with and without stunning and the implementation of the Regulation (EC) No 1099/2009. Then, a second survey for slaughterhouses was conducted for six selected Member States (Belgium, France, Italy, The Netherlands, Spain, The United-Kingdom) in order to get an overview of restraint devices currently in used and of the practices.

This work package also included an updated literature review in order to describe the scientific background available about the use of restraint systems for slaughter of bovine animals without stunning.

The results of this work package were used to:

- determine the sample of the slaughterhouses where socio-economic data were collected (work package 3) and the sample of restraining systems that were studied for their effect on animal welfare (work package 2)
- design the method of assessment of welfare (work package 2)
- design and analyse different scenario for future European policies (work package 3)

Work package 2: Welfare impacts

The main objective of this second work package was to compare the animal welfare advantages and disadvantages of the different types of restraint systems commercially used in European slaughterhouses for slaughtering bovine animals without stunning.

A common methodology was first established and tested in slaughterhouses during a joint meeting of all partners in April 2013. Based on results of the work package 1, the sample for data collection was designed to include:

- both categories of bovine animals (calves and adults)
- the diversity of restraint systems used in the seven selected Member States by including the different positions of the animals at the time of bleeding (upright, lateral and inverted)
- different restraint device designs and practices that have been previously suggested to have particular impacts on animal welfare (positive and negative).

Table 1 : Summary of the location visited in the different countries and the groups of animals assessed according to the category of animals and the restraining method

(Source: BoRest study “Methodology”)

Category of animals	Country	Slaughter-house code	Restraining method of the group of animals observed	Number of animals assessed
Adults	Spain	SH1	Inverted	60
		SH2	Inverted	60
		SH3	Inverted	20
		SH4	Inverted	60
		SH5	Inverted	60
	France	SH6	lateral	57
		SH7	Inverted	63
		SH8	Inverted	51
	Italy	SH9	Inverted	60
		SH10	Lateral	60
		SH11	Upright	60
		SH12	Inverted	24
	The Netherlands	SH13	Inverted	61
	United Kingdom	SH14	Upright	56
		SH15	Upright	28
Calves	France	SH16	Inverted	64
		SH16	Upright	9
		SH8	Inverted	58
	Italy	SH12	Inverted	36
	The Netherlands	SH17	Inverted	16
		SH17	Upright	82
	Belgium	SH18	Inverted	68
	Total Number	6**	18	22*** (21)

*SH16 upright not included in the analysis

** Lacking data from Ireland and Israel (1 location expected in each country)

*** 25 groups expected and 1500 animals expected

(Number of observations – groups or animals - Included in the analysis)

Initial plan was to collect data from sixty animals per slaughterhouse, in twenty-five slaughterhouses of seven Member States and Israel (1,500 animals in the overall). It was expected that each slaughterhouse would be considered as a statistical unit characterized by the restraint device used and the position of the animals at the time of bleeding.

However, it was decided with Commission officials to include both calves and bovine adults in the sample (due to the number of calves slaughtered without stunning). Consequently, in some locations i.e. “slaughterhouses”, where both bovine adults and calves were slaughtered but in separate line or according to different restraining method, we considered each group from the two categories of animals as an independent statistical unit.

The visits finally carried out were depending on the willingness of slaughterhouses to participate in the survey and their characteristics. Eventually, eighteen locations were visited representing 22 groups of animals assessed (**Table 1**).

Deviation from expected number of visits was observed in the United Kingdom, the Netherlands and Israel due to the refusal of some contacted slaughterhouses to participate. While, no visits were conducted in Ireland because of delays in completion of survey 1 by the competent authority, despite the best efforts of the research teams. In order to partially compensate this deviation, additional observations or visits were organised in some slaughterhouses and in some countries.

Furthermore, in some cases, due to the line speed or the willingness of slaughterhouses to collaborate, a reduced number of animals was observed compared to the sixty expected. This was compensated partly by additional days of observations. Finally, for the analysis, we considered that this had only a limited effect.

Consequently, at the end, 21 groups representing 1,105 animals assessed were included in the analysis and the twenty second one (9 animals) was used only for additional information.

Data collection in slaughterhouses took place from July to December 2013. In each slaughterhouse, animal welfare was assessed on a random sample of animals from the entry in the restraining system to the release out of the device after the cut. Data were collected on the device, the operating procedure, the practices of operators, the behaviour of the animals, the characteristic of the bleeding and the sign of consciousness.

All data were centralized and processed to produce descriptive statistics. These statistics were further classified according to opinion of four experts on the project. Based on their judgement, key points for operating procedure, indicators of monitoring and range of best practices observable were proposed.

Work package 3: Socio economic implications

The goal of this work package was to determine the socio-economic implications of the different restraint systems with special attention to economics, religious expectation and freedom, working condition and safety of operators.

At the end, different scenarios of future EU policy options were proposed and analysed according to their effect on different judgement area, in particular animal welfare and socio-economic implications.

To achieve this goal, the following tasks were carried out:

- Meetings with religious representatives in the selected Member States
- A synthesis of economic data, religious opinion, working condition and animal welfare in order to perform a SWOT (strengths, weaknesses, opportunities and threats) analysis for restraint systems taking into account the competitiveness of EU slaughterhouses, the social implications, the freedom of religion and the welfare of animals.
- An evaluation of the future situation in EU based on different scenarios including the baseline and different EU policy options to implement new technical rules or to phase out certain restraining systems.

Data about animal welfare, economics of slaughterhouse and work safety were collected during visits of slaughterhouses that took place during the work package 2. Meetings with religious representative were carried out by each partner in the selected Member States and were based on a common methodology consisting in the collection of opinion regarding the two main restraint systems (upright and inverted). Meetings took place from November 2013 to March 2014. Future EU options and scenarios were proposed and discussed during the two steering committees (January and November 2013) and refined following direct exchanges with DG SANCO. Analyses were carried out from November 2013 to April 2014 taking into account the output from the other tasks.

Work Package 4: Management and coordination

The main objective of this Work Package was to ensure a close coordination between the different tasks. To achieve this objective, different tasks were performed:

- Monthly phone meeting of the consortium, organization of the steering committees (January 2013, November 2013 and March 2015) and exchanges with DG SANCO.
- Organization of a joint meeting (April 2013) between all partners to analyse the first output of WP 1 and to finalise the methodology used for data collection on welfare and collection of social and economic data.
- Reporting.

Table 2 : Basic principles of restraint device design common for all restrain systems - adapted from Grandin's (2013)

(Source: BoRest study "literature survey")

- Provision of non-slip flooring surfaces leading up to and in the pen.
- Raceways/entrance ways should be curved and avoid sharp corners to prevent balking and allow easy access into the pen.
- There should be no obstructions that can cause the animals to balk or cause injury when entering or being restrained in the pen.
- There should be sufficient lighting to minimise balking.
- Equipment should be engineered to minimise noise that could cause agitation/distress to the animals.
- All parts of the restraint pen that contact the animal should move with smooth, steady motion, as sudden jerky motions may cause the animal to become agitated / distressed.
- The pressure applied by the device should not be excessive. The application of excessive pressure could cause struggling, vocalizations, pain and distress.
- Stunning or slaughter without stunning should occur immediately after the animal is fully restrained.
- Solid panels should be used to prevent entering animals from seeing people or moving equipment.
- Animals must be irrecoverably insensible before release from the pen.
- The pen should be designed to allow the safe and effective ejection of the carcass from the device, without putting the operators in harms way.

3. REVIEW OF THE CURRENT LITERATURE ON UPRIGHT AND ROTATING RESTRAINT SYSTEMS FOR SLAUGHTER OF BOVINE ANIMALS WITHOUT STUNNING

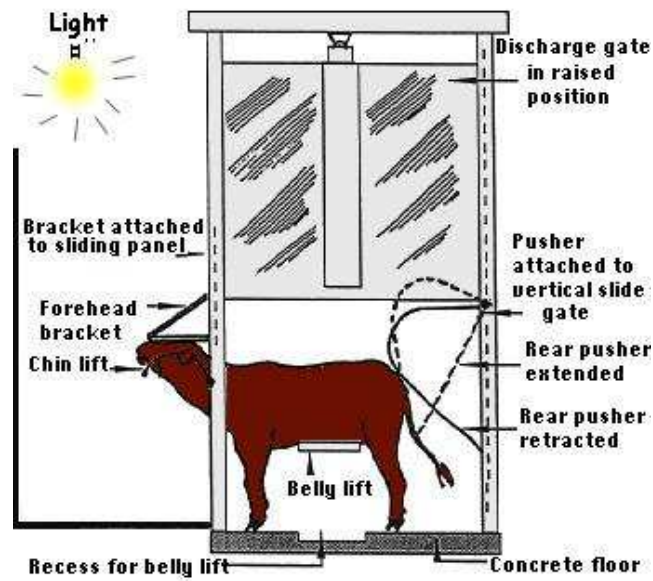
Task leader: T. Gibson (RVC)

INTRODUCTION

An essential requirement for the slaughter of animals with or without stunning is adequate restraint. The objective of the different systems is to restrain the animal in the pen so that stunning and slaughter can be performed effectively, safely, while minimising stress, distress and pain to the animals (Anil 2012). **Table 2** highlights some of the basic principles of restraint design that are common to all systems.

Inadequate restraint is an important welfare concern for slaughter with and without stunning. During slaughter without stunning it is essential for welfare and religious requirements that the animals are sufficiently restrained. It is important that the restraint system allows the operator to perform a sufficient cut to the ventral surfaces of the neck that severs the jugular veins, carotid arteries, trachea, oesophagus, connective tissue, vagus and other sensory nerves. The restraint should be designed to allow the wound site to remain open to enable sufficient bleeding, while preventing further stimulation of the wound. Furthermore the animal should be restrained for a sufficient period post-cut to allow exsanguination, onset of insensibility/unconsciousness and to minimise the risk of injuries to slaughterhouse staff.

Restraint systems for slaughter without stunning often incorporate both body and head/neck holder devices that allow the operation of the specific slaughter method. Devices should be designed to hold the animal sufficiently to facilitate immobilization, while not causing significant discomfort, pain, stress or distress. Cattle when distressed in slaughterhouses often struggle, kick, vocalize and attempt to escape. This can lead to hesitation when entering the restraint, poor presentation in the restraint and frustration in slaughterhouse staff which can sometimes lead to the excessive use of electric cattle prods to position the animal. In both rotating and upright systems the design of the neck yoke and chin-lift i.e. the head/neck holder has an important impact on the performance of the cut. The chin-lift should provide good access to the neck, allow for efficient cutting and bleeding, avoid excessive neck tension (which could be painful), should not obscure the face, eyes (for assessment of consciousness/sensibility) or potential stunning positions (if a post-cut stun is required). Furthermore the metal work of the chin-lift must not obstruct the cutting action. In Europe a variety of restraint systems are used for the slaughter without stunning of bovine animals.



[Figure 2 : Minimum requirements for restraint device \(Source: Grandin\)](#)



[Figure 3 : Example of rotating restraint in inverted position \(source: Banns\)](#)

They can be broadly grouped into:

- Rotating restraints: where the animal is slaughtered in dorsal (inverted 180°) or lateral recumbency (90°).
- Upright restraints: where the animal is slaughtered in the upright position.

Examples of design of upright restraint (ASPCA) and rotating restraint are given in **figures 2 and 3** respectively. Both devices should be operated from rear to front. After entrance of the animals, the back or rear pusher is engaged, this is followed by the belly lift (in case of upright restraint) or the lateral pusher (in case of rotating restraint). Finally the head and neck is restrained with the chin-lift and neck yoke. With well-designed and operated rotating restraints, the rotation should start immediately after the head and neck is restrained. After performance of the cut to the ventral tissues of the neck by the slaughterman, there may be rotation back to upright position depending on the operating procedure of slaughterhouses. Rotating restraint may be also used for slaughter in upright position.

The slaughter of un-stunned cattle in dorsal recumbency (inverted) is prohibited in many countries (Grandin 1994), because of the stress involved in inverting the animal (Dun 1990, Grandin & Regenstein 1994, Shragge & Price 2004). Upright restraining systems have replaced inverted systems in many countries (Gregory 2005). In the EU, Slovakia, Denmark and the United Kingdom prohibit the use of rotating or inverted restraint pens for use for slaughter without stunning. In the UK, it is a legal requirement that cattle slaughtered without stunning are restrained in an upright pen (Rosen 2004), all pens in operation are to be approved by the Minister (Anon 1995). Council Regulation (EC) No 1099/2009 (2009) states that for animals killed without prior stunning, checks should be made to ensure “that animals do not present any signs of consciousness or sensibility before being released from restraint”. Current UK legislation makes it mandatory for cattle slaughtered without stunning, to remain in the upright restraint (including chin-lift) until unconscious and not before the expiry of 30 seconds (Anon 1995).

Rotating designs are widely used in many other EU countries and are currently allowed under Regulation (EC) No 1099/2009. In The Netherlands representatives of the Jewish and Muslim communities with the Ministry of Economic Affairs, have agreed on a period where if the animal is still conscious 40 seconds after the neck cut, the animal is to be immediately stunned (Tyler 2012). In France, the slaughterhouse industry has produced in consultation with the Ministry and the National Food Safety Agency, guidelines on good practice at slaughter (Guide to Good Practices of Animal Care at Slaughter). The guidelines detail standard operating procedures for minimizing risks of poor welfare when using rotating pens. In the guidelines a mandatory period of restraint of, at least, 45 seconds after the cut (and before checking for sign of consciousness) for all categories of cattle is specified.

It is further recommended in the guidelines that any cattle that still display signs of consciousness/sensibility after this period, are immediately stunned (<http://www.interbev.fr/ressource/guide-de-bonnes-pratiques-pour-la-maitrise-de-la-protection-animale-des-bovins-a-labattoir/>).

A number of bodies have stated that the inversion of cattle for slaughter without stunning could result in welfare compromise compared to upright restraint (Blokhuis, et al. 2004, FAWC 1995, Wathes 2012). Many of the restraint systems used in slaughterhouses are modified or custom made, often making it difficult to make assessments on the relative merits and disadvantages of different systems. It is important to note that irrespective of the system or slaughter method, all restraints including those of the highest standards are open to operator abuse if used incorrectly and can result in poor animal welfare (Grandin & Regenstein 1994). It is important with any restraint system employed, that adequate training and supervision are also provided.

This review aims to critically examine the major studies examining upright and rotating restraint systems in regards to animal welfare. The shackling and hoisting of live cattle is prohibited in Europe and is not discussed.

In summary:

There are a variety of restraint systems that are employed by slaughterhouses for the slaughter of cattle without stunning. These can be broadly broken down into upright and rotating systems (45°, 90° and 180°). The objective is to restrain the animal so that slaughter can be performed effectively and without compromising worker safety. Both types of devices generally include: rear, ventral (upright) lateral and head holding restraints. They should be operated from rear to front and improper use can compromise animal welfare. Rotating designs are used in a number of EU countries but a few of Member States prohibit the use of rotating restraint due to animal welfare concerns.

ROTATING RESTRAINT

The first widely adopted mechanized restraint pen for slaughter without stunning of cattle was the Weinberg casting pen (Grandin 1980). When introduced it was seen as a major improvement over traditional casting or shackling systems in both slaughterhouse worker safety and animal welfare (Hall 1927, Levinger 1979). Since the introduction of the Weinberg pen there has been significant alteration to the original design and operation (by manufacturers such as Facomia, Banss, Dyne, North British, Nawi). Now the pens are operated by electrical or hydraulic systems and don't rely on manual operation like the original Weinberg design. Rotating pens, restrain the animal after they enter with adjusting side plates, back-pusher, neck yoke and chin-lift. Then the animal is rotated 45 °, 90 ° or 180 ° depending on the practice of the slaughterhouses. Grandin and Regenstein (1994) stated that improved rotating pens, such as the Facomia pen, are probably less stressful for the animal than the original Weinberg design, however the authors did further state "that a well-designed upright restraint system would be more comfortable for cattle". Rotating systems should be designed to quickly and smoothly restrain and rotate the animal without interruption. This is to reduce the time spent restrained in the unnatural and possibly stressful position.

Much of the public and scientific debate on the welfare aspects of rotating restraint systems have focused on issues regarding unnatural posture, abdominal pressure on visceral tissues, and stress during inversion. Van Oers (as cited in Gregory (2005)) observed more vigorous struggling in animals where the chin-lift was applied after the animal was inverted compared to prior to inversion. This suggests that in inverted designs it is important that the chin-lift is applied prior to the process of inversion. Wagner (1990) reported that in cattle both lateral and dorsal recumbency can significantly impair arterial oxygenation. It was hypothesised that lateral or dorsal recumbency can result in reduced lung volumes, due to compression of the thoracic cavity by the weight of the rumen and abdominal viscera pressing against the diaphragm. Furthermore in another study the process of inversion from an upright position was demonstrated to significantly decrease arterial blood oxygenation ($P < 0.001$) in conscious restrained cattle due to the inhibition of oxygenation of blood in the lungs (Tagawa, et al. 1994). Inversion also resulted in significantly increased plasma cortisol concentrations (control 1.6 ± 1.0 ; inverted 4.8 ± 2.2 $\mu\text{g/dl}$, $P < 0.001$) reaching peak concentrations 30 minutes after onset of inversion, compared to upright or lateral restraint (Tagawa, et al. 1994). This suggests that inversion causes a larger stress response compared to upright or lateral restraint.

However in a study comparing restraint systems for claw trimming of cows, it was reported that cattle restraint upright in a walk-in crush had significantly higher faecal cortisol metabolite concentrations nine hours after trimming compared to those trimmed at 90° on a tilt table (mean concentrations of 292 and 218 nmol/kg respectively, $P < 0.001$). The authors associated this difference with the significantly increased time required to perform the procedure in the walk-in crush compared to the tilt table (Pesenhofer, et al. 2006).

In an slaughterhouse based experiment, Dunn (1990) reported significantly increased cortisol (upright 143.2 ± 102.0 ; inverted 259.6 ± 104.0 nmol/l, $P < 0.001$), haematocrit (upright 0.41 ± 0.03 ; inverted 0.47 ± 0.03 litres/litre, $P < 0.001$) values and vocalisations (upright 0.3 ± 0.75 ; inverted 4.65 ± 6.09 , $P < 0.05$) in cattle slaughtered in the inverted Weinberg pen compared to the upright position. Bourguet et al (2011), reported cattle restrained in rotating pens had an increased incidence of vocalisations per animal compared to those in upright stunning pens without head or body restraint (0.73 ± 0.2 ; 0.02 ± 0.02 respectively). However 20% of the animals in rotating pen vocalised before inversion and the number of vocalisations was significantly reduced (10.5%) following inversion prior to the neck cut ($P < 0.03$) (Bourguet, et al. 2011). The authors hypothesised that the physical restraint in the rotating pen may have exerted too much pressure on some animals.

It has been suggested that lateral restraint can reduce the pressure of the rumen depressing on the internal organs and diaphragm, compared to full 180° inversion (Von Holleben, et al. 2010). The Dialrel project suggested that lateral restraint can reduce pressure on the aorta, major veins and diaphragm compared to full inverted restraint (Von Holleben, et al. 2010). Petty et al (1994) found that cattle restrained in lateral recumbency during Shechita and secular (captive bolt stunning) slaughter showed no significant difference in catecholamine and cortisol concentrations compared to upright restraint, the authors suggested that these animals were not significantly stressed by lateral recumbency. Lambooiij (2012) reported that independent of the angle (90°, 120°, 180°), inversion caused a significant increase in heart rate (from already raised levels following handling and entrance into the restraint) from 113-118 to 126-138 beats/min (bpm) ($P < 0.05$), suggesting a stress mediated sympathetic response. Furthermore the authors found a significant decrease in oxygen saturation from entrance into the restraint and rotation ($P = 0.02$) (Lambooiij, et al. 2012). Work by Rushen (1986) reported that sheep in a forced paired-choice experiment, found upright restraint in a wire cage (0.5 x 1.2 x 0.9 metres) compared to manual inversion by a human less aversive. This result should be taken with caution as the presence of a human and the isolation of sheep during inversion, compared to the sheep in the wire cage which were surrounded by 4-6 sheep would be expected to have influenced the results.

The advantage of the 180° rotating systems is that they often provide good presentation of the ventral surface of the neck for the neck incision. However a criticism of inverted restraint positions is that blood and rumen content can contact the cranial and caudal aspects of the wound surface. This could result in carcass contamination, aspiration of liquid into the respiratory tract (Blokhuis, et al. 2004, Grandin & Regenstein 1994), and possible further stimulation of the wound site which could cause pain and distress (Gibson, et al. 2009a). However blood aspiration in the respiratory tract has been reported in upright restrained cattle (Gregory, et al. 2009).

In summary:

Since the introduction of the Weinberg pen, there have been significant alterations to the original design of rotating restraints. The animal welfare issues that have been associated with inverted restraints include: restraint in a unnatural posture, abdominal pressure on visceral tissues, stress during inversion and duration of inversion. It is suggested that immobilization, including head, should be carried prior to inversion.

UPRIGHT RESTRAINT

Upright restraint systems confine cattle in an upright position for slaughter. This can either be free standing or straddling a centre track conveyor restrainer in sternal recumbency, where the feet are off the floor and the conveyor and walls support the body weight via the brisket, abdomen and flanks (Grandin 1990). The head is secured and stretched by a chin-lift into position for the ventral neck cut, either mechanically (hydraulic or electrical) or sometimes manually for calves. Many systems such as the Cincinnati or ASPCA pen have a back-pusher/tailgate and belly plate that further confines the animal. Dunn (1990) reported that when entering the upright ASPCA pen some animals stopped to investigate the belly plate on the floor before walking over it to enter the pen. To improve entry into upright restraints it has been recommended that the belly plate when loading the animal should be recessed into the floor (flush with the floor surface), this will prevent the plate from being an obstruction and facilitate more effective entry (Grandin 1992).

A common complaint of upright systems is that animals can be over restrained. Poorly designed upright restraints can apply excessive pressure (Berg & Jakobsson 2007, Grandin & Regenstein 1994). For example excessive pressure of the back-pusher, lifting of animals with the belly plate (problematic with smaller or young stock) and excessive neck tension (hyperextension) with the chin-lift, could all cause discomfort, pain and suffering. Grandin (1998) reported that in two separate slaughterhouses 3.25% and 8% of cattle vocalized due to excessive pressure of the back-pusher and chin-lift respectively. In the second slaughterhouse it was found that animals were initially quiet in the chin-lift, but vocalized as the pressure was increased (Grandin 1998). The Dialrel project reported that during the spot visits 63% of cattle restrained in upright pens showed struggling compared to 37% in inverted pens (Velarde & Cenci-Goga 2010), potentially due to excessive pressure from the chin-lift, back-pusher and belly plate. Chin-lifts and back-pushers should be designed with pressure limiting devices when possible (Grandin 1992, Grandin & Regenstein 1994), and should be operated with the concept of “optimal pressure” required to firmly restrain the animal, but not cause discomfort (Grandin & Regenstein 1994). Even with the use of the chin-lift and neck yoke, the ventral cutting surface of the neck in upright pens is less well presented than for animals restrained in the inverted position. The cut is made upwards against the ventral aspect of the neck, this makes the cut more awkward (Gregory 2005). Furthermore due to the action of the cut, it is possible to incompletely sever the carotids on the contralateral side to the operator. When slaughtering animals in upright restraints it is important to assess the success or otherwise of the neck cut either visually (blood flow) or by palpation, however this can be difficult in upright restrained animals. A greater level of skill may be required to achieve an appropriate cut and manage the post-cut period with slaughter of cattle in the upright versus the inverted positions. Work on the Dialrel project reported that in the slaughterhouses surveyed (n=12, 315 animals) the mean number of cuts

performed was higher for cattle restrained in upright (9) compared to 180° (5), 90° (3) and 45° (1) pens (Velarde & Cenci-Goga 2010).

It has been stated that the advantage of the chin-lift is that it can help in the prevention of re-occlusion of the carotid arteries (Rosen 2004). However research has demonstrated that the prevalence of false aneurysm formation is not influenced by method of restraint (rotating pen; manual casting into lateral recumbency; upright restraint pen; shackled by one leg and lowered into lateral recumbency) ($P>0.05$) (Gregory, et al. 2008). A disadvantage of upright pens from the operators perspective is that when performing the cut they are more likely to be covered with blood because of their position relative to the cut (Gregory 2005).

There have been concerns that during slaughter without stunning animals with prolonged sensibility could aspirate blood into the respiratory tract (Grandin & Regenstein 1994, Gregory, et al. 2009). This could cause irritation and distress. Previously concern over blood aspiration was focused on cattle held in inverted systems (Blokhuys, et al. 2004). Recent research has shown that in cattle slaughtered in the upright position by *Shechita* and *Dhabiha* that 19% and 58% had substantial amounts of blood in the trachea respectively (Gregory, et al. 2009). Severance of the vagus nerves was previously thought to prevent lower respiratory irritation. However stimulation of the glottis (innervated by the cranial laryngeal nerve) and hemorrhage or blood entering the lower respiratory tract (innervated by a collateral spinal afferent pathway) could cause distress and suffering (Gregory, et al. 2009). Grandin and Regenstein (1994) reported that in some slaughterhouses where cattle are released from the upright restraint pen before becoming insensible, that welfare can be compromised when the neck cut wound edges contact each other or make contact with the metal work of the restraint. This would be likely to cause further pain and suffering (Von Holleben, et al. 2010), therefore it is essential that the animal is completely insensible before release from the pen.

In summary:

A common complaint of upright systems is that animals can be over restrained. Consequently, they should be operated with the concept of “optimal pressure”. Even with the use of head holder, the ventral cutting surface of the neck in upright pens compared with rotating pens is less well presented. This may lead to more awkward cut and impaired working conditions.

Table 3 : Studies investigating the interval between entry and slaughter for rotating and upright restraint systems (standard deviation SD; standard error SE)

(Source: BoRest study “literature survey”)

Restraint	Mean interval between entry and slaughter (seconds)	Number of animals	Reference
Rotating (180°)	103.8 ± 18.4 (SD)	18	(Dun 1990)
Upright	11.1 ± 3.8 (SD)	50	
Rotating (180°)	69.2 (range 19 – 241)	1628	(Koorts 1991)
Upright*	14.3 (range 2 – 120)	1563	
Rotating (90°)	115.8	14	(Cenci-Goga, et al. 2010)
Upright	97.5	30	
Rotating (180°)†	17.6 ± 2.7 (SE)	95	(Bourguet, et al. 2011)

* Held in the same pen but upright and stunned.

† Interval between end of inversion and the neck cut

Table 4: Medium time and range (seconds) for entry and initiation of physical of restraint, start of restraint and end of rotation, and end of rotation and cut in cattle slaughter without stunning (Warin-Ramette & Mirabito 2010)

Angle of rotation	Entry and start of restraint (seconds)	Start of restraint and end of rotation (seconds)	End of rotation and neck cut (seconds)	Number of animals
180°	10 (7-37)	16 (12-111)	4 (1-14)	116
135°	19 (5-110)	15 (10-54)	1 (1-3)	35
<90°	12 (1-107)*	4 (1-13)*	1 (1-34)	108

* Limit between the 2 periods was difficult to evaluate due to observer position

ENTRY TO SLAUGHTER INTERVAL

The interval from entry of the animal into the pen and the act of slaughter with or without stunning has direct consequences on animal welfare. Delays in operation of the restraint/slaughter procedure can cause undue stress, pain and distress to the animal. **Table 3** details studies that have reported the interval between entry and slaughter for rotating and upright restraint systems. The findings suggest that for the majority of restraint designs assessed the interval between entry and restraint is longer for rotating systems (90° and 180°) compared to upright. However it is important to note that the studies of Dunn (1990) and Koots (1991) were performed with the older Weinberg restraint system. Bourguet et al (2011) reported that of 95 animals observed in a modern rotating pen for Dhabiha slaughter, the interval between end of inversion and the neck cut was 17.6 ± 2.7 seconds. They also reported a significant correlation between percent haematocrit and delays before inversion ($r=0.55$, $P=0.008$) of cattle in the rotating pen. Meanwhile in a study by Warin (2009) it was observed that the median time from start of restraint and completion of rotation was longest for cattle restrained in the 180° (range 12-111) compared to 135° (range 10-54) and <90° (range 1-13) positions (**Table 4**). While the interval between end of rotation and neck cut for all restraint positions ranged from 1 to 34 seconds ($n=259$). Modern rotating restraint systems rotate the animal around its own axis. It has been observed that pens that are designed to rotate outside of the animals own axis can take a prolonged period of time from initiation of restraint to full 180° rotation (range 53-77 seconds, un-published data).

Anil (2012) stated that some designs of rotating pens can take an unduly long period to rotate and present the animal for slaughter. Furthermore, Velarde and Cenci-Coga (2010) reported that during the Dialrel slaughterhouse spot visits the restraint to cut interval for cattle was longer in animals restrained at 45°, 90° compared to those inverted 180° or in the upright position. Koorts (1991) compared struggling in cattle restrained in the inverted position for Shechita slaughter, with cattle restrained in the same pen but in a upright position for secular slaughter (captive bolt stunning). It was reported that animals in the upright position struggled less with 68.5% been classified as 'calm' compared to 31.2% in the inverted position. Warin-Ramette and Mirabito (2010) reported in a study of rotating restraint systems in France that the frequency of vocalizations was directly linked to the time spent by the animals in inverted position (**table 4**).

In summary:

Delays between entry of the animal into the pen and the act of slaughter with or without stunning can cause undue stress, pain and distress to the animal. The findings suggest that for the majority of restraint designs assessed the interval between entry and restraint is longer for rotating systems (90° and 180°) compared to upright.

Table 5 : Studies investigating the time to insensibility after ventral neck incision slaughter without prior stunning in cattle and the parameters reported.

(Source: BoRest study “literature survey”)

Restrain	Parameter	Mean time to insensibility \pm SD (seconds)	Time to insensibility range (seconds)	Reference
Upright	EEG, B	-	2-10	Levinger (1961)
-	EEG	-	3.5-5	Nangeroni and Kennett (1964)
-	EEG	-	10-23	Schulze et al (1978)
Upright	EEG, B	-	10	Groß (1979)
-	EEG, B	-	28-168	Blackmore and Newhook (1981); Blackmore et al (1983)
-	EEG	-	34-85	Newhook and Blackmore (1982)
Upright	B	146 (\pm SD 174)	20-385	Blackmore (1984)
Upright	VEP	17 (\pm SD 4)	11.5-23	Gregory and Wotton (1984b)
Rotated (180°)	SEP, VEP	72 (\pm SD 48)	19-113	Daly et al (1988)
Upright	ECoG	-	10-52	Bager et al (1992)
Rotated (180°)	EEG	34 (\pm SD 16)*	16-63*	Gibson (2009)
Upright	TLP	20 (\pm SD 33)	-265	Gregory et al (2010)
Rotated (180°)	B	-	10-210	Bourguet et al (2011)
Rotated (90°, 120°, 180°)	B, EEG, CD	80	-	Lambooij et al (2012)
Upright	TLP	18 (\pm SD 24)	1-257	Gibson et al unpublished preliminary data

B: behaviour; CD: correlation dimension analysis; ECoG: electrocorticogram; EEG: electroencephalogram; SEP: somatosensory evoked potentials; TLP: time to loss of posture; VEP: visually evoked potentials. * Animals where anaesthetised, time to loss of active EEG waveform.

TIME TO INSENSIBILITY IN ROTATING AND UPRIGHT RESTRAINTS

During slaughter without stunning there is a window following the neck incision and before the onset of cerebral hypoxia and insensibility during which the animal is both conscious and sensible to pain, distress and stress (Gibson, et al. 2009a, Gibson, et al. 2009b). There is a range in time to insensibility for all species and this is shortest and narrowest in sheep (2 to 14 seconds), then in pigs (13 to 25 seconds), poultry (12 to 26 seconds) and longest and widest in cattle (2 to 385 seconds) (Bager, et al. 1992, Barnett, et al. 2007, Blackmore 1984, Blackmore & Newhook 1981, Blackmore, et al. 1979, Bourguet, et al. 2011, Daly, et al. 1988, Gregory, et al. 2010, Gregory & Wotton 1984a, b, Groß 1979, Lambooi, et al. 2012, Levinger 1961, Nangeroni & Kennett 1964, Newhook & Blackmore 1982, Wotton & Gregory 1986). In contrast, acute arrest of cerebral blood circulation in normal healthy young men with the use of a cervical pressure cuff has been demonstrated to produce a loss of consciousness on average in 6.8 seconds (range of 6.4 to 6.9) (Estrella, et al. 1992, Rossen, et al. 1943). **Table 5** details studies that have examined time to insensibility in cattle and the different slaughter positions used. The reported times to insensibility ranged from 2 to 385 seconds. Based on the limited data it can be concluded that there is little effect of restraint system on time to insensibility (upright 1-385; rotating 10-210 seconds).

Caution must be taken when interpreting this data, as the restraint systems used varied significantly between the studies, there are differences between experimental and slaughterhouse observational based experiments, and variations in sample sizes. However it can be similarly concluded that:

- The time to undoubted insensibility is longest in cattle compared to other species. The causation of this is potentially due to the anatomy of the blood supply to the brain in different species and the formation of false aneurysms (carotid occlusion) on the carotid arteries during and after slaughter in cattle.
- There is a large amount of variability between individual cattle in the time to undoubted insensibility.
- Restraint appears not to have a significant effect on the time to undoubted insensibility, however further data is required to validate this hypothesis.

In summary:

After the neck incision and before the onset of cerebral hypoxia and insensibility, there is a window during which the animal is both conscious and sensible to pain, distress and stress. The range in time for bovine animals is the longest and widest (2 to 385 seconds) compared with other farm animals. Based on the limited data available, it can be concluded that there is little effect of restraint system on time to loss of sensibility, however further data is required to validate this hypothesis.

CONCLUSION

Based on the existing literature both rotating and upright restraint systems have strengths and weakness. Specific animal welfare concerns of rotating systems are delays in operation between entry and slaughter, and pain/stress/distress from being restrained in an unnatural position. While upright restraints can cause pain and distress to the animal if excessive pressure is applied, and more skill is required to perform a successful neck cut. Irrespective of restraint pen, they should be designed to allow a post-cut stun if required; this is for any animals that are declared as non-kosher, non-halal, or take a prolonged period to die. Furthermore for both restraint systems the cutting technique needs to be sufficient to achieve complete severance of the major blood vessels of the neck to allow for exsanguination.

4. CURRENT SITUATION OF THE RESTRAINT PRACTICES OF BOVINE ANIMALS SLAUGHTERED WITHOUT STUNNING

Task leader: V. Marzin (*Institut de l'Élevage*)

INTRODUCTION

The objective of this part of the study was to provide an overview of the general situation of meat production and restraining practices used for religious slaughter in the European Union and in some third countries.

In the EU, we emphasized the current situation in six Member States (Belgium, France, Italy, Spain, The Netherlands and the United Kingdom) where further investigations and assessment were carried out in slaughterhouses during the project. In these countries, details were collected, at slaughterhouses level, about the restraint devices used and the restraining procedure for slaughtering bovine animals without stunning. The situation was not further assessed in Germany because no slaughter without stunning was performed according to the competent authorities at the time we contacted them¹.

METHODOLOGY

The data collection was based on a two-step survey in Member States.

The competent authorities were firstly interviewed to collect general information on slaughter without stunning, implementation of the Regulation (EC) No 1099/2009 and if possible practices in terms of type of restraining systems in use (**Annex 1**). This survey was carried out in all Member States and in some third countries.

In the second step, slaughterhouses licensed to practice slaughter without stunning in six Member States (FR, BE, UK, NL, ES, IT) were sent a questionnaire (**Annex 2**) to get information about their used restraint system and operating procedure.

It was first intended to carry out the detailed investigations in Ireland but the answer to the questionnaire from the competent authority was received too late to allow us to include Ireland in our sample.

¹ Slaughter without stunning is performed in Germany according to a recent audit DG(SANCO)2014-7073 but probably at a very limited scale.

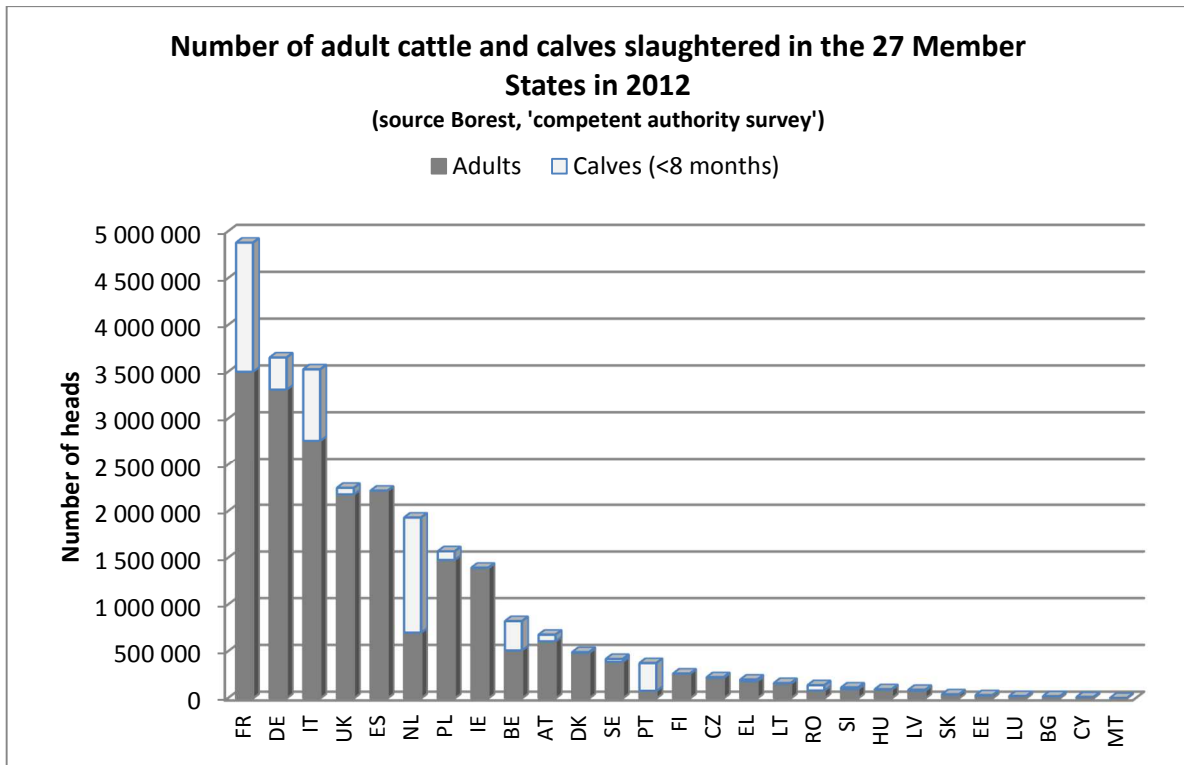


Figure 4 : Number of adult cattle and calves slaughtered in the 27 Member States
(Source: BoRest study “competent authorities survey”-Data: 2012)

Table 6 : General situation of slaughter without stunning practices in the 27 Member States
(Source BoRest study “competent authorities survey”-Data: 2012)

<p>Member states where slaughter without stunning was performed in 2012</p> <p>(* slaughter without stunning was allowed only if a post-cut stun was applied)</p>	<p>Austria*</p> <p>Belgium</p> <p>France</p> <p>Hungary</p> <p>Ireland</p> <p>Italy</p> <p>Latvia*</p> <p>Portugal</p> <p>Romania</p> <p>Slovakia*</p> <p>Spain</p> <p>The Netherlands</p> <p>United Kingdom</p>
<p>Member States where slaughter without stunning was not performed in 2012 (forbidden or not performed for other reasons)</p>	<p>Cyprus</p> <p>Denmark</p> <p>Estonia</p> <p>Finland</p> <p>Germany</p> <p>Lithuania</p> <p>Luxemburg</p> <p>Malta</p> <p>Poland</p> <p>Slovenia</p> <p>Sweden</p>
<p>No data available</p>	<p>Bulgaria</p> <p>Czech Republic</p> <p>Greece</p>

RESULTS

The questionnaires have been collected from 23 Member States including all the selected countries. Conversely, no data was received from Bulgaria, Czech Republic and Greece.

One of the expected results from the questionnaire sent to competent authorities was the list of slaughterhouses known to perform religious slaughter. We expected to use these lists to submit to the second questionnaire for a detailed analysis of the practice in these slaughterhouses. However, it appeared that in some countries, the list was not available because of lack of centralization or because of confidentiality rules; this was the case in France and the UK respectively. In these countries, slaughterhouses were identified from other sources (for example, from knowledge of partners, animal welfare non-governmental organizations and industry organizations). In other case, the list obtained needed to be updated. In Italy, for instance, based on phone call, it appeared that one third of slaughterhouses listed are closed or do no longer perform slaughter without stunning.

OVERVIEW OF MEAT PRODUCTION AND RESTRAINT PRACTICES USED FOR RELIGIOUS SLAUGHTER OF BOVINE ANIMALS IN EUROPEAN UNION

NUMBER OF ANIMALS SLAUGHTERED IN THE 27 MEMBER STATES IN 2012

In the 27 Member States, 25 million bovine animals were slaughtered in 2012. It corresponds to almost 20 million adults and 5 million calves (**Figure 4**).

GENERAL SITUATION OF SLAUGHTER PRACTICES IN THE MEMBER STATES IN 2012

According to competent authorities, slaughter of bovine animals without stunning was performed in 13 Member States in 2012. However, three of these (Austria, Latvia and Slovakia) require slaughterhouses to systemically perform a stun after the throat cut.

On the other hand, 11 Member States didn't perform slaughter without stunning in 2012 (according to our respondents), because of a legal ban or for other reasons. Finally, the situation in Bulgaria, Czech Republic² and Greece was not included because no data were provided by these countries (**Table 6**).

² According to FVO report 2014-7060, slaughter without stunning is allowed in Czech Republic under very specific conditions.

Table 7 : Number of slaughterhouses officially registered in the selected Member States and number and percentage of slaughterhouses performing slaughter of bovine animals without stunning

(Source: BoRest study “competent authorities survey”-Data: 2012)

Member State	Number of slaughterhouses officially registered in the country	Number of slaughterhouses slaughtering bovine animals without stunning	Percentage of the slaughterhouses registered that perform slaughter without stunning
Austria	2,560	17	0,66%
Belgium	48	43	90%
France	210	99	47%
Hungary	64	10	16%
Ireland	31	7	23%
Italy	1,369	106*	8%
Latvia	48	2	4%
Portugal	41	No data	No data
Romania	100	5	5%
Slovakia	66	No data	No data
Spain	286	60	21%
The Netherlands	205***	67	33%
United Kingdom	227	18**	8%
TOTAL	5255	434	8%

* Current estimate based on partner contact suggest 74 plants slaughter without stunning (closed slaughterhouses or no longer performing slaughter without stunning)

** Data from September 2011, current estimates suggest less than 10 plants slaughter without stunning in the UK.

***Include all slaughterhouses of domestic ungulates

(<http://www3.vwa.nl/EUlijst%20SECTION%20I-Meat%20of%20domestic%20ungulates-Slaughterhouse.pdf>)

NUMBER OF SLAUGHTERHOUSES OFFICIALLY REGISTERED AND NUMBER OF SLAUGHTERHOUSES THAT PERFORM SLAUGHTER OF BOVINE ANIMALS WITHOUT STUNNING IN THE EU

According to the competent authorities, 10,294 slaughterhouses are officially registered according to Regulation (EC) No 853/2004 for slaughtering cattle in the 27 Member States.

Considering the 13 countries where slaughter without stunning is allowed, 5,255 slaughterhouses are officially registered. Of these, **434 have the possibility to slaughter cattle without stunning**, corresponding to 8% of the slaughterhouses.

Data provided by the different countries show that there is a huge difference between countries with a range of slaughterhouses approved varying from 10 to 90% of the total **(Table 7)**.

NUMBER AND PERCENTAGE OF ANIMALS SLAUGHTERED WITHOUT STUNNING IN THE EU

According to the competent authorities who answered to the questionnaire, 2.1 million bovine animals were slaughtered without stunning in 2012 (approximately 8% of the animals slaughtered in the EU). Nearly all of these animals were slaughtered in seven Member states (FR, NL, ES, UK, BE, IE, IT, sorted by descending number of bovine animals - **Table 8**). However, it should be noticed that this number of animals should be seen as a maximum because, in several slaughterhouses, post-cut stun may be performed depending on local agreements with religious authorities that are not known by the competent authorities. Furthermore, in some countries, figures collected in 2012 should be considered as rough estimation that need to be updated in particular because the conditions for the derogation were updated with the implementation of the new regulation in 2013 and because data were not routinely collected at the time of the study (e. g. France).

Table 8 : Number and percentage of bovine animals slaughtered with and without stunning in each of the 13 Member States where slaughter without stunning is performed
 (Source: BoRest Study “competent authorities survey”-Data: 2012)

Country	Number of animals slaughtered without stunning	% of animals slaughtered without stunning in the country
France	1,269,009	24%
The Netherlands	310,000	15%
Spain	222,226	10%
United Kingdom	151,661	6%
Belgium	82,468	10%
Ireland	46,741	3.3%
Italy	44,032	1%
Hungary	13,088	13.5%
Latvia	4,505	5%
Romania	2,798	2%
Austria	760	0,11%
Portugal	10	0.003%
Slovakia	2	0.005%
TOTAL	2 147 300	

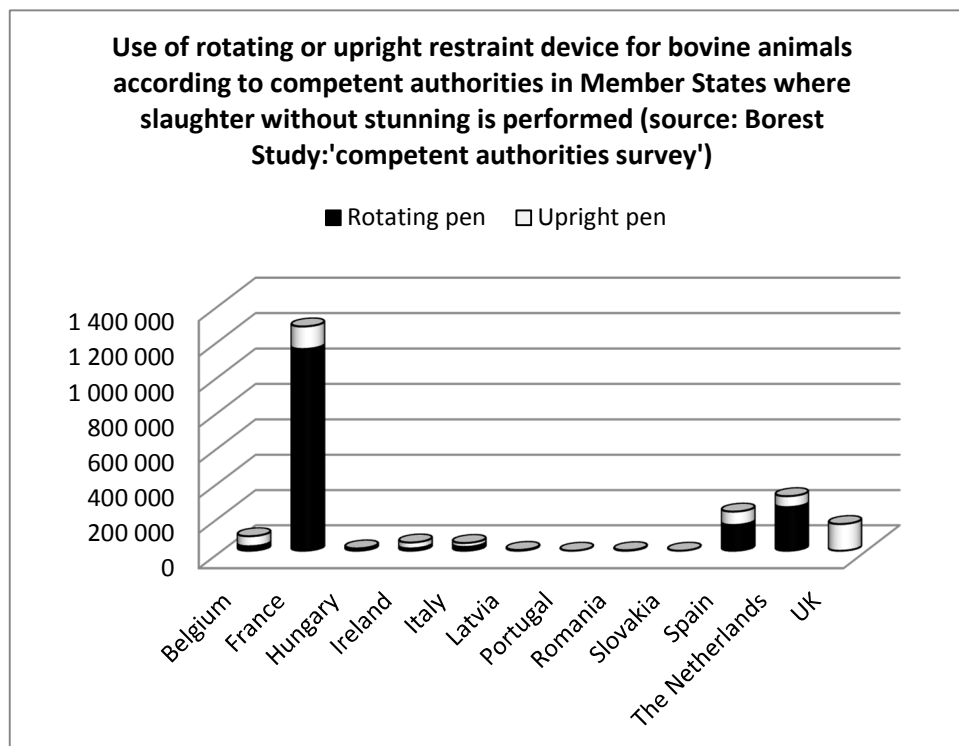


Figure 5 : Use of rotating or upright restraint device for bovine animals in the 13 Member States where slaughter without stunning is performed

(Source: BoRest Study “competent authorities survey”-Data: 2012)

RESTRAINT SYSTEMS USED IN THE MEMBER STATES WHERE SLAUGHTER WITHOUT STUNNING WAS PERFORMED

Rotating restraining systems are in use in all the main (in terms of number of bovine animals slaughtered without stunning) Member States with the exception of the United Kingdom where it is legally banned. These restraint systems are not in use in the following countries: Latvia, Portugal, Romania, Slovakia (**Figure 5**).

Based on the estimates provided in **Table 9**, it can be calculated that more than **1.6 million bovine animals are annually slaughtered without stunning in a rotating device** (78% of the animals slaughtered without stunning) while a little more than half a million are slaughtered in an upright device (22% of the animals slaughtered without stunning).

The United Kingdom represented 28.3% of the total of the animals slaughtered using upright device followed by Belgium (10.6%) and Ireland (6.2%) where more than two third of the bovine animals were estimated to be slaughtered with this system according to competent authorities.

On the contrary, in France, Hungary, The Netherlands and Spain, the rotating devices are the most frequent ones (70 to 99% of the animals). In France, this may be considered as a rough estimate because other sources gave higher percentage of plants using the rotating device. In Spain, according to the data collectors, the information provided by the competent authorities may have over-estimated the number of animals slaughtered in upright devices. This could be due to confusion between the restraint systems used for conventional and slaughter without stunning. In Italy, the numbers of animals are similar between the two restraint systems. This may be linked to a high number of small slaughterhouses involved, which did not invest in expensive restraining devices.

Table 9 : Use of rotating or up right restraint device for slaughter without stunning of the bovine animals according to competent authorities in the Member States in 2012*

(Source: BoRest study “competent authorities survey”-Data: 2012)

Country	Rotating device		Upright device	
	Number of animals	% of animals	Number of animals	% of animals
Belgium	25,565	31%	56,903	69%
France	1,142,108	90%	126,901	10%
Hungary	12,957	99%	131	1%
Ireland	13,555	29%	33,186	71%
Italy	22,016	50%	22,016	50%
Latvia	0	0%	4,505	100%
Portugal	ND	0%	10	100%
Romania	0	0%	2,798	100%
Slovakia	0	0%	2	100%
Spain	146,669	66%	75,557	34%
The Netherlands	248,000	80%	62,000	20%
United Kingdom	0	0%	151,661	100%
TOTAL	1,610,870	78%	535,670	22%

*no data is available for Austria

Table 10 : Implementation of regulation EC NO1099/2009 regarding religious slaughter in the Member States (Source BoRest study “competent authorities survey”-Data: 2013)

Member States where slaughter without stunning is allowed	<i>without any explicit authorization</i>	Belgium Portugal	Romania
	<i>under conditions provided by competent authority</i>	Ireland France Luxemburg Estonia Hungary	Germany Cyprus Italy Spain The Netherlands United Kingdom
	<i>only if a post-cut stun is performed</i>	Austria Slovakia	Latvia Estonia Finland
Member states where slaughter without pre-stunning is forbidden		Sweden Denmark Malta	Poland* Slovenia Lithuania
No data available		Bulgaria	Czech Republic Greece

*This ban has been considered unconstitutional in December 2014 but applied during the study.

SITUATION IN SOME THIRD COUNTRIES

Different attempts were made to get information (direct contact, sending of questionnaires) from North African and South American countries. Eventually, data were obtained from only Israel and Argentina

In Israel, 105,800 bovine animals were slaughtered in 2012. 100% of the animals were slaughtered without stunning in rotating devices.

In Argentina, 5,861,729 bovine animals were slaughtered in 2012 and 438,472 animals without stunning (7.5% of the animals slaughtered). According to the information received, 100% of the bovine animals slaughtered without stunning were slaughtered in upright position and there is no specific authorization for slaughterhouses.

ENFORCEMENT OF THE REGULATION (EC) No 1099/2009 ON THE PROTECTION OF ANIMALS AT THE TIME OF KILLING IN THE MEMBER STATES

Regarding the general situation in EU on practices for slaughter without stunning, at the time of this study (2013) and according to answers received, three main categories of countries can be identified: countries where religious slaughter without prior stunning is allowed without any explicit authorization, countries where religious slaughter without prior stunning is allowed under certain conditions (as an authorization provided by competent authority or a post-cut stun, for example), and countries where slaughter without pre stunning is completely forbidden (**Table 10**).

In Belgium, Portugal, and Romania, there is no specific condition for slaughterhouses to slaughter without stunning. Every slaughterhouse officially approved by the competent authority according to the Regulation (EC) No 853/2004 for slaughtering cattle is allowed to perform slaughter without stunning on the condition they comply with the Regulation (EC) No 1099/2009. Consequently, business operators are not obliged to inform competent authorities that slaughter without stunning is performed.

Conversely, in 11 Member States, food business operators must apply to the competent authority for official permission to slaughter without pre-stunning. In some countries, derogations have never been accorded by the relevant competent authorities or competent authorities answered that no animal was slaughtered without stunning in 2012 (Germany, Estonia, Finland and Luxembourg).

In other countries, the competent authority can have additional requirements to Regulation (EC) No 1099/2009 that concern the method to kill animals in accordance with religious rites.

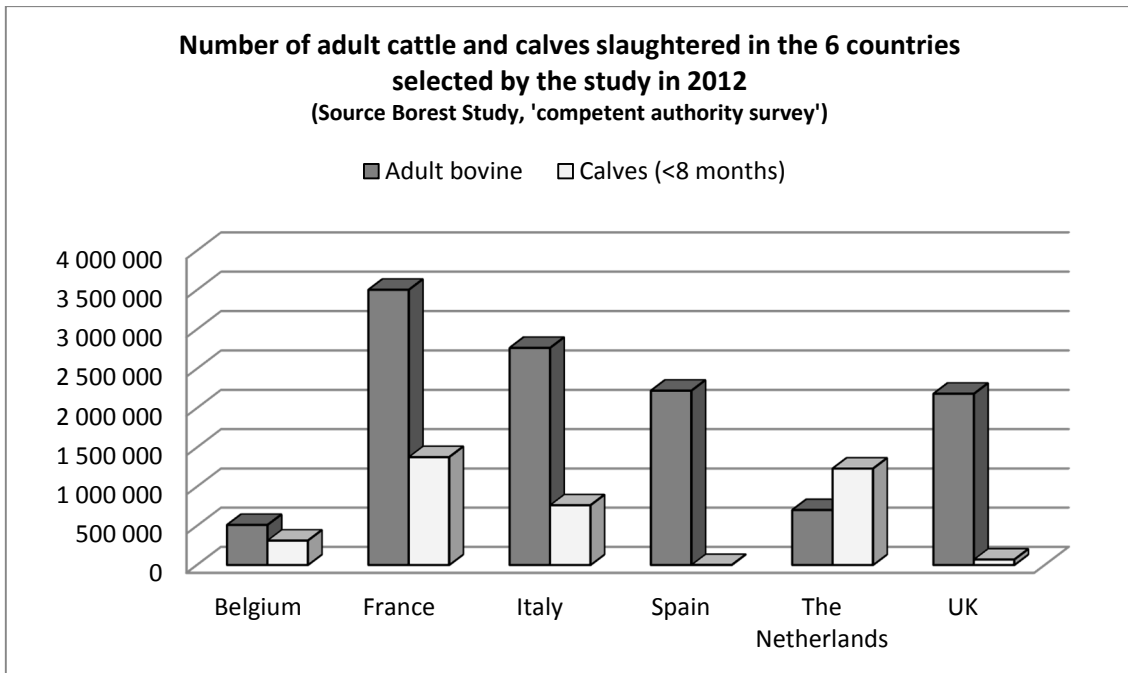


Figure 6 : Number of adult cattle and calves slaughtered in the 6 countries selected by the study
(Source: BoRest study “competent authorities survey”-Data: 2012)

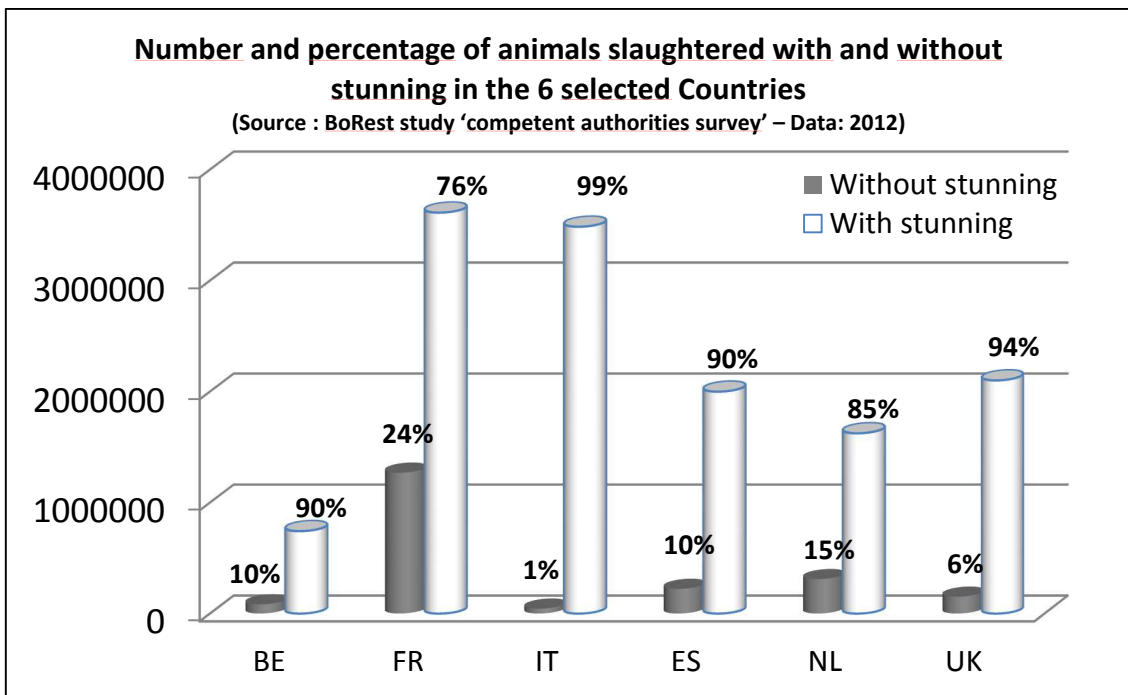


Figure 7 : Number and percentage of bovine animals slaughtered with and without stunning in the 6 selected countries in 2012
(Source: BoRest study “competent authorities survey”-Data: 2012)

For example in the United Kingdom, DEFRA has laid down several requirements in the WATOK (Welfare of Animals at the Time Of Killing) so that animals must be restrained in an upright position. In Latvia, Austria, Slovakia, Estonia, a post-cut stun applied immediately after the beginning of the bleeding process is mandatory. In Finland, stunning and bleeding at the same time (two operators) is mandatory according to the Animal Welfare Act (247/1996) in the presence of an official veterinarian. But no animal was slaughtered without stunning in 2012 in this country.

Finally, six Member States have forbidden the slaughter of cattle without stunning: Sweden, Denmark, Malta³, Poland⁴, Slovenia and Lithuania. However, in this last country, a discussion has been engaged to change actual legislation and allow slaughter without stunning.

So far, different additional rules may have been implemented in the Member States since the adoption of Regulation (EC) No 1099/2009 regarding ritual slaughter:

- Regarding the position of the animals during slaughter without stunning, upright position is mandatory in two countries (United Kingdom and Estonia). Furthermore, in the United Kingdom, all new slaughter restraint systems must be inspected and approved on behalf of the Minister. In the other Member States, no specific requirement has been specified in the survey by competent authorities.
- A traceability system for incoming and outgoing orders of meat obtained from animals religiously slaughtered has been implemented in 3 countries: Austria, France and Ireland. In these countries, slaughterhouses must have a written customer specification for meat from cattle slaughtered without pre stunning. They must demonstrate that numbers slaughtered match with customer orders.
- In France, the United Kingdom, Spain and The Netherlands, a minimum duration of restraining in the pen before releasing the animals must be respected. This duration is 45 seconds in the Netherlands and France, 30 seconds in the UK, while in Spain it depends on the regions (from 30 seconds to 5 minutes).
- Similarly, a minimum time between bleeding and processing is applied in France (5 minutes and 30 seconds) and in Spain (from 2 to 7 minutes depending on the regions). In Portugal and Germany, animals must not be hanged before their bleeding has ended.

³ Slaughter without stunning in Malta is legally possible but the Competent Authority had reached an agreement in 2008 with the religious community to carry out stunning prior to slaughter.

⁴ This ban has been considered unconstitutional in December 2014 but applied during the study

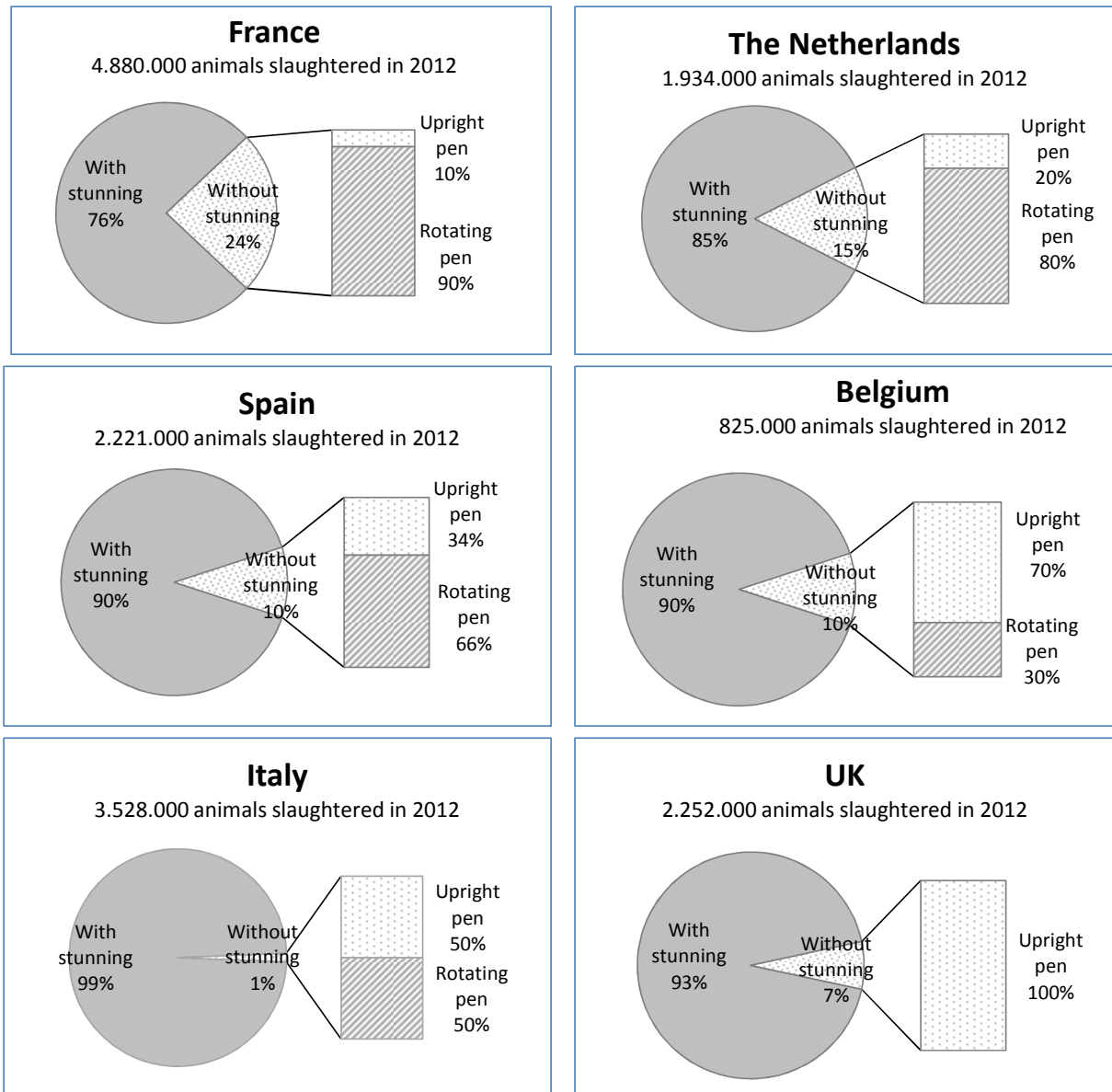


Figure 8 : Number and percentage of bovine animals slaughtered with or without stunning and restraining systems used to perform slaughter without stunning
 (Source: BoRest study “competent authorities survey”-Data: 2012)

Other additional requirements (e.g. sharpness of the knife, number of cuts, etc...) regarding the procedure exist in some Member States (for example, in France and the United Kingdom). Regarding how, in each country (2013), it is ensured that slaughterhouses employees dealing with live animals are competent regarding animal welfare, no answer was given by Italy, Hungary, Latvia, Romania, Finland, Spain and the United Kingdom. Almost all other Member States, mentioned training and licensing to reach this objective. Seven Member States mentioned also the presence of an Animal Welfare Officer (EE, FR, DE, IE, PT, SE and NL) in the slaughterhouses. Three countries (DK, FR, IT) mentioned the implementation of standard operating procedures.

OVERVIEW OF THE SITUATION IN SIX SELECTED MEMBER STATES IN 2012 (BE, FR, IT, NL, SP, UK)

Of the total number of bovine animals slaughtered in the EU (i.e. 20 million adults and 5 million calves), 60% of the adults and more than 80% of the calves are slaughtered in the 6 Member States selected for the second part of this study (**Figure 6**).

Slaughter without stunning of bovine animals takes place nearly entirely (97%) within these six Member States. It corresponds to 2,079,396 million bovine animals slaughtered without stunning. In these Member States, **393 slaughterhouses are approved to slaughter cattle without stunning** according to the Regulation (EC) No 853/2004.

According to the data, France accounts for more than 60% of the animals slaughtered without stunning in the selected countries. In France, nearly a quarter of the bovine animals are slaughtered without stunning. The Netherlands with 15% of the cattle slaughtered without stunning is the second Member States (**Figure 7**).

The situation regarding the percentage of animals slaughtered without stunning and the percentage of use of both types of devices in the 6 selected countries is synthesized in **Figure 8**.

Table 11 : Number of slaughtermen registered in the 6 selected Member States (Source: Borest study “competent authorities survey”-Data: 2012)

Country	Total	Dhabiha	Shechita
Belgium	unknown	73	unknown
France	unknown	unknown	unknown
Italy	unknown	unknown	unknown
Spain	40	39	1
The Netherlands	unknown	unknown	unknown
United-Kingdom	unknown	unknown	unknown

* Italy: Additional partial data were obtained by phone call from 17 plants but not included in this analysis

In most of the countries, the number of slaughtermen registered seems to be unknown (**Table 11**). In France, for example, this information is not available at the veterinary services level.

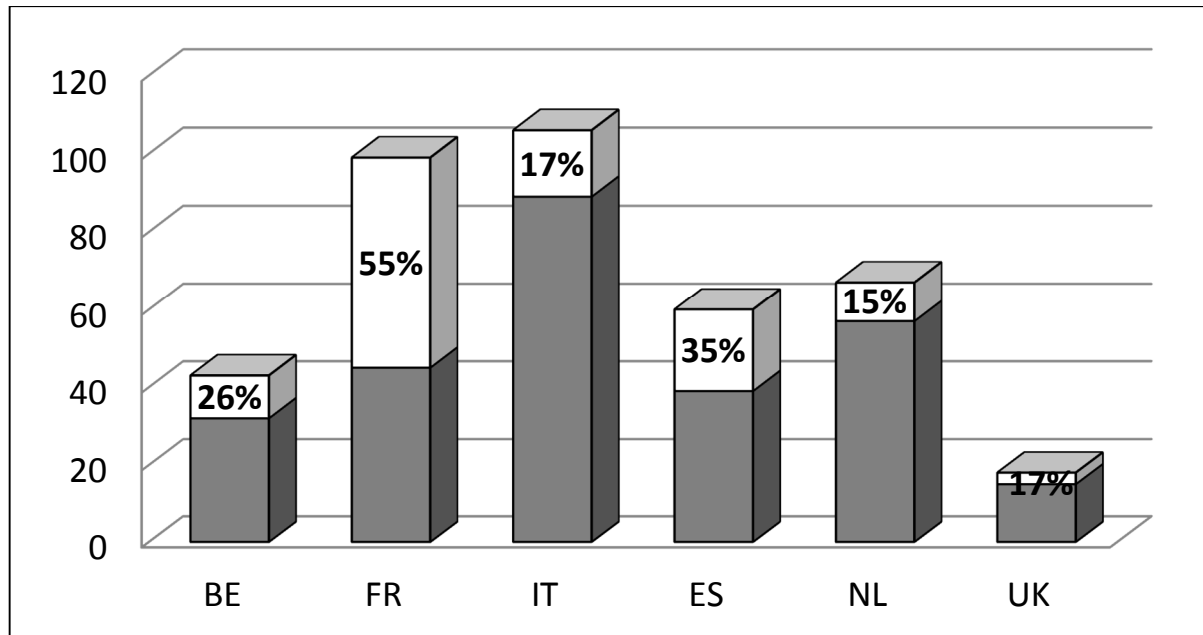


Figure 9 : Number and percentage of respondents to the survey compared to the total number of slaughterhouses licensed to perform slaughter of bovine animals without stunning in the selected countries

(Source: BoRest study “competent authorities survey”-Data: 2012)

Table 12 : Profile of the respondents of the slaughterhouses survey (calves: less than 8 months old - adult: more than 8 months old)

(Source: BoRest study “competent authorities survey”-Data: 2012)

Country	Number of respondents to the survey	Number of slaughterhouses which mainly slaughter adult cattle	Number of slaughterhouses which mainly slaughter calves	Number of slaughterhouses which mainly slaughter other species
Belgium	11	8	2	1
France	54	39	11	4
Italy	17	15	1	1
Spain	21	18	1	2
The Netherlands	10	7	1	2
United Kingdom	3	3	0	0
TOTAL	116	90	16	10

INVENTORY OF THE RESTRAINT DEVICES USED BY COMMERCIAL SLAUGHTERHOUSES PERFORMING SLAUGHTER WITHOUT PREVIOUS STUNNING IN SIX SELECTED MEMBER STATES

NUMBER OF RESPONDENTS TO THE SURVEY

The questionnaires (**Annex 2**) were sent to slaughterhouses in March 2013, it took up to four months for all the responses to be returned.

The mean response rate was 28% and ranged between 15 and 55% for the slaughterhouses that perform slaughter without stunning (Figure 9). Data from 116 slaughterhouses (approximately 30% of the estimated number of slaughterhouses performing slaughter of bovine animals without stunning in the surveyed Member States) were finally collected.

Table 12 describes the profile of the respondents to the survey by country according to the specialization of the slaughterhouse.

Responses were received from 90 slaughterhouses that mainly slaughter adult cattle (80% of them are located in France, Spain and Italy) and from 16 slaughterhouses that mainly slaughter calves i.e. bovine animals of less than 8 months old (France and Belgium mainly in terms of number of animals). Ten respondents were multispecies slaughterhouses, which mainly slaughter sheep and limited numbers of cattle.

NUMBER OF ANIMALS SLAUGHTERED IN THE SLAUGHTERHOUSES SURVEYED

The data collected in the 116 slaughterhouses through the survey covers more than 3 million bovine animals slaughtered: 2 million adults and 1 million calves (**Figure 10**). From these data, approximately one quarter of bovine animals (calves and adults) were slaughtered without stunning (737,134 animals), most of them being slaughtered according to Dhabihah (80% of the calves and 90% of the adult cattle slaughtered without stunning).

On average, **22% of the calves and 20% of the adults cattle are slaughtered according to Dhabihah. Shechita is carried out for approximately 5% of the calves and 3% of the adults slaughtered without stunning of this survey (Figure 10).**

All the slaughterhouses except one responded that they perform Dhabihah slaughter. Shechita is performed in 13 slaughterhouses for calves and in 17 slaughterhouses for adult cattle.

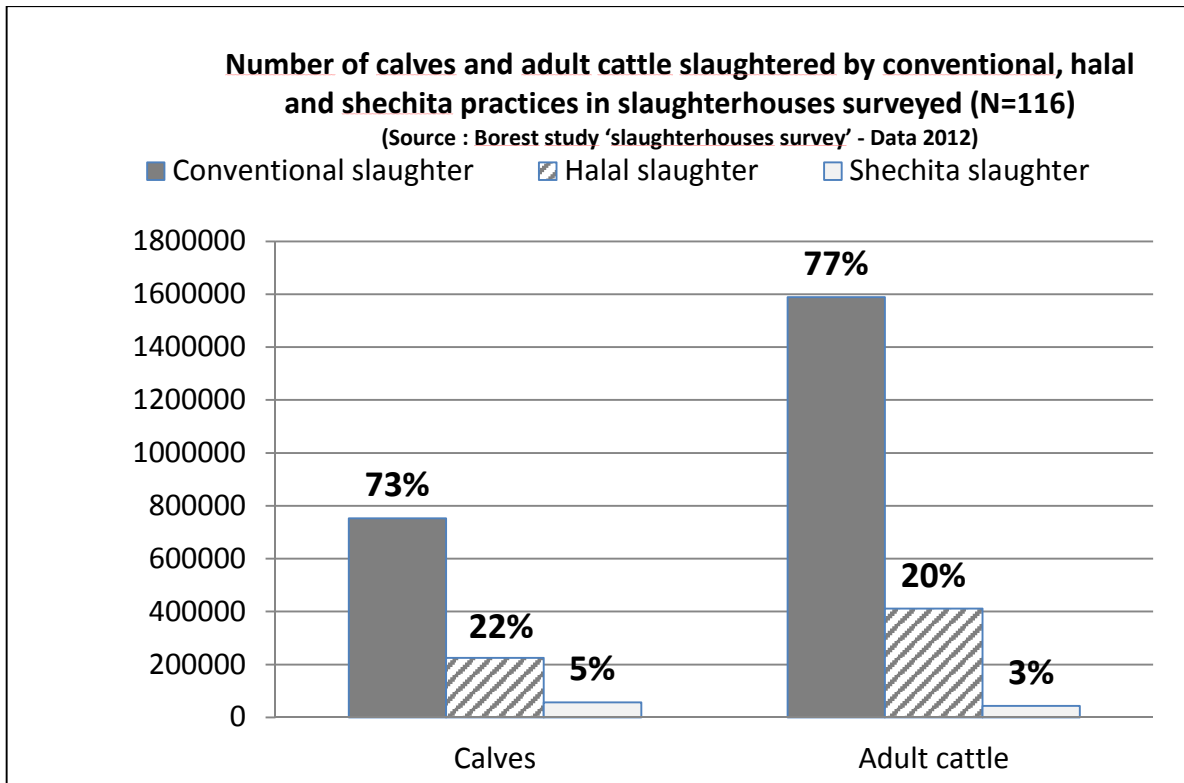


Figure 10 : Number of calves and adult cattle slaughtered according to conventional slaughtering, dhabiha and shechita rite in the 116 slaughterhouses surveyed (Source: BoRest study "slaughterhouses survey"–Data: 2012)

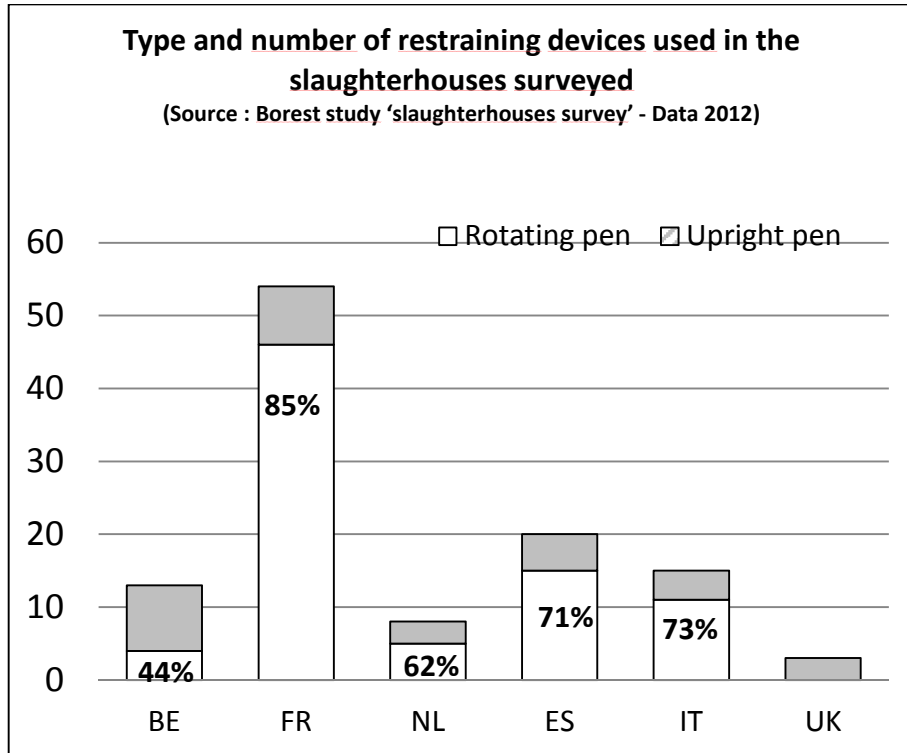


Figure 11 : Type and number of restraining devices used in the 116 slaughterhouses of the sample (Source: BoRest study "slaughterhouses survey"–Data: 2012)

TYPE AND NUMBER OF RESTRAINT DEVICE USED IN THE SLAUGHTERHOUSES

Of 116 respondents to the survey, seven did not give any answer to the question asking for the type of restraining system in use in the slaughterhouse mainly because they stun the animals systematically before sticking. Consequently, the following data on the use of restraining systems and practices is based on the answers of 109 slaughterhouses.

Overall, 70% of the slaughterhouses of the sample are using mainly a rotating restraint device (Figure 11). In all the countries, a majority of the slaughterhouses are using this device except in Belgium and in the United Kingdom where rotating devices are not permitted.

Regarding France, Spain, Belgium and the United Kingdom, these data are consistent with the estimates provided by the competent authorities. However, for the Netherlands, the rotating pen is less often present in the slaughterhouses of the sample compared to the estimates of competent authorities (62% instead of 80%). Conversely, regarding Italy, the use of rotating pen in the Italian slaughterhouses of the sample is more frequent than estimates by competent authorities (73% instead of 50%).

Of the 82 slaughterhouses that mainly slaughter adult cattle, rotating pens represent the majority (70%) of the restraint devices used. Conversely, in slaughterhouses that specialized in calf slaughter, the proportion is more balanced (**Table 13**).

In 48 slaughterhouses, the unique or most used restraint device is dedicated to adult cattle and in five slaughterhouses to calves. Thirty one slaughterhouses have restraint devices that can be adapted to slaughter either calves or adult cattle. It should also be noted that nine slaughterhouses have two restraint devices and when looking at the second equipment, it is always dedicated to one category of animals (two for adult and five for calves and two for others).

Table 13 : Type and number of restraining system installed in the slaughterhouse according to the main species slaughtered

(Source: BoRest study “slaughterhouses survey”–Data: 2012)

Main species slaughtered	Number of rotating pens	Number of upright pens
Adult cattle	58	24
Calves	8	6
Sheep	7	3
TOTAL	74	35

MANUFACTURERS AND MODELS

Thirty two different manufacturers (list in Annex 3) have been identified through the survey sent to the slaughterhouses while ten slaughterhouses have declared to have a self-made pen. In most of the cases, it seems however that this self-made pen is a modified commercial device.

Fifty percent of the devices in the sample are from three manufacturers (Facomia, Couedic Madoré and Vendramini) (n = 103) but it should be noted that this is the result of French market share of these manufacturers (80% of the total market share). In fact, **most of the manufacturers are local and few are present in the different countries**. In our sample, Banss and Couedic Madore are present in France and Spain, Nawi in Belgium and The Netherlands and Norman in Belgium and France. Furthermore, in countries other than France, there does not appear to be manufacturers with dominant market share.

Manufacturers are specialized in one type of device. Nevertheless, according to respondents, two manufacturers, Facomia and Couedic Madoré produce both rotating and upright restraint device. Regarding the first manufacturer it seems however that, in one slaughterhouse, it is a rotating device used in upright position. In the case of Couedic Madoré, this is explained by the existence of a classical rotating restraint device and of a “restrainer” i.e. conveyor with head restraint at one end that is used for calves exclusively in upright position.

When looking at the type of device, according to the respondents, it appears that approximately 80 different models are quoted. However this result should be interpreted in view of:

- Denominations are frequently inaccurate or unclear.
- Most of the manufacturers are only present in one slaughterhouse of the sample.
- 36 slaughterhouses have asked for major modification of the device (12 for the chin lift, 9 for adjustment for calves, and 15 for others).
- 10 slaughterhouses have self-made pen

The only model that appeared to be frequently quoted is the F7BV from Facomia which is consistent with the market share of this manufacturer and its long history in the field.

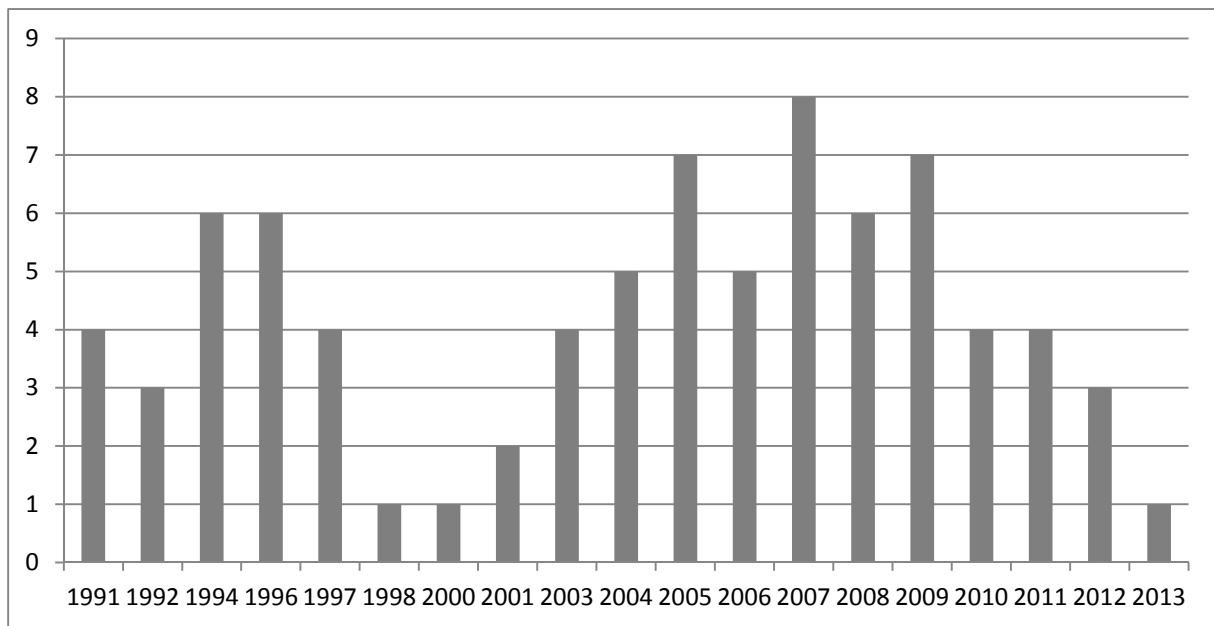


Figure 12 : Number of devices according to the year of investment

(Source: BoRest study "slaughterhouses survey")

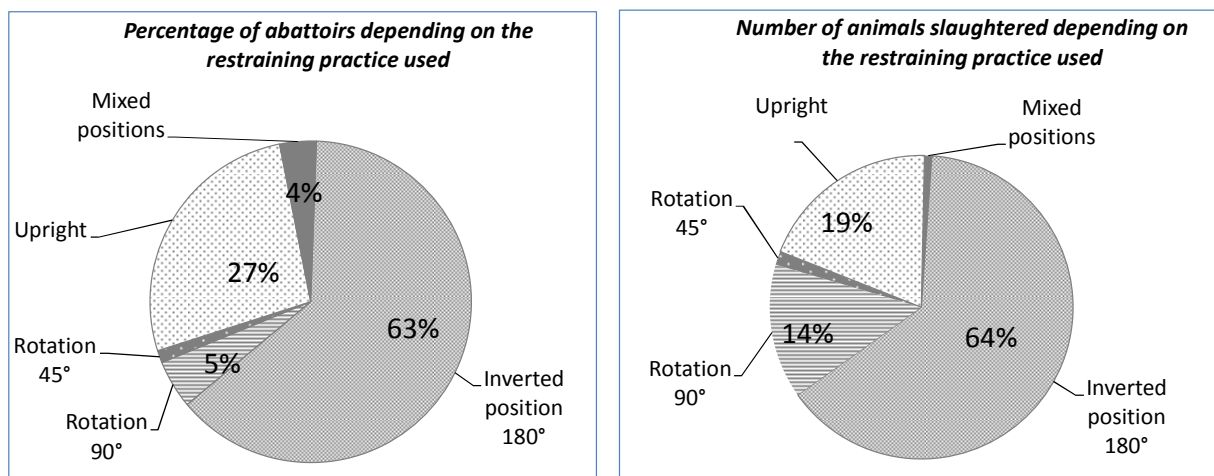


Figure 13 : Description of the restraining practices used to slaughter adult cattle in terms of number of slaughterhouses and in terms of number of animals slaughtered

(Source: BoRest study "slaughterhouses survey"—Data: 2012)

YEAR OF INVESTMENT

In the sample, two peaks of investment can be emphasized: in the mid-nineties and during the ten last years. But taking into account available data of the sample (n=81), **54 devices i.e. 67% are less than ten years old.** 11 slaughterhouses (not included in the **Figure 12**) answered that the device was built before 1990 but by looking at the model it appears that most of them were produced after this date i.e. major change/renovation have been carried out since the first investment.

RESTRAINT PRACTICES IN THE SLAUGHTERHOUSES

Using a rotating device may offer different possibilities of restraint practices depending on the angle of rotation and including an upright position.

Restraining practices for adult bovine

Overall, 323 020 animals in 60 slaughterhouses of the sample (76% of the adult cattle and 60% of the slaughterhouses) are slaughtered without stunning after rotation while 77 600 animals in 22 slaughterhouses (18% of the adult cattle and 20% of the slaughterhouses) are slaughtered without stunning in upright position. In the other 18 slaughterhouses which slaughter limited number of adult bovine animals according to Dhabiha (7% of the adult animals), stunning is reported by the respondents to be performed systematically before exsanguinations (only Dhabiha) and/or information is lacking.

In more than 60% of the slaughterhouses surveyed and for 64% of the adult bovine animals in the sample, the main restraining practice used for slaughter without stunning is “inverted position” (180° rotation on the back). It may be noted that, for the Shechita, in our sample, 75% of the adult bovine animals are slaughtered in inverted position compared to 58% for Dhabiha.

Only four slaughterhouses are performing the “90° rotation” (lateral recumbency) for the slaughter of adult cattle but this practice is quite relevant in terms of number of animals slaughtered (15% of the animals of the sample), and quite similar (in terms of number of animals) to the upright position (**Figure 13**). Finally, other restraint practices are a mix between different positions, generally including inverted position. The use of different position in the same slaughterhouse is due to the presence of several slaughtermen with different practices and procedures.

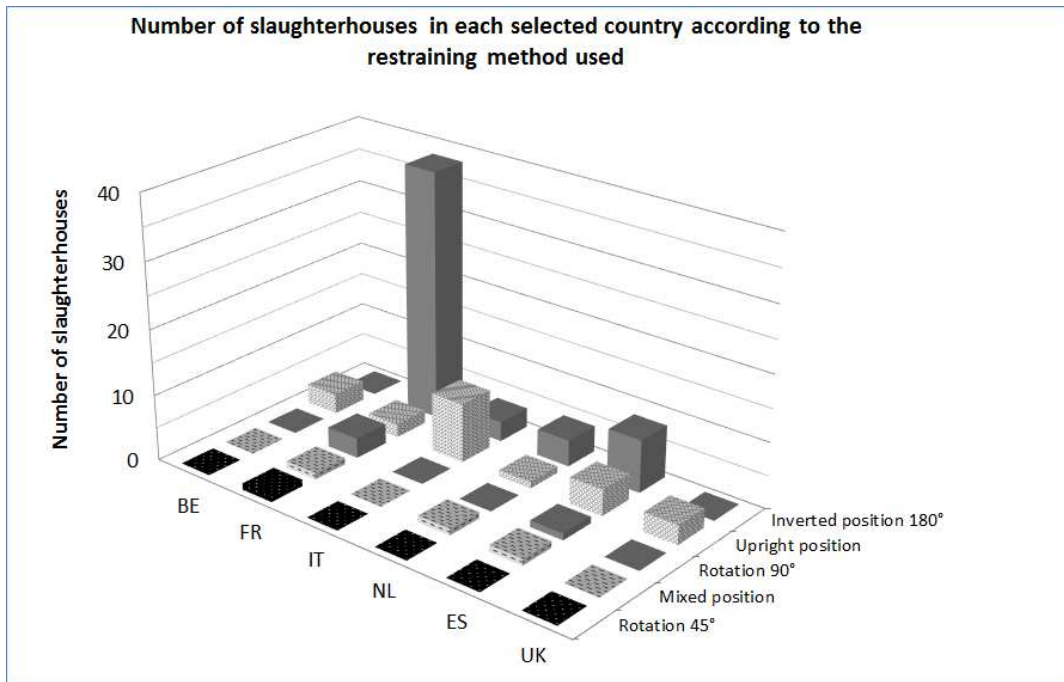


Figure 14 : Number of slaughterhouses according to the restraining practices used
 (Source: BoRest study “slaughterhouses survey”–Data: 2012)

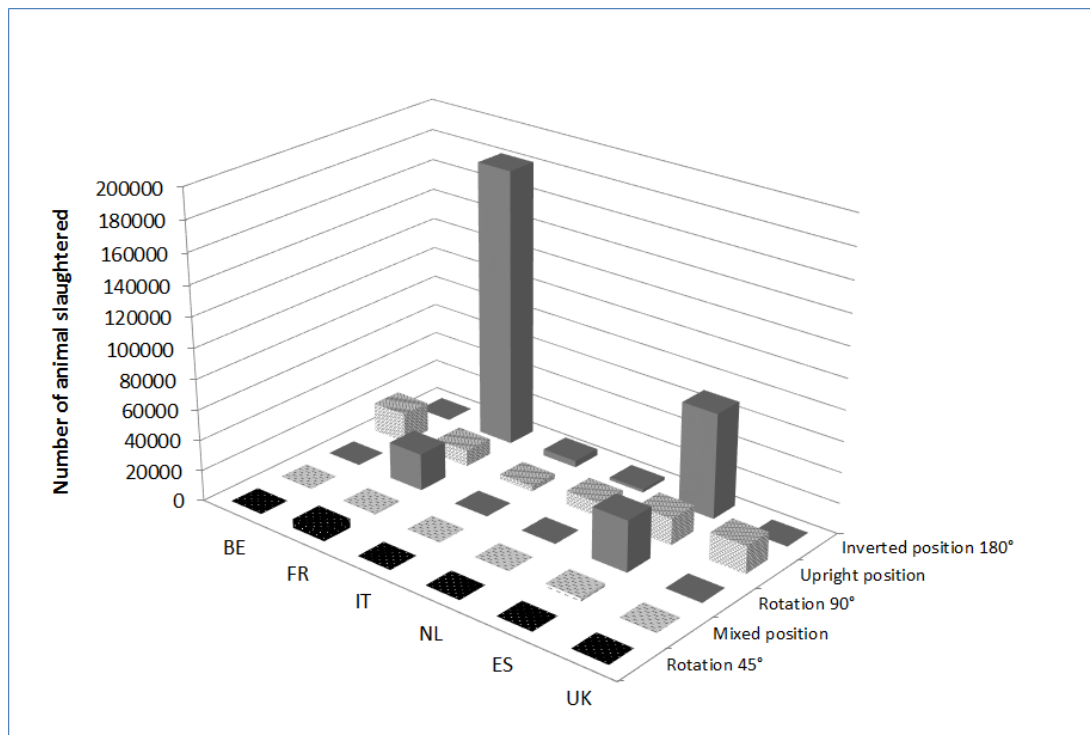


Figure 15 : Number of adult bovine animals slaughtered without stunning according to the restraining practices used in the 6 selected countries
 (Source: BoRest study “slaughterhouses survey”-Data: 2012)

When considering the countries of the sample, the situation in France and Spain is quite similar. The inverted position is the most widely used practice in slaughterhouses. Lateral recumbence is not frequently used but it is not negligible in terms of total numbers of animals slaughtered. Conversely, Belgium and the United Kingdom were similar by the exclusive practice of upright restraint for slaughter without stunning. In Italy and The Netherlands, the situation is more balanced but this is also due, in the case of The Netherlands, to the limited number of slaughterhouses in the sample (**Figures 14 and 15**).

Restraint practices for calves

Thirty slaughterhouses (65%) restrain calves in the inverted position, representing 57% of the animals. Restraint in lateral recumbence is used in one slaughterhouse, which is one of the largest plants in the survey. Similarly, it has to be noticed that “mix practice” (70% of the calves are bleeding in inverted position and 30% in upright position) is performed in one large plant. **Overall, it is estimated that 233 138 calves (83% of the sample) were slaughtered without stunning using rotating restraint practice.**

Consequently, **even if upright restraint is quite more frequent in terms of number of slaughterhouses (29%) compared to adult, it only represents 17% of the animals of the total sample (Figure 16).**

Differences between countries are not relevant because Belgium and France are the main contributors to the sample for calves with a reduced number of slaughterhouses in Belgium compared to France.

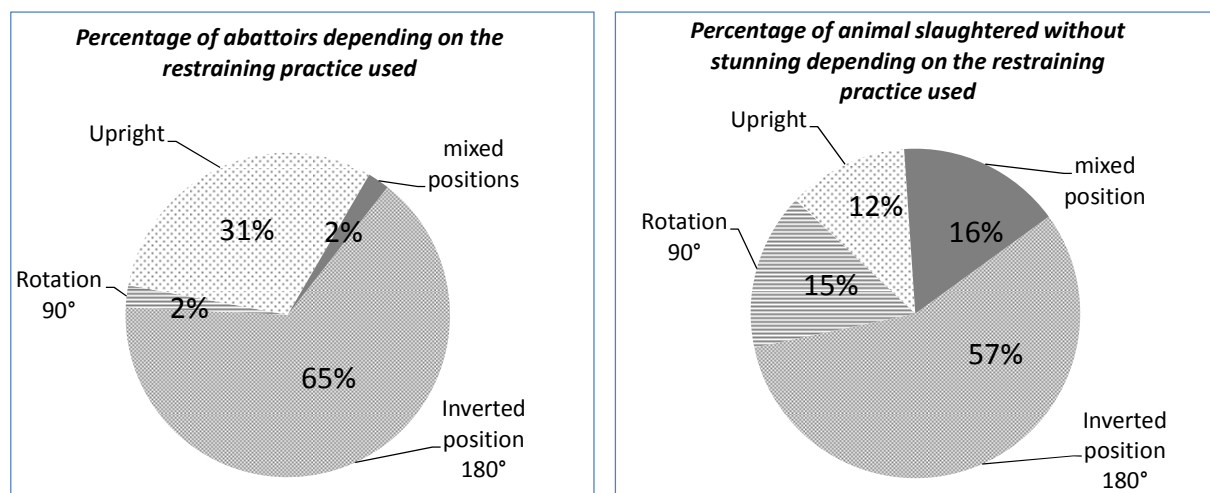


Figure 16 : Percentage of slaughterhouses and calves slaughtered without stunning according to the restraining practices

(Source: BoRest study “slaughterhouses survey”–Data: 2012)

Table 14 : Number of slaughterhouses and adult cattle slaughtered without stunning according to the device (manufacturer) and the restraining practice
(Source: BoRest study “slaughterhouses survey”-Data: 2012)

Restraining device	Manufacturer	Restraining practice	Number of devices	Number of adult cattle slaughtered
Rotating pen	Facomia	180°	21	83,073
	BANSS		3	71,011
	Couedic Madoré		6	28,801
	Vendramini		6	24,906
	SUCMANU		1	14,618
	MECÁNICAS GARROTXA		1	9,638
	Self made		3	6,939
	BEMO		1	5,377
	Emme		3	4,194
	Bulgarelli Engineering & Trade SRL		1	3,250
	SIBEMIA		1	2,347
	ROVANI		1	960
	Nuova Innocenti e Cipollini		1	30
	STORK	90/180	1	1,000
	Couedic Madoré	90	1	33,446
	BAERT		1	22,353
	BSM IA		1	1,575
	Facomia	45	1	5,875
	Norman	Upright	1	10,000
Upright pen	TAESA	Upright	1	14,110
	Self made		4	10,366
	AVI SILVA		1	10,000
	Baeten		1	8,500
	BERMEJO		2	3,014
	Facomia		1	435
	VITELLI / VITELLONI MASCHI E FEMMINE		1	229
	Bob Snarr		1	167

RESTRAINING PRACTICES RELATED TO THE DEVICE USED

As stated above, there are a wide variety of types of devices used by slaughterhouses in the sample. A large part of the market is shared by three manufacturers, while rest is made up of numerous small local manufacturers (upright or rotating).

When looking at the relationship between practices and manufacturers (**Tables 14 and 15**), it should be noted that:

- For both categories of bovine animals, there is no direct link between the frequency of device in slaughterhouses and the number of animals slaughtered with this device. This results from the size heterogeneity of slaughterhouses
- For both categories, a small number of manufacturers/device are used for a large part of the animals slaughtered without stunning in the inverted position while there is a more balanced situation in the upright position
- For adults, the 90° position is not linked to a particular device and is performed with 4 different ones
- For calves, when the upright position is used, the most frequent situation is the use of conveyors with head restraint at the end using a Couedic Madoré device (4 slaughterhouses and 22,134 calves).

Table 15 : Number of slaughterhouses and calves slaughtered without stunning according to the device (manufacturer) and the restraining practice

(Source: BoRest study “slaughterhouses survey” -Data: 2012)

Restraint device	Restraining Practice	Manufacturer	Number of devices	Number of animals slaughtered
Rotating pen	180°	Nawi	2	80,050
	180°	Facomia	16	54,942
	180°	Vendramini	6	20,554
	180°	Couedic Madoré	3	3,638
	UR/180 ° (30/70°)	Couedic Madoré	1	45,000
	180°	Norman	1	1,323
	180°	BEMO	1	781
	180°	BANSS	1	153
	180°	ROVANI	1	9
	180°	Self made	1	5
	90°	Nawi	1	43,094
	UR	Facomia	1	4,613
Upright pen	UR	Couedic Madoré	4	22,134
	UR	BSM IA	1	6,260
	UR	AVI SILVA	1	4,000
	UR	Facomia	1	2,598
	UR	J&W Services	1	1,065
	UR	Baeten	1	450
	UR	COMAZZI	1	357
	UR	Self made	2	281
	UR	Self made per vitelli/vitelloni	1	39

CONCLUSION

Regarding the general situation in the European Union in 2012

Of 25 million bovine animals slaughtered in the EU, more than 2 million are annually slaughtered without stunning, corresponding to 8% of the animal slaughtered. Of 24 Member States that answered the questionnaires, 13 have performed slaughter without stunning in 2012. Meanwhile, this practice was legally banned (or there is an agreement to not perform it) in five Member States at the time of the study.

There is significant variation in the numbers of animals slaughtered without stunning in the different Member States. In the EU: France, The Netherlands, Spain and the United Kingdom (which account for approximately 45% of the total cattle slaughtered in the EU) account for 84% of all cattle slaughtered without stunning, while Belgium, Italy and Ireland (which account for approximately 20%) only account for 8%.

In the EU, almost 80% of the animals slaughtered without stunning are slaughtered in a rotating pen and 20% in an upright pen. The slaughter of cattle in the inverted position is currently not permitted in 2 countries (the United Kingdom and Estonia). The use of rotating device is the most common practice in the other major countries (France, The Netherland and Spain).

Regarding the current situation in the six selected countries in 2012

Based on data collected from both competent authorities and slaughterhouses, rotating devices are the most widely used system, approximately 70% of the slaughterhouses⁵.

Inverted position is the most frequent restraint practice used in more than half of the slaughterhouses. Upright restraint is used in 20-30% of the slaughterhouses while other practices are mainly a mix between different practices or lateral recumbence.

The percentage of animals killed without stunning while restrained in inverted position is of 60% (64% of the adults and 57% of the calves), in upright position of 20% of the adults and 12% of the calves, in lateral recumbence of 15% for both with the remaining being a mix of different practices.

There is a large variety of manufacturers/models used for the restraint of cattle for slaughter without stunning. Manufacturers are generally specialized in one type of device.

⁵ All these estimations are including the United Kingdom where rotating devices are not permitted

Rotating restraint devices in the majority of slaughterhouses, and in particular in large scale slaughterhouses, originate from a few manufacturers. The remaining slaughterhouses source the rotating devices from many different, mainly local, manufacturers. Altogether, the “Facomia like” design is the most frequent and only a few devices seem to be based on different principles.

Regarding the upright restraint manufacturers/devices, almost all of the other slaughterhouses are using different manufacturers/devices. In The United Kingdom, due to the national requirements, upright devices are based on the ASPCA principles. In other countries, a larger diversity was observed.

Overall, most of the investments were recent ones with 67% of the devices less than 10 years old. This implies that most of the device are supposed to be used for the next decades.

5. ASSESSMENT OF WELFARE OF BOVINE ANIMALS SLAUGHTERED WITHOUT STUNNING USING DIFFERENT RESTRAINT DEVICES/PRACTICES

Task leaders: L. Mirabito (Idele), A. Dalmau (IRTA) and C. Terlouw (INRA)

INTRODUCTION

The main objective of this second step of the project was to analyze the animal welfare advantages and disadvantages of the different types of restraining systems commercially used in European slaughterhouses and to provide recommendations on good practice.

The results of the survey in slaughterhouses that are licensed to perform slaughter without stunning of cattle were used to define sampling principles and to select slaughterhouses in which observations would be carried out to assess the impact of the different restraining systems and operating procedure on animal welfare.

In this objective, a common methodology was elaborated and tested in slaughterhouses during a three days meeting, which was held in Girona in April 2013.

It was first planned that at least four slaughterhouses would be visited in five selected European countries (Spain, France, Italy, The Netherlands and The United Kingdom), one in Belgium and Ireland and a third country (Israel). The expected sample of slaughterhouses was defined on the basis of the results of the survey about practices and restraining systems used in slaughterhouses considering both categories of animals (calves and adults) separately. However, due to willingness of the slaughterhouses to participate to the study, eventually a total of twenty two different groups of animals (category of animals combined with restraining method) were assessed in eighteen locations. A total of 1113 bovine animals were observed.

Data collection took place from July to December 2013 by each partner in its country and monthly phone meetings were organized to finalize the analysis and the recommendations from January to April 2014.

The main results and conclusions are reported in this document.

Table 16: Characteristics of the slaughterhouses
(Source: BoRest study “assessment of welfare”)

Slaughterhouses	Number of cattle slaughtered per year (dhabiha or shechita)	Total number of animals studied	Line speed	Slaughter method	Post-cut stunning	Animal position during the cut	Device manufacturer	Head restraint
ADULT CATTLE (n = 780)								
SH1	9,700	60	20	Dhabiha	No	180 °	Mecanicas Garrotxa SA	Metal chinlift
SH2	33,500	60	30	Dhabiha	Yes	180 °	Couedic Madore	Metal chinlift
SH3	6,000	20	18	Dhabiha	No	180°	Home made	Metal chinlift
SH4	11,000	60	22	Dhabiha	Yes	180 °	BANSS	Metal chinlift
SH5	38,000	60	30-40	Dhabiha	No	180°	BANSS	Metal chinlift
SH6	10,488	57	20-22	Dhabiha	No	90°	Facomia	Metal chinlift
SH7	-	63	30-34	Dhabiha	No	150 °	Norman	Metal chinlift
SH8	2,747	15	48	Dhabiha	No	180 °	Sceria	Metal chinlift
	3,919	36	48	Shechita				
SH9	3,425	60	20-25	Dhabiha	No	180 °	Bulgarelli Engineering & Trade srl	Metal chinlift
SH10	400	60	10	Dhabiha	No	90 °	Mancini IMAS	Rope
SH11	470	60	10	Dhabiha	No	0°	Home made	Rope
SH12	960 (adult cattle and calves)	24	12	Shechita	No	180 °	Rovana	Metal chinlift
SH13	15,000	61	21	Dhabiha	No	180 °	NAWI	Metal chinlift
SH14	14,500	56	30	Shechita	No	0°	-	Metal chinlift
SH15	7,800	28	20	Dhabiha	No	0 °	JC Engineering	Metal chinlift
CALVES (n = 333)								
SH16	45,000	64	30	Shechita	No	180 °	Couedic Madore	Metal chinlift
		4		Shechita		0 °		
		5		Dhabiha		0 °		
SH8	20,301	58	44	Shechita	No	180 °	Vendramini	Metal chinlift
SH12	960 (adult cattle and calves)	36	12	Shechita	No	180 °	Rovana	Rope
SH17	1,250	16	20	Shechita	No	180 °	Home made	Metal chinlift
	150,000	82	60	Dhabiha	Yes	0 °		
SH18	87,000	68	80	Dhabiha	No	180 °	NAWI	No chinlift

MATERIAL AND METHOD

DESCRIPTION OF THE SAMPLE OF GROUPS OF ANIMALS

Slaughter plants were first sampled according to the following principles:

- Categories of animals (calves and adult cattle)
- Position of the animal at the time of bleeding (Upright, inverted and lateral recumbence)

For the Rotating device:

- Main manufacturers in term of number of slaughterhouses and animals slaughtered without stunning in inverted position for both categories of animals (i.e. Facomia Couedic Madoré, Vendramini/Sceria, Nawi, Banss)
- Random sampling of at least one slaughterhouse restraining bovine animals in lateral recumbency
- Sampling of slaughterhouses to provide a “picture” of national diversity
- Additional slaughter plants were added to the sample when it was known that special devices/practices were carried out.

For the upright device:

- Random sampling of at least an slaughterhouse using conveyor for calves with head restraint at the end
- Sampling of slaughterhouses to provide a “picture” of national diversity included as far as possible “special” design

The British, Dutch and Israeli partners encountered difficulties getting access to slaughterhouses (due to management refusals). Furthermore, the delayed answers from Ireland to the first survey prevented us from contacting the Irish slaughterhouses. Consequently, the final number of slaughterhouses visited was lower than expected in these countries. To compensate, five groups of animals in total were observed in France, Italy and Spain. Some difficulties were also encountered regarding the availability of slaughterhouses with restraining systems other than rotating device. For example, in France, upright position using a rotating device and upright position using a conveyor of calves were no longer used in the two initially sampled (from survey 2) slaughterhouses of calves. Eventually, this study was carried out in eighteen locations representing 22 different groups of bovine animals (combinations of category of animals and restraining practices - **Table 16**). Thirteen slaughterhouses performed slaughter without pre stunning of adult bovine animals, three performed slaughter without pre stunning of calves and the last two slaughtered both categories of animals. In two slaughter plants, we observed bovine animals slaughtered in inverted and upright position in the same device.

The slaughterhouses were located according to the following distribution: five in Spain, four in France including one with two separate lines for adults and calves and one slaughtering calves in inverted and upright position, four in Italy including one slaughtering both adults and calves in the same device after adjustment, two in the Netherlands including one slaughtering calves in inverted and upright position, two in the UK and one in Belgium.

Slaughterhouses were very variable in terms of numbers of animals slaughtered without pre stunning: from limited numbers (< 5000 animals/year) to very large throughputs (> 80 000 animals/year). Average line speeds varied between slaughterhouses but the line speed observed during the observation days were similar to the average speed provided by the slaughterhouses.

Except in the United Kingdom, the majority of bovine animals slaughtered without pre stunning are killed in the inverted position. Attempts were made to visit slaughterhouses that slaughter bovine animals in the upright position in the other countries. In the Netherlands, the upright position for calves was also associated with performance of a post-cut stun (Dhabiha). In Italy, the upright position for adult bovine animals also involved the use of rope for head restraint (SH11). In France, one upright-slaughtering slaughterhouse was identified but refused to participate in the study and another one, specialised in calves, accepted but changed its operating procedure between the first survey and the visit. Then only a small number of animals slaughtered in the upright positions were observed here, after the observers requested this.

Regarding the rotating restraint device, the sampling was based firstly on the distribution of restraint devices in the different countries. The main manufacturers are therefore represented in the sample: Facomia, Couedic Madoré, Vendramini/Seria, Banss, Nawi and Norman. In the other slaughterhouses, restraining devices were either built by a local manufacturer or were “self-made” by the slaughterhouses. In two slaughterhouses, adult bovine animals were slaughtered in the lateral position.

At last, we also made attempts to identify some special restraint devices used in slaughterhouses that were thought to have a particular effect on animal welfare. The use of a mobile head restraint device for calves at the end of the conveyor was one of these systems but the slaughterhouse selected did no longer use it. One slaughterhouse was selected because of the use of a rotating device where the restraining device was not rotating around its own axis but followed a semi-circular path. One slaughterhouse used a concrete device with a window at the front end and the use of rope for the restraint of the head. Another slaughterhouse used a device consisting of two separate parts. In this case, when the first bovine animal is inverted and cut, the slaughterman introduces the second animal into the other part. Then after the bleeding and the release of the first animal, the restraining device turns around, the second animal is cut in inverted position and a third animal enters the part previously occupied by the first animal.

The number of animals observed per plant was set at an objective of 60 animals slaughtered. A total of 1113 bovine animals were finally observed during slaughter plant visits (780 adults – *more than 8 months* –and 333 calves – *less than 8 months*).

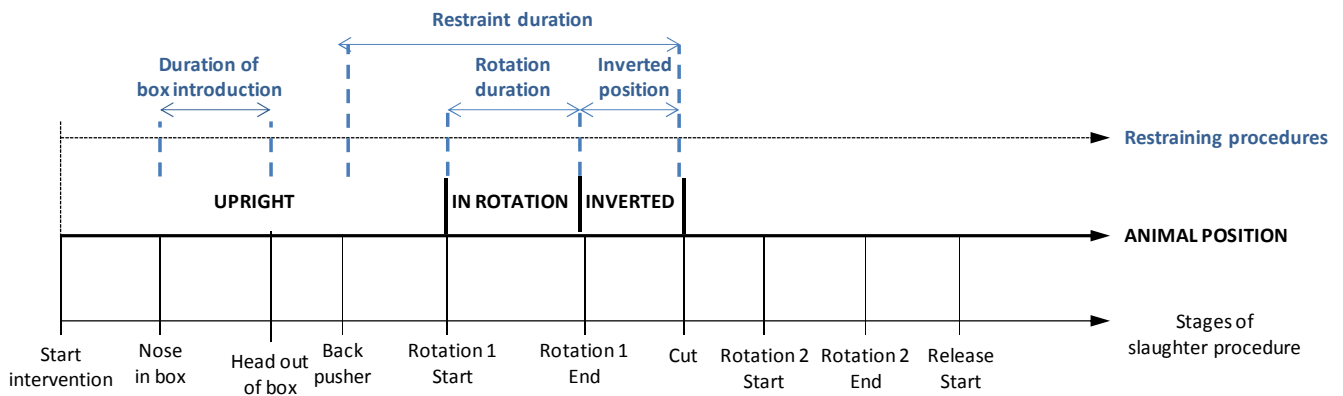


Figure 17 : Standard pattern of the used of rotating device

(Source: BoRest study “assessment of welfare”)

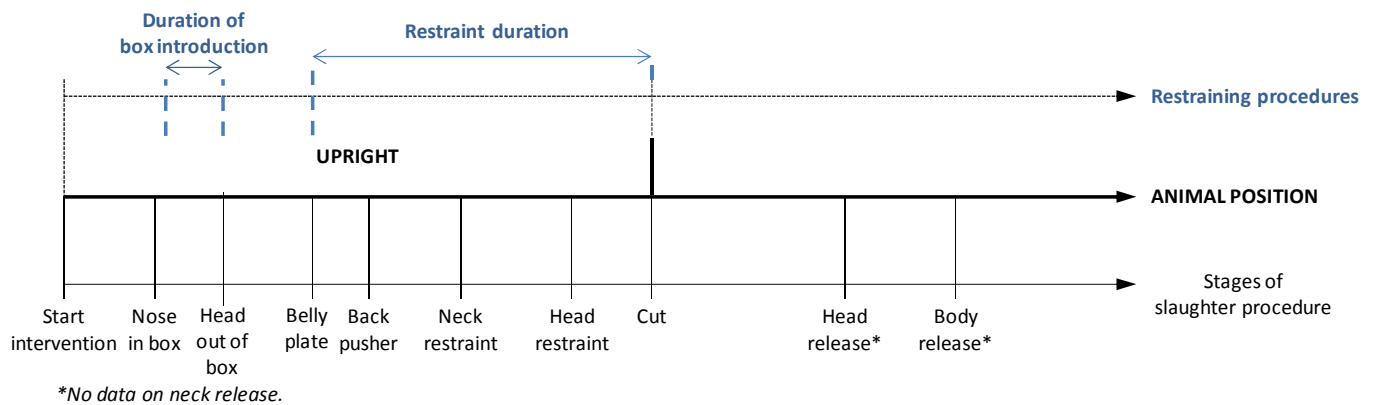


Figure 18 : Standard pattern of the used of upright device

(Source: BoRest study “assessment of welfare”)

MEASURES

PROCEDURES DEVELOPMENT

The first draft of the protocol was produced by the task leaders (C. Terlouw, INRA and A. Dalmau, IRTA) and sent to all partners by the end of March 2013.

Subsequently, a three days meeting was held in Girona (hosted by IRTA) with all project partners. During the meeting, the observation protocol was discussed and improved accordingly. Several local slaughterhouses were visited to test and refine the observation protocol. The output of the standardization meeting was a description of a list of variables that was discussed and finalized by mail in April 2013. Some additional descriptions were then added by V. Marzin and B. Ducreux (Institut de l'Élevage) after having tested some of the variables in slaughterhouses for another French project.

OVERVIEW OF THE FUNCTIONING OF THE DEVICE

The general patterns of the use of rotating and upright devices are described at **Figures 17 and 18**. The observations started when the animals were in the corridor before the entrance of the device. Then the animals start entering the device (nose in box), go through and have their head out of the device on the other side (head out of box). At this moment, the restraining procedure is started by activating the back pusher, the lateral pusher (or the belly plate in upright devices) and finally the head restrainer and the chin lift. Then the rotation takes place and, at the end of the rotation, the throat of the animal is cut. After the cut, the animals may stay in inverted position until the release or they can be rotated back again.

OBSERVATIONS

During the visits, we gathered information on:

- The layout of the area including the corridor, restraining device and releasing area
- The organization of the work (operators, slaughtermen) and the equipment used (**Annex 4**)
- The functioning of the device

Table 17 : Definition of the variables analysed

(Source: BoRest study “assessment of welfare”)

Period	
Duration of entrance	from “nose in device” at the back end to “head out of device” at the front end
Duration of restraint	from “back pusher” to “start cut”
Duration of rotation	from “start rotation” to “rotation completed”
Duration of inverted position	from “rotation completed” to “start cut”
Human-animal interactions	
Negative contact (entrance)	Tail twist + Door on back + Give a kick
Prod-use (entrance)	Electric prod used
Animal behaviour	
Stress-related behaviour (entrance)	Walk backwards + Walk forwards + Is compressed + Compresses + Is mounted + Mounts + Other
Slips and falls (entrance)	Slips + Falls
Vocalisations (entrance and restraint)	vocal sound intentionally expressed by the animal
Cut and bleeding	
Quality of head restraint	Judgment
Number of cuts	number of movements (total of backwards and forwards) of the blade while in contact with the neck tissue
Both carotids	Both carotids severed
Impeded flow	Impeded flow after the cut due to blood clot or other restriction
Signs of consciousness/unconsciousness	
spontaneous eyes movements	eyelids closing without previous pressure on the cornea
eyes convulsing	eye white visible, eyes turning inwards
loss of corneal reflex	absence of eye closure after a LIGHT touch on the canthus of the eye (brush fixed on a stick)
struggles (before or after cut)	movements involving the whole body, legs and possible head with the intention to escape from the situation
loss of posture	animal sitting or lying down. Apparent loss of posture: animals seems not to carry its weight but is carried by the restraining system.
Attempt to inspire	successful or unsuccessful inspiration movement discontinued with guttural sound

Moreover, we observed for each animal:

- Behavioral indicators of stress from the beginning of human intervention until its death (falls and slips, vocalizations and other behaviors).
- Human-animal interactions (use of electric prods and other negative contacts)
- The cut and indicators of bleeding efficiency
- The signs of consciousness

The details are given in **Annex 5, 6 and 7**.

Each slaughterhouse was visited for one or several days (according to the line speed) and a sample of animals were observed according to the methodology, which was commonly defined by the consortium.

Observations were carried out on animal behavior from the corridor to a minimum duration of 45 seconds after the cut. However due to technical limitations, it was not possible to observe all the variables in every slaughterhouses.

All observations were continuously voice recorded except the corneal reflex which was tested every 15 seconds after the cut.

For the analyses, we calculated the duration of the different period and, for a given period, the number of occurrence per animal and/or the frequency of animals that expressed or were subject of the behavior/events. The definitions of the variables are given in **Table 17**.

The variables were coded in MS Excel sheet. Descriptive statistics were calculated with Excel StatExact.

PLANNING

Data collection started in July and ended in December 2013.

Data analysis was carried out from January to April 2014.

Table 18 : Duration (s) of entry of the adult bovine into the restraint device (from “nose in box” to “head out of box”) (Source: BoRest study “assessment of welfare”)

	DURATION		
	Number of animals	Range	Mean (SD)
UPRIGHT			
SH11	60	1 – 25	7.2 (5.3)
SH14	56	0 – 20	2.0 (4.1)
SH15	28	0 - 139	15.4 (26.2)
LATERAL			
SH6	57	1 – 94	12.3 (16.4)
SH10	60	0 – 24	7.8 (5.5)
INVERTED			
SH1	60	0 – 58	8.5 (9.0)
SH2	60	3 – 48	13.6 (9.6)
SH3	20	2 – 23	13.0 (6.5)
SH4	60	2 – 52	12.4 (8.8)
SH5	60	3 – 72	14.6 (9.8)
SH7	63	0 – 38	6.9 (7.1)
SH8	51	1 - 130	10.1 (18.0)
SH9	60	0 – 53	19.3 (14.2)
SH12	24	0 – 50	9.6 (10.4)

Table 19 : Human-animal interactions (HAI) during entry of adult bovine into the restraining device (Range and Mean: occurrence per animal- Freq: %of animals) (Source: BoRest study “assessment of welfare”)

	Negative contact			Prod-use		
	Range	Mean (SD)	Freq	Range	Mean (SD)	Freq
UPRIGHT						
SH14	0 – 1	0.2 (0.3)	17.9%	0 – 8	1.1 (1.8)	50.0%
SH15	0 – 0	0 (0)	0.0%	0 – 3	0.3 (0.8)	17.9%
LATERAL						
SH6	0 – 1	0.04 (0.2)	3.5%	0 – 11	0.9 (2.3)	19.3%
INVERTED						
SH1	0 – 1	0.02 (0.1)	1.7%	0 – 4	0.4 (0.7)	36.7%
SH2	0 – 2	0.1 (0.4)	8.3%	0 – 13	1.4 (2.2)	55.0%
SH3	0 – 2	0.6 (0.8)	35.0%	0 – 2	0.1 (0.5)	5.0%
SH4	0 – 2	0.2 (0.5)	21.7%	0 – 17	0.5 (2.5)	8.3%
SH5	0 – 1	0.03 (0.2)	3.3%	0 – 10	3.0 (2.3)	90.0%
SH7	0 – 1	0.1 (0.3)	9.5%	0 – 6	0.7 (1.4)	31.7%
SH8	0 – 1	0.2 (0.4)	17.6%	0 – 10	2.8 (2.9)	58.8%

RESULTS

ENTRY OF THE BOVINE ANIMALS INTO THE RESTRAINT DEVICE (FROM “NOSE IN DEVICE” TO “HEAD OUT OF DEVICE” BEFORE START OF THE RESTRAINING PROCEDURE)

CASE OF ADULT BOVINE

Duration of entry into the restraint device (Table 18)

In most of the slaughterhouses, the time it took the adult bovine animals to enter into the device was between 5s and 15s. In some cases, this time could increase dramatically up to 2 minutes, the maximum time registered.

The layout of the area may explain some delays. For example, lighting environment was judged as “bad” by observers in SH2, SH3 and SH5. But, where the longest average duration was recorded (SH9), this result could be explained by the design of the device and the added factor that the animal was introduced in the second part of the device while the other one in the first part was being bleeding.

Human-animal interactions, in the corridor especially, also had an effect on duration of entry. For example, in SH14, the animals “ran” into the box in 2s because of a highly frequent use of the electric prod in the badly designed end of corridor.

Human-animal interactions into the restraint device (Table 19)

For 40% of the animals, there were no human-animal interactions during the entry into the restraint device. When human-animal interactions were observed, this was exclusively the use of electric prods (used in all slaughterhouses) for 137 animals over 293 (47%).

The use of electric prod was low in some slaughterhouses i.e. in SH3 and SH4 (less than 10% of the animals) while, in others, more than 50% of the animals were stimulated with an average number of prods higher than one per animal (SH8, SH2, SH5, SH14). The frequent use of the electric prod was linked to the design of the entry of the device (e.g. SH14) or to the behaviour of some operators who tended to use it repetitively on some animals with a counter-productive effect. (e.g. SH8).

Table 20 : Animal behaviour in the restraint device- Adult bovine
 (Range and Mean: occurrence per animal- Freq: %of animals)
 (Source: BoRest study “assessment of welfare”)

	Stress-related behavior			Fall or slip			Vocalisation		
	Range	Mean (SD)	Freq	Range	Mean (SD)	Freq	Range	Mean (SD)	Freq
UPRIGHT									
SH11	-	-	-	-	-	-	0 – 1	0.5 (0.5)	50.0%
SH14	0 – 5	0.5 (1.1)	7.1%	0 – 1	0.04 (0.2)	3.6%	0 – 6	0.3 (1.2)	10.7%
SH15	0 - 2	0.2 (0.5)	17.9%	0 – 0	0 (0)	0.0%	0 – 0	0 (0)	0.0%
LATERAL									
SH6	0 – 10	1.6 (2.3)	45.6%	0 – 0	0 (0)	0.0%	0 – 12	0.9 (2.1)	29.8%
SH10	-	-	-	-	-	-	0 – 1	0.6 (0.5)	60.0%
INVERTED									
SH1	0 – 1	0.2 (0.4)	15.0%	0 – 2	0.07 (0.3)	5.0%	0 – 1	0.02 (0.1)	1.7%
SH2	0 – 4	0.3 (0.7)	18.3%	0 – 9	0.6 (1.4)	31.7%	0 -	0.2 (0.4)	16.7%
SH3	0 – 1	0.1 (0.3)	10.0%	0 – 2	0.3 (0.6)	25.0%	0 – 6	0.3 (1.3)	5.0%
SH4	0 – 2	0.3 (0.5)	30.0%	0 – 1	0.02 (0.1)	1.7%	0 – 2	0.1 (0.4)	8.3%
SH5	0 – 2	0.3 (0.5)	26.7%	0 – 2	0.1 (0.4)	10.0%	0 – 6	0.6 (1.2)	30.0%
SH7	0 – 2	0.1 (0.5)	9.5%	0 – 1	0.1 (0.3)	9.5%	0 – 2	0.1 (0.4)	9.5%
SH8	0 – 1	0.04 (0.2)	3.9%	0 – 1	0.04 (0.2)	3.9%	0 – 10	0.7 (1.8)	19.6%
SH9	-	-	-	-	-	-	0 – 4	1.7 (1.3)	78.3%
SH12	-	-	-	-	-	-	0 – 1	0.5 (0.5)	50.0%
SH13	0 – 2	0.4 (0.6)	29.5%	0 – 3	0.05 (0.4)	1.6%	0 – 1	0.05 (0.2)	4.9%

Negative contacts (i.e. tail twist, door on back, give a kick or use the prod as a stick) other than the use of an electric prod were rarely observed (55 bovine animals and 1 interaction per animal almost exclusively when it happened) but in all slaughterhouses. There did not appear to be any link between the use of electric prod and the other negative behaviour of slaughtermen as, in some slaughterhouses, less relative use of the electric prod was associated with high relative other negative contacts (SH3, SH4) and the contrary (SH15, SH5) while, in others, the relative use was the same (SH6, SH1, SH8, SH14).

Animal behavior in the restraint device (Table 20)

Stress-related behaviours of the animals (Walk backwards + Walk forwards +kick + struggle) were observed in all slaughterhouses. Overall, 117 out of 576 animals expressed these behaviours. Except in SH6 where 44% of the animals expressed these behaviours, with an average of 1.6 behaviour/animal and a large variability, in the other slaughterhouses, the frequency varied between 4% (SH8) and 30% (SH4).

These behaviours did not appear to be directly linked to the human interactions and, in particular, the frequency of prod-use. In fact, these behaviours could depend on the emotional status of the animals, the operators' strategy and the environment that the animals encountered when seeing the outside of the device. This may explain that, for example in SH6, in spite of a handling that is supposed to be not too stressful, the animals expressed very frequently these behaviours.

Falls or slips were observed in a limited number of cases: 47 animals out of 576 animals (8%), including 19 animals out of 60 in SH2 (31.7%) and 5 out 20 in SH3 (25%). In these slaughterhouses however, observers noticed that the junction of the floor between corridor and the restraining device needed to be improved. We did not observe any clear relationship between the frequency of the use of the prod in the restraint device and the frequency of falls and slips.

In contrast, except for SH6 (and SH9 to 12 where the use of prod was not recorded), a positive relation was apparent between the frequency of prod-use and the frequency of vocalisations, which were expressed by 0 to 30% of the animals depending on the slaughterhouse.

Table 21 : Duration (s) of entry of the calves into the restraint device
(Source: BoRest study “assessment of welfare”)

	Duration		
	Number of animals	Range	Mean (SD)
SH8	58	5 – 16	8.7 (2.3)
SH10	36	1 – 12	2.8 (3.1)
SH16	73	0 – 30	5.7 (5.6)

Table 22 : Behaviour of the calves during the entry into the restraint device
(Source: BoRest study “assessment of welfare”)

	Stress-related behaviour			Vocalisation	
	Number of animals	Nb	% animals	Nb	% animals
SH8	58	0	0	0	0
SH10				18	50%
SH16	73	0	0	0	0
SH17	98	24	24.5%	19	19.4%
SH18	68	36	52.9%	-	-

ENTRY OF CALVES IN THE RESTRAINT DEVICE

The duration of entry of calves into the restraining device was estimated in three slaughterhouses (SH16, SH8, SH12) because it was impossible to distinguish between corridors and device in SH18 and SH17 (**Table 21**). The mean duration range was between 2.8s (SH12) and 8.6s (SH8) with more than 90% of the calves entering the box in less than 15s. This duration appeared to be lower than those observed for adults. As for the adult bovine animals, the shortest duration observed in SH12 could be explained partially by frequent negative human-calves interactions in the corridor just before the restraining device.

Human-calves interactions were observed in the device on a sub sample of animals in SH16 and SH17. Respectively, 66 and 71% of the calves were “handled” with an average number of interactions per animal of 1.1 and 1.4. No negative contact (i.e. tail twist, door on back, give a kick or use the prod as a stick) was observed, nor the use of electric prod.

No falls and slips were observed. 24.5% of calves expressed behavioural indicators of stress in SH17 and 0% in SH16 and SH8. Over 19.4% of the calves in SH17 and 50% in SH12 (probably in relation with human-calves interactions in the corridor) vocalized, none vocalized in SH16 and SH8 (**Table 22**).

CONCLUSION

In conclusion, the duration of the entry of the bovine animals into the restraint device could be very variable depending on the slaughterhouses. Almost half of the animals were handled without any interaction and the use of electric-prod was the most frequent negative interaction observed for the others. The lay-out of the end of the corridor / entry to the device and the human-animals interaction in this part are the main factors of variation. Human-animals interactions in the device, particularly the prod-use, could be inefficient and result in high frequency of vocalizing animals. Slips and falls were mainly related to the floor quality.

The duration of the entry of the calves in the restraining device appeared to be shorter and less stressful than those observed for adult bovine. However, it was again observed that the shorter duration observed was associated with intensive negative interaction in the corridor and this could also be linked with a high percentage of calves that vocalized.

It is not possible to set precise objective for the duration of entry into the device. The animal should be handle with care and remain as quiet as possible. Recommendation for the lay-out of this area are provided by different guidelines. It is however frequent that restraining devices were introduced later. This can explain some poor design due to existing constraints. Where relevant, progress in this point should be prioritized. Knowledge and skill of the handlers should also be improved as, in some cases, their behaviour appeared to have a counter-productive effect. Entry of the animals in restraint device is usually a critical point and therefore should be regularly monitored by the managers of the slaughterhouses.

Table 23 : Restraint durations (s) of adult bovines

(Source: BoRest study "assessment of welfare")

	Restraint duration <i>From start restraint to start cut</i>			Rotation duration <i>From start to end of the rotation inside "Restraint duration"</i>		Inverted duration <i>From end rotation to start cut inside "Restraint duration"</i>	
	Nb	Range	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)
UPRIGHT							
SH11	60	10 – 335	90.1 (60.5)	-	-	-	-
SH14	56	15 – 63	25.7 (9.6)	-	-	-	-
SH15	28	12 - 46	16.9 (7.2)	-	-	-	-
LATERAL							
SH6	57	6 – 55	23.0 (8.9)	1 – 6	3.8 (0.9)	0 – 52	3.18 (7.3)
SH10	60	23 – 208	83.5 (27.7)	2 – 40	10.1 (5.2)	0 – 12	3.95 (3.2)
INVERTED							
SH1	60	29 – 99	52.2 (16.1)	0 – 23	15.6 (3.0)	0 – 40	6.5 (7.5)
SH2	60	12 – 37	18.4 (5.7)	6 – 11	8.5 (1.6)	0 – 10	1.4 (3.5)
SH3	20	53 – 112	68.2 (13.5)	23 – 35	29.0 (2.9)	6 – 57	18.7 (10.8)
SH4	60	28 – 84	48.3 (13.3)	2 – 44	12.1 (4.8)	0 – 41	7.6 (7.9)
SH5	60	21 – 24	22.5 (2.1)	9 – 26	14.1 (2.9)	0 – 57	3.3 (8.2)
SH7	63	7 – 27	16.0 (4.1)	4 – 9	6.3 (1.3)	0 – 5	0.75 (1.0)
SH8	42	14 – 58	23.1	5 – 10	7.5	0 – 21	3.9
SH9	60	21 – 258	113.7 (44.8)	1 – 44	13.1 (8.02)	1 – 55	10.8 (7.3)
SH12	24	-	-	1 – 14	10.9 (2.9)	1 – 33	7.6 (9.4)

RESTRAINT PROCEDURE

ADULT BOVINE ANIMALS

Restraint duration (Table 23)

We observed a wide range of average restraint duration (start of restraint to start of cut), from 16s to 114s.

For the duration measured, we can distinguish between slaughterhouses where the mean durations were lower than 30s with maximum values lower than 65s (SH6, SH7, SH8, SH2, SH5, SH14, SH15) and slaughterhouses where the mean durations were higher than 60s with minimum values higher than 20s (SH9, SH10, SH11, SH3).

The position of the animals at the cut could not be linked to these mean durations. Both groups (short duration and long duration) included animals in the inverted position (SH6, SH7, SH8, SH2, SH5 and SH9, SH3 respectively), in the lateral position (SH6 and SH10 respectively) and in the upright position (SH14, SH15 and SH11 respectively).

On the contrary, all these results could be explained by the specifications of the device or the management of the animals. For example, with the double part rotating device observed (SH9), the restraint (not a full head and body restraint) of a given animal started while the previous one was already being bled and lasted until it was released out of the device. In SH3, the device used was not a "Facomia like" and did not turn around its own axis but following a semicircular path at a very low speed. In SH10 and SH11, ropes were used for the head restraint and the preparation of the animals took a longer time than with automatic head restraint.

At last, in SH1 and SH4, intermediate restraint durations were recorded. For SH4, this could be explained in part by difficulties encountered by the operators during the handling of the animals (animals offering resistance to the back pusher).

Duration of rotation (Table 23)

The duration of rotation (included in restraint duration) varied between 6s and 15s when the animals were inverted except in one case (SH3) where it took 29s in average to rotate the animals. Some extreme values (more than 40s) were observed in some slaughterhouses, generally linked to problems of head positioning.

Table 24 : Vocalisation of adult bovine during restraint
 (Range and Mean: occurrence per animal- Freq: %of animals)
 (Source: BoRest study “assessment of welfare”)

	Vocalisation during restraint		
	Range	Mean (SD)	Freq
UPRIGHT			
SH11	0 – 1	0.05 (0.2)	5.0%
SH14	0 – 0	0.00 (0.00)	0.0%
SH15	0 - 0	0.00 (0.00)	0.0%
LATERAL			
SH6	0 – 11	0.9 (2.1)	30.4%
SH10	0 – 1	0.07 (0.25)	6.7%
INVERTED			
SH1	0 – 2	0.2 (0.5)	11.7%
SH2	0 – 1	0.05 (0.2)	5.0%
SH3	0 – 2	0.1 (0.45)	5.0%
SH4	0 – 5	0.1 (0.7)	3.3%
SH5	0 – 1	0.1 (0.3)	13.3%
SH7	0 – 3	0.2 (0.6)	15.9%
SH8	0 – 6	0.6 (-)	30.9%
SH9	0 – 2	0.1 (0.4)	10.0%
SH12	0 – 1	0.04 (0.20)	4.2%
SH13	0 – 5	0.4 (1.1)	13.1%

Where the animals were inverted, the lowest duration observed in SH7 could be explained by the final position of the animal which was 150° rather than 180°. The longest duration recorded in SH3 was directly linked with the specific design of the restraint device (semi-circular path) and the low speed of rotation.

Where the animals were restrained in lateral position (90°), the two slaughterhouses were quite different with mean duration of 3.8s in SH6 and 10.1s in SH10.

Duration of inverted or lateral position (Table 23)

Where bovine animals were rotated, the mean duration between the end of the rotation and the start of the cut (included in the restraint duration) varied within the interval of 1s and 18.7s.

These differences could be explained by the organization of work in SH3 where the operator in charge of the cut was most of the time out of the bleeding area. On the contrary, in SH7, operating procedure has been optimized to reduce this delay. It should also be noticed that limited range of variation (0-5s in SH7 and 0-10s in SH2) were associated with the lowest mean duration observed in these slaughterhouses confirming the possibility of optimization.

At last, in the two slaughterhouses where animals were cut in lateral position, the average duration was similar and equal to 3 or 4 seconds.

Vocalisation during restraint and rotation (Table 24)

Except in SH6 and SH8, where 30% of the animals vocalised, and in SH14, SH15 where no animals vocalised, the frequency varied between 3% (SH4) to 16% (SH7).

Animals may vocalise at several steps of the process. Rotation in itself, even if it is a stressful procedure (which is characterised by some specific reactions of the eye balls), may not be the main factors. Poor head restraint (in particular hyperextension) was often linked to vocalisation.

Quality of head restraint

Head restraint was carried out using either a classical metal equipment or a rope halter (SH10 with an additional metallic chin lift, SH11).

During the cut, the knife was seen, in certain cases, coming in contact with the head restraint (SH16, SH7, SH11 and SH13).

Table 25 : Frequency of adult bovine with a “bad head restraint” according to the slaughterhouse
(Source: BoRest study “assessment of welfare”)

	Number of animals	nb	% animals with “bad head restraint”
UPRIGHT			
SH11	60	60	100%
SH14	56	3	5.4%
SH15	28	0	0%
LATERAL			
SH6	51	1	1,7%
SH10	60	0	0%
INVERTED			
SH1	7	6	85.7%
SH4	9	9	100%
SH5	36	36	100%
SH7	63	2	3,2%
SH9	60	3	5%
SH12	24	0	0%
SH13	61	61	100%

Table 26: Restraint durations (s) of calves

(Source: BoRest study “assessment of welfare”)

	Restraint duration <i>From start restraint to start cut</i>			Rotation duration <i>From start to end of the rotation inside “Restraint duration”</i>		Inverted duration <i>From end rotation to start cut inside “Restraint duration”</i>	
	Nb	Range	Mean	Range	Mean (SD)	Range	Mean (SD)
SH8 inverted	46	15 – 32	20.3	4 – 7	5.8 (-)	0 – 6	3.8 (-)
SH12 inverted	36	-	-	5 – 19	12.4 (2.7)	6 – 55	26.6 (10.5)
SH16 inverted	73	10 – 196	23.8	4 – 13	6.9 (1.8)	0 – 13	2.6 (3.0)
SH16 upright	9	5 – 16	8.4	-	-	-	-
SH18 inverted	68	-	-	3 – 7	4.7 (0.7)	0 – 6	1.5 (1.1)

Head restraint was judged as “bad” almost systematically in some slaughterhouses (SH11, SH13, SH1, SH4, and SH5) (**Table 25**). In others, the frequency varied from 0% (SH10, SH15) to 5% (SH9, SH14) with SH6 and SH7 in-between. In SH1, SH4 and SH5, bad head restraint was systematically associated with the start of the rotation before the end of the head restraint. In SH11, the use of rope was considered as not satisfactory by the observers. In SH13, animals were able to move their head after restraining. Head movements or bad head positioning were generally the reason why the observers considered the head restraint as bad in the other slaughterhouses.

CASE OF CALVES

Restraint durations were measured in SH16 and SH8 and varied between 23.8s and 20.3s. In SH16, based on the nine calves cut in upright position, we also calculated duration of 8.4s of restraint in upright position. Rotation duration varied between 4.7s and 6.9s in SH18, SH16 and SH8. The duration in SH12 was more than twice of those observed in other slaughterhouses (12.4s). The time spent in inverted position by the calves was less than 3.8s in SH18, SH16 and SH8 but 26.6s in SH12 (**Table 26**). The results obtained in SH12 suggested an inadequate management of the calves that could be explained by the use of rope for head restraint which induced a very bad head restraint of the animals (100% - **Table 27**). Head restraint was also judged as bad for all the animals in SH18 in relation with the lack of real head restraint. A specific design was present in this slaughterhouse with the head restrained simultaneously with the body by a mobile part situated on the top of the device

Calves did not vocalize during the restraint in SH18 and SH8 and only 1 out of 36 did in SH12. In SH16, 10.9% of the calves slaughtered in inverted position and none of the 9 in upright position vocalized but the contrary was recorded in SH17 where 18.3% of the animals slaughtered in upright position vocalized and none of those slaughtered in inverted position (**Table 27**).

Table 27: Vocalization and quality of head restraint of calves
 (Source: BoRest study “assessment of welfare”)

	Number of animals	% animals with “Vocalization”	% animals with “Bad head restraint”
SH8 inverted	47	0%	-
SH12 inverted	36	2.8%	100%
SH16 inverted	64	10.9%	17.2%
SH16 upright	9	0%	0%
SH17 inverted	16	0%	0%
SH17 upright	82	18.3%	0%
SH18 inverted	68	0%	100%

CONCLUSION

Restraint duration is one of the key factors regarding the risk of poor welfare when animals are slaughtered without stunning. It is expected that the longer it is the higher the risk to have an impaired welfare. Rotation and duration in the inverted position will increase the stress of the animals.

Regarding the duration of immobilization, our results show that, with the current operating procedure and restraint devices used, the mean duration observed to perform all these operations are in the same range of time duration using a rotating system or an upright system for adults. The duration measured confirmed the reduction of the time needed to restrain the animals by using modern rotating device ("Facomia-like") compared to older design (Dun et al., 1990).

In the present study, the main factors that increase the duration of restraint are the design of the device (especially with some particular rotating device observed during our visits), the head restraining procedure (manual vs automatic independently of the restraint system) and the optimization of the process (operator ready to perform the bleeding at the end of the head restraint or rotation).

The time it takes to rotate the animals can be less than 10s and represents, in the optimized situation observed, approximately one third of the total restraint duration. Using the upright position may allow reducing the total duration when using the same device. But due to the limitation of the sample size, the behaviour of the calves and the fact that this device does not include any belly plate, this remains theoretical.

In most of the slaughterhouses visited, the animals spent less than 10s in inverted position. It is possible to optimize the operating procedure to reduce this duration. Evidence from this study show that the cut can be performed immediately at the end of the rotation. In order to do so, a good head restraint before the rotation and a sufficient number and well organised operators are of particular importance.

Vocalization could be an indicator of stress of the animals. Regarding the different position, our results suggest that they are less frequent in the upright position for adults but no conclusion can be drawn for calves. For improvement, it would be of particular relevance to interpret vocalization regarding the different step of the restraining procedure e.g. vocalizations associated with risk of hyperextension and vocalizations associated with inverted position.

Table 28 : Number of cuts per animal - Adult bovine

(Range and Mean: occurrence per animal)

(Source: BoRest study "assessment of welfare")

	Nb	Range	Mean (SD)	Method	Knife length
UPRIGHT					
SH11	60	8 – 28	15.1 (4.4)	D	30
SH14	56	1 – 6	3.3 (1.5)	S	NA
SH15	28	3 - 4	2.5 (0.2)	D	20
LATERAL					
SH6	57	1 – 10	5.2 (1.5)	D	36
SH10	60	4 – 11	5.8 (1.6)	D	40
INVERTED					
SH1	60	1 – 9	3.7 (1.6)	D	26
SH2	60	4 – 18	10.3 (2.4)	D	26
SH3	20	1 – 3	1.2 (0.5)	D	26
SH4	60	4 – 23	8.5 (4.4)	D	26
SH5	60	3 – 22	8.8 (3.7)	D	26
SH7	63	2 – 4	2.4 (0.6)	D	45-50
SH8	51	2 – 8	4.4 (2.2)	S + D	45
SH9	60	4 – 15	8.7 (2.0)	D	30
SH12	24	1 – 4	1.7 (0.8)	S	45
SH13	61	2 – 8	3.6 (1.4)	D	45

D: Dhabiha, S: Shechita

CUTTING AND BLEEDING

NUMBER OF CUTS FOR ADULTS

Fifteen animals out of 726 adult bovine vocalised during the cut. This happened mainly in SH6 (6 animals) and occasionally in SH7, SH9, SH10, SH11 and SH13. It could be noticed that the highest frequency of animals vocalizing during restraint was also recorded in SH6 suggesting also an effect of the emotional status of the animals.

The average number of cuts varied from 1.2 to 15.1 depending on the slaughterhouses (**Table 28**). However, the variability per slaughterman was relatively low suggesting that number of cuts is a good indicator of the practice or the skill of the operator.

The highest number of cuts was observed in SH11 (15.1) where the animals were in the upright position but, on the contrary, in SH14 and SH15 (also upright), the mean number of cuts varied from 2.5 to 3.3 and were similar to those recorded in other slaughterhouses where the bleeding was performed in the inverted position (SH7, SH12, SH13, SH1, SH3).

Where the cut was performed with the animals restrained on the side, the results were similar in the 2 slaughterhouses (5.2 to 5.8 – SH6 and SH10). This could suggest increased number of cuts in this position but it is difficult to draw firm conclusions as we also observed higher number of cuts in slaughterhouses where animals were in the inverted position (SH9, SH2, SH4, and SH5).

The length of the knife used by the operators varied from 20cm to 45cm and there was no obvious relation between this specification and the number of cuts.

The Jewish operators (SH12 and SH14) performed the cut with a limited number of movements (1.6 and 3.3 respectively) but, even though the variability was higher between Muslim operators, we observed similar number of cuts for several Muslim slaughtermen (SH7, SH13, SH1, SH3, and SH15).

The objective data do not allow to directly link the number of cuts to the quality of head restraint but according to observers, there were obvious relations in some cases e.g. in SH4 and SH5.

Table 29 : Quality of bleeding – Adult bovine
 (Source: BoRest study “assessment of welfare”)

	Number of animals	% animals with no « Both carotids » severed		% of animals with impeded flow	
		Nb	Freq	Nb	Freq
UPRIGHT					
SH11	60	2	3.3%	0	0%
SH14	37	5	13.5%	5	9.1%
SH15	28	0	0%	6	21.4%
LATERAL					
SH6	57	1	1.8%	10	17.5%
SH10	60	17	28.3%	8	13.3%
INVERTED					
SH1	25	2	8%	2	3.4%
SH2	60	2	3.3%	0	0%
SH3	20	0	0%	-	-
SH4	60	1	1.7%	4	6.7%
SH5	60	0	0%	10	16.7%
SH7	63	0	0%	0	0%
SH8	42	0	0%	18	42.8%
SH9	60	9	15%	4	6.7%
SH12	24	0	0%	0	0%
SH13	31	1	1.6%	6	9.8%

QUALITY OF BLEEDING OF ADULTS

Both carotids cut

On average, one carotid was not severed in 5.4% of the animals (**Table 29**). Relative high level were observed in all three positions. 8.0% and 15% where slaughter was performed in inverted position (in, respectively, SH1 and SH9), 28.3% where slaughter was performed in lateral position (SH10) and 13% where the animals were in upright position (SH14).

The type of slaughter (Shechita and Dhabiha) did not appear to have an effect.

Impeded flow

Overall, “impeded flow” was observed in 9.8% of the animals (**Table 29**). The highest levels were recorded in SH6, SH8, SH10, SH5, SH14, and SH15 where more than 15% of the animals showed “impeded flow”.

This result may suggest that the lateral position (SH6, SH10) or upright position (SH14, SH15) may lead to an increased risk for “Impeded flow”. In SH15, for example, the observers reported that after the animals were cut, the lower part of the neck made contact with the metal part of the restraint device and this appeared to cause physical occlusion of the vessels and “impeded flow”.

However, it should also be noticed that in SH8 and SH5 (animals in the inverted position), high frequencies were also recorded, linked to poor skills of slaughtermen according to the observers.

In most of the cases “impeded flow” was clearly linked with blood clots and both variables were generally similar when they were both observed.

Blood in trachea

Blood in the trachea was assessed in sub samples of SH8, SH13, SH1, SH2, SH3, SH4, SH5 representing 148 animals. Presence of blood was observed in almost all the animals (except 4 animals).

Table 30 : Number of cuts per animal - calves
 (Range and Mean: occurrence per animal)
 (Source: BoRest study “assessment of welfare”)

	Nb	Range	Mean (SD)	Method	Knife length
SH18	68	1 – 2	1.0 (0.1)	D	30
SH12	36	1 – 4	1.8 (0.8)	S	45
SH16 inverted	64	3 - 7	4.7 (0.8)	S	42
SH16 upright	9	2 - 3	2.9 (0.33)	S+D	42
SH17 upright	82	1 - 2	1.1 (0.2)	D	40
SH17 inverted	16	1 – 5	2.8 (1.3)	S	40
SH8	58	2 – 4	2.6 (0.7)	S	40

D: Dhabiha, S: Shechita

Table 31 : Quality of bleeding – calves
 (Source: BoRest study “assessment of welfare”)

	Number of animals	% animals with no « Both carotids » severed		% of animals with impeded flow	
		Nb	Freq	Nb	Freq
SH8	46	0	0%	25	54.3%
SH12	36	4	11.1%	5	13.9%
SH16 inverted	64	4	6.3%	43	67.3%
SH17 upright	82	0	0.0%		
SH17 inverted	16	0	0.0%	9	56.3%
SH18	19	1	5.3%	12	63.2%

NUMBER OF CUTS AND QUALITY OF BLEEDING OF CALVES

It should be noticed firstly that, except in SH18 and SH17 upright, all the animals were bleeding according to the Shechita. It appeared that the mean number of cuts when Dhabiha was performed was lower (1.0 – 1.1) than when Shechita was applied (1.8 – 4.7). This could be explained by the religious requirement of absence of “knife pressure” for the Shechita. Overall, only one calf vocalized during the cut.

The mean number of cuts for calves was generally lower than those observed for adults with less extreme value. Regarding the position of the animals at the cut, when Dhabiha was performed, the number of cuts was similar between the inverted (SH18) and upright position (SH17 upright). In the other slaughterhouses, all the animals were cut in inverted position according to the Shechita method (**Table 30**).

Nine calves out of 283 were observed with only one carotid severed representing 5.3% to 11.1% of their respective groups (SH18, SH16, and SH12). The frequencies of animals with “impeded flow” were high in all the slaughterhouses (range 13.9% - 63.2%) (**Table 31**).

CONCLUSION

The number of cuts can be similar when the animals are slaughtered in upright or in inverted position. From this study, the skill of the operators appeared to be the main factor of variation. Overall, when adult animals were cut in upright position, our results suggest a higher risk of impeded flow in relation with the head movement of the animals during bleeding and the design of the device.

The number of cuts per calve is reduced compared to adults. But the frequency of animals with impeded flow is higher suggesting a need for further research and improvement.

Due to the limited number of observations, no firm conclusion can be drawn regarding the effect of lateral position. However, our results suggest some possible negative effects on the number of cuts and the quality of bleeding and further investigations are needed.

Table 32 : Frequency of animals with spontaneous eyes movements according to the period after the cut (Source: BoRest study “assessment of welfare”)

Group	Time elapsed from the start of cut					
	0-15s	15-30s	30-45s	45-60s	60-75s	75-90s
LATERAL						
total SH6 (n°)	51	51	51	39	25	0
"Yes" (n°)	35	7	2	2	0	-
"Yes" (%)	68.4	13.7	3.9	5.1	0.0	-
total SH10 (n°)	60	60	60	60	60	60
"yes" (n°)	60	28	0	0	0	0
"yes" (%)	100.0	46.7	0.0	0.0	0.0	0.0
INVERTED						
total SH1 (n°)	60	60	60	60	60	60
"yes" (n°)	52	13	2	0	0	0
"yes" (%)	86.7	21.7	3.3	0.0	0.0	0.0
total SH3 (n°)	20	20	20	20	20	20
"yes" (n°)	19	2	0	0	0	0
"yes" (%)	95.0	10.0	0.0	0.0	0.0	0.0
total SH5 (n°)	60	60	60	60	60	60
"yes" (n°)	54	5	2	1	1	0
"yes" (%)	90.0	8.3	3.3	1.7	1.7	0.0
total SH7 (n°)	62	62	61	25	37	49
"Yes" (n°)	37	24	8	7	4	5
"yes" (%)	59.7	38.7	13.1	28.0	10.8	10.2
total SH8 (n°)	42	42	42	0	0	0
"Yes" (n°)	27	8	4	-	-	-
"Yes" (%)	64.3	19.1	9.5	-	-	-
total SH13 (n°)	58	61	61	61	58	50
"yes" (n°)	58	60	57	50	34	21
"yes" (%)	100.0	98.4	93.4	82.0	58.6	42.0
CALVES – INVERTED						
total SH8 (n°)	46	46	46	0	0	0
"Yes" (n°)	39	12	2	-	-	-
"Yes" (%)	84,8	26,1	4,35	-	-	-
total SH16 (n°)	65	65	62	46	22	0
"Yes" (n°)	29	19	6	10	4	-
"Yes" (%)	44,6	29,2	9,68	21,7	18,2	-
total SH17 (n°)	16	16	16	13	2	0
"Yes" (n°)	16	16	16	5	0	-
"Yes" (%)	100	100	100	38,5	0	-

SIGNS OF CONSCIOUSNESS

SPONTANEOUS EYES MOVEMENTS

In all the slaughterhouses, blinking and spontaneous eye movements were present in the majority of the adult animals at the beginning of bleeding varying from 59.7% in SH7 to 100% in SH10 and SH13 (**Table 32**).

The frequency dropped during the 15s – 30s period in all slaughterhouses between 8.3 and 46.7% except in SH13 where it remained at a high level of 98.4% with no particular explanation.

During the third period (30s – 45s), in most of the slaughterhouses, we did not observe this sign except in SH7 where it was still present for 13.1% of the animals and in SH13 (93.4%).

The frequency of animals that showed eye ball rotation followed exactly the same tendency as the spontaneous eye movements with a strong decrease of frequencies between the first and the third period after the cut. This evolution was also observed in SH13 (**Table 33**).

The course of spontaneous eyes movements was similar for calves in SH16 and SH8 to those generally observed for adults with a decrease between the first fifteen seconds period when the frequencies varied between 44.6% and 84.8 and the third period when the frequencies varied between 4.3% and 9.7%. On the contrary, the frequency was stable in SH17 inverted until 45s but seemed to drop after (5 over 13 between 45s and 60s). Frequencies of eye ball rotation were seen in all slaughterhouses decreasing from the cut (8.7% - 62.5% during the 0 – 15s period) to the third period (0% - 1.6% during 30s – 45s period).

Table 33 : Frequency of animals with Eye ball rotation according to the period after the cut
(Source: BoRest study “assessment of welfare”)

Group	Time elapsed from the start of cut					
	0-15s	15-30s	30-45s	45-60s	60-75s	75-90s
LATERAL						
total SH6 (n°)	51	51	51	39	25	14
"Yes" (n°)	27	8	0	0	0	0
"Yes" (%)	52.9	15.8	0.0	0.0	0.0	0.0
INVERTED						
total SH1 (n°)	60	60	60	60	60	60
"yes" (n°)	42	12	5	1	0	0
"yes" (%)	70.0	20.0	8.3	1.7	0.0	0.0
total SH3 (n°)	20	20	20	20	20	20
"yes" (n°)	20	2	1	0	0	0
"yes" (%)	100.0	10.0	5.0	0.0	0.0	0.0
total SH5 (n°)	60	60	60	60	60	60
"yes" (n°)	44	5	0	1	0	0
"yes" (%)	73.3	8.3	0.0	1.7	0.0	0.0
total SH7 (n°)	62	62	61	25	39	49
"Yes" (n°)	57	27	5	1	4	3
"yes" (%)	91.9	43.5	8.2	4.0	10.3	6.1
total SH13 (n°)	59	61	61	61	59	50
"yes" (n°)	39	38	4	2	0	0
"yes" (%)	66.1	62.3	6.6	3.3	0.0	0.0
CALVES - INVERTED						
total SH8 (n°)	46	46	46	0	0	0
"Yes" (n°)	4	6	0	-	-	-
"Yes" (%)	8,7	13,0	0	-	-	-
total SH16 (n°)	65	65	62	0	0	0
"Yes" (n°)	9	7	1	-	-	-
"Yes" (%)	13,8	10,8	1,61	-	-	-
total SH17 (n°)	16	16	16	13	0	0
"Yes" (n°)	10	9	0	0	-	-
"Yes" (%)	62,5	56,3	0	0		

Table 34 : Frequency of animals with corneal reflex according to the period after the cut
 (Source: BoRest study "assessment of welfare")

Group	Time elapsed from the start of cut							
	15s	30s	45s	60s	75s	90s	105s	120s
UPRIGHT								
total SH11 (n°)	60	60	0	0	0	0	0	0
"yes" (n°)	60	60	-	-	-	-	-	-
"yes" (%)	100	100	-	-	-	-	-	-
LATERAL								
total SH6 (n°)	28	42	41	26	11	0	0	0
"Yes" (n°)	28	28	22	8	2	-	-	-
"Yes" (%)	100	66.6	53.7	30.8	18.2	-	-	-
INVERTED								
total SH1 (n°)	60	60	60	60	60	60	60	60
"yes" (n°)	60	60	60	60	60	60	58	53
"yes" (%)	100	100	100	100	100	100	96.7	88.3
total SH3 (n°)	20	20	20	20	20	20	20	20
"yes" (n°)	20	20	20	20	20	20	18	15
"yes" (%)	100	100	100	100	100	100	90	75
total SH5 (n°)	60	60	58	47	27	15	3	1
"yes" (n°)	60	60	58	47	27	15	2	1
"yes" (%)	100	100	100	100	100	100	66.7	100
total SH7 (n°)	0	57	51	33	33	27	22	10
"Yes" (n°)	-	21	20	10	5	6	2	2
"yes" (%)	-	36.8	39.2	30.3	15.2	22.2	9.1	20.0
total SH10 (n°)	60	60	60	59	60	60	60	60
"yes" (n°)	60	60	60	59	55	50	40	27
"yes" (%)	100	100	100	100%	91.7	83.3	66.7	45.0
total SH12 (n°)	24	24	24	23	20	19	16	16
"yes" (n°)	23	22	17	12	6	5	3	2
"yes" (%)	95.8	91.7	70.8	52.2	30.0	26.3	18.8	12.5
total SH13 (n°)	58	61	61	61	54	42	29	14
"yes" (n°)	58	61	61	58	40	24	14	3
"yes" (%)	100	100	100	95.1	74.1	57.1	48.3	21.4
CALVES – INVERTED								
total SH16 (n°)	65	63	33	48	59	0	0	0
"Yes" (n°)	65	61	30	43	6	-	-	-
"Yes" (%)	100	96,8	90,9	89,6	10,2	-	-	-
total SH8 (n°)	43	30	25	0	0	0	0	0
"Yes" (n°)	1	10	11	-	-	-	-	-
"Yes" (%)	2,33	33,3	44	-	-	-	-	-
total SH12 (n°)	36	36	36	35	35	32	31	31
"Yes" (n°)	36	35	34	32	31	22	19	13
"Yes" (%)	100	97,2	94,4	91,4	88,6	68,8	61,3	41,9
total SH17 (n°)	15	16	16	12	2	0	0	0
"Yes" (n°)	15	16	16	8	0	-	-	-
"Yes" (%)	100	100	100	66,7	0	-	-	-

CORNEAL REFLEX

The corneal reflex was present in almost all the adult animals tested during the first period (**Table 34**).

The frequency of animals that showed corneal reflex decreased with time after the cut but more or less quickly according to the slaughterhouse. At 45s, the frequency ranged from 39.2% (SH7) to 100% (SH10, SH13, SH1, SH3, SH5) with intermediate results for SH6. In some slaughterhouses, this decrease was clearly delayed after 90s (SH1, SH3 and SH5).

In some cases, it is possible that we have overestimated the percentage of animals that have prolonged corneal reflex because, in most slaughterhouses, the sample was reduced after 60s due to the release or hoisting of some animals. Therefore, we can suppose that those which were not released/hoisted at this time expressed more frequently some signs of consciousness.

Nevertheless, there appeared to be huge differences in terms of percentage of animals and patterns of decline between slaughterhouses suggesting differences in terms of bleeding efficiency.

Similar patterns were observed for calves. The frequency of calves with positive corneal reflex was stable (SH17) or slightly decreasing (SH16, SH12) between the cut and 45s. Then the frequencies started to decrease more or less quickly depending on the slaughterhouse: between 45s and 60s in SH17 (100% to 66.7%), between 60s and 75s in SH16 (89.6% to 10.2%), between 75s and 90s in SH12 (88.6% to 68.8%).

However, from a practical point of view, several points should be noticed. It may sometimes be difficult to avoid touching the eyelid and the eye lashes, reason why several observers used as much as possible a paintbrush or a pen. This technical problem may explain part of the differences in our results. Furthermore, at the beginning of the bleeding period, because of blinking and eye movements or the muscular tonus of the eyes, the test of the corneal reflex may not be fully relevant. For example, in several cases, we observed that animals may be negative at one time and positive some seconds later due to a change in the status of the eyes becoming open-fixed.

Table 35 : Frequency of animals with Struggle according to the period after the cut

(Source: BoRest study "assessment of welfare")

	Time elapsed from the start of cut							
	0-15s	15-30s	30-45s	45-60s	60-75s	75-90s	90-105s	105-120s
LATERAL								
total SH6 (n°)	51	51	51	39	25	0	0	0
"Yes" (n°)	4	2	0	0	0	-	-	-
"Yes" (%)	7.8	3.9	0.0	0.0	0.0	-	-	-
INVERTED								
total SH1 (n°)	60	60	60	60	60	60	60	60
"yes" (n°)	5	2	0	0	0	1	0	0
"yes" (%)	8.3	3.3	0.0	0.0	0.0	1.7	0.0	0.0
total SH3 (n°)	20	20	20	20	20	20	20	20
"yes" (n°)	2	1	0	0	0	0	0	0
"yes" (%)	10.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0
total SH5 (n°)	60	60	60	60	60	60	60	60
"yes" (n°)	13	2	1	0	0	0	0	0
"yes" (%)	21.7	3.3	1.7	0.0	0.0	0.0	0.0	0.0
total SH7 (n°)	62	62	61	24	38	50	42	25
"Yes" (n°)	20	6	1	2	2	1	0	0
"yes" (%)	32.3	9.7	1.6	8.3	5.3	2.0	0.0	0.0
Total SH8 (n°)	42	42	38	0	0	0	0	0
"yes" (n°)	6	4	9	-	-	-	-	-
"yes" (%)	14.3	9.5	23.8	-	-	-	-	-
total SH10 (n°)	60	60	0	0	0	0	0	0
"yes" (n°)	33	38	-	-	-	-	-	-
"yes" (%)	55.0	63.3	-	-	-	-	-	-
total SH13 (n°)	59	61	61	61	60	50	33	17
"yes" (n°)	17	17	7	6	0	1	2	1
"yes" (%)	28.8	27.9	11.5	9.8	0.0	2.0	6.1	5.9
CALVES - INVERTED								
total SH8 (n°)	46	46	46	0	0	0	0	0
"Yes" (n°)	12	9	0	-	-	-	-	-
"Yes" (%)	26.1	19.6	0	-	-	-	-	-
total SH16 (n°)	65	65	62	46	22	0	0	0
"Yes" (n°)	10	13	2	4	1	-	-	-
"Yes" (%)	15.4	20	3.23	8.7	4.55	-	-	-
total SH17 (n°)	16	16	16	13	2	0	0	0
"Yes" (n°)	3	3	0	0	0	-	-	-
"Yes" (%)	18.8	18.8	0	0	0	-	-	-

POSTURE AND BODY MOVEMENTS

Loss of posture

It was only possible to assess loss of posture when the animals were weight bearing on all four feet (i.e. upright without a belly plate or a lateral pusher). In the UK, it was impossible to observe this behaviour because the animals were supported by the restraint device even when fully insensible. This sign was only observed in SH11 where 41 out of 60 animals lost posture during the first 15s and the other 19 between 15s and 30s.

Righting body or head reflexes

No body righting reflex was observed.

Head righting reflex was only observed in SH7 where the percentage of animals varied between 11.2 at 30s and 2.4 at 105s (with an unexpected value of 25.9% at 60s but monitored on half of the animals and defined as reflex movements by the observer) and SH13 where it declined from 28.6% at 30s to 16.3% at 105s.

However, righting reflex should be interpreted with caution because it may depend on the restraint applied to the animals during the post-cut period. Therefore it is difficult to compare between slaughterhouses. Furthermore, it is also difficult to distinguish between intentional or reflex movements.

Struggle

The possibility of recording struggle and the frequency may also depend on the restraint procedure and the device. However, struggle is typical reaction of bovine animals in restraint devices and was observed for adults in all the slaughterhouses during the first 30 second with a decreasing course (**Table 35**). The frequency varied from 7.8% to 55% during the first period and from 3.3% to 63.3% during the second period. After 30s, this sign was only observed in SH8 and rarely in SH7 and SH13.

In SH10, lateral position of the animals may have enhanced the expression of this sign but this was not confirmed by SH6.

Struggles were less frequent in calves (from 15.4% to 26.1% during the first period) and also almost disappeared in the third period (0% to 3.2%).

Table 36 : Frequency of animals who inspire according to the period after the cut
(Source: BoRest study "assessment of welfare")

	Time elapsed from the start of cut							
	0-15 s	15-30 s	30-45 s	45-60 s	60-75 s	75-90 s	90-105 s	105-120 s
LATERAL								
total SH6 (n°)	51	51	51	40	25	14	0	0
"Yes" (n°)	17	42	48	34	22	12	-	-
"Yes" (%)	33.3	82.3	94.1	85	88	85.8	-	-
INVERTED								
total SH7 (n°)	61	60	61	60	33	46	40	24
"Yes" (n°)	2	39	56	22	20	38	33	20
"yes" (%)	3.3	65.0	91.8	36.7	60.6	82.6	82.5	83.3
Total SH8 (n°)	42	42	42	0	0	0	0	0
"yes" (n°)	10	16	37	-	-	-	-	-
"yes" (%)	23.8	38.1	88.1	-	-	-	-	-
total SH13 (n°)	58	61	60	60	58	50	33	17
"yes" (n°)	41	52	47	27	14	5	1	0
"yes" (%)	70.7	85.2	78.3	45.0	24.1	10.0	3.0	0.0
CALVES – INVERTED								
total SH8 (n°)	46	46	46	0	0	0	0	0
"Yes" (n°)	3	28	39	-	-	-	-	-
"Yes" (%)	6,52	60,1	84,8	-	-	-	-	-
total SH16 (n°)	65	65	62	46	22	6	0	0
"Yes" (n°)	2	19	49	36	16	6	-	-
"Yes" (%)	3,08	29,2	79,0	78,3	72,7	100	-	-
total SH17 (n°)	16	16	16	13	2	0	0	0
"Yes" (n°)	14	12	7	2	0	-	-	-
"Yes" (%)	87,5	75	43,8	15,4	0	-	-	-

ATTEMPT TO INSPIRE

This behaviour was assessed in SH6, SH7, SH8 and SH13 for adults (**Table 36**).

During the first 15s, the percentage of animals inspiring was relatively low although depending on the slaughterhouses. Subsequently, the frequency of animals that inspired increased until 30 to 45s. Then the frequency subsequently decreased. It should be noticed that this late decrease may also result from a decrease in number of inspirations per unit time. Consequently, the interpretation of these figures may depend on the time the animals are observed.

Frequency of “attempt to inspire” behaviour followed a similar scheme for calves with increased frequencies between the first and third period in SH16 and SH8 (stable also during the fourth period in this slaughterhouse). In SH17, however, the frequency appeared to be very high at the beginning and then decreased quickly until the fourth period.

CONCLUSION

It has already been emphasized that loss of consciousness after the cut i.e. during haemorrhaging cannot be easily monitored in slaughterhouses and may be very variable from an animal to another. At the end, the death of the animal may be characterised by the end of bleeding and permanent loss of breathing, the loss of muscle tone and the loss of eyes’ reflexes and presence of permanent midriasis.

Some authors hypothesized that the animals may probably experience different states of consciousness during the bleeding. Gregory et al. (2009) suggested that loss of posture may be a first sign of loss of consciousness. Some authors proposed to check different signs based on the ability of the animals to exhibit signs of brain function or cognitive responses (Limon et al., 2010). The Dialrel project also proposed similar recommendations (Velarde et al., 2010) such as loss of posture and no attempt to regain it, absence of response to threatening movements, absence of eye movements.

In this study, we have included some of these signs of consciousness with a particular focus on the course after the cut as we expected that differences between groups will first appear on the frequency of the different signs in relation with the time after the cut. However, due to numerous practical limitations and probably a high variability between and within slaughterhouses, it is not possible to draw simple conclusions about an effect of restraining system.

Table 37 : Summary of the frequencies of adults bovine showing the different signs of consciousness or loss of consciousness according to the period after the cut
(Source: BoRest study “assessment of welfare”)

Time after the cut	Signs observed	Frequency range	Tendency	Comments
0 - 15s	Upright posture	33%	-	SH11 only
	Struggle	7.8% - 55%	-	
	Spontaneous eyes movements	59.7% - 100%	-	
	Eye ball rotation	52.9% - 100%	-	
	Corneal reflex	95.8% - 100%	=	SH7 not included
	« Inspire »	3.3% - 70.7%	+	
	15s – 30s	Upright posture	0%	-
Struggle		3.9% - 63.3%	-	
Spontaneous eyes movements		8.3% - 98.4%	-	8.3% - 46.7% without SH13
Eye ball rotation		8.3% - 43.5%	-	
Corneal reflex		36.8% - 100%	=/-	66.6% - 100% without SH7
« Inspire »		38.1% - 85.2%	+	
30s – 45s		Upright posture		
	Struggle	0% - 23.8%	-	
	Spontaneous eyes movements	0% - 93.4%	-	0% - 13.1% without SH13
	Eye ball rotation	0% - 8.3%	-	
	Corneal reflex	39.2% - 100%	=/-	53.7% - 100% without SH7
	« Inspire »	78.3% - 94.1%	+	
	45s – 90s	Upright posture		
Struggle		0% - 9.8%	-	
Spontaneous eyes movements		0% - 82%	-	0% - 13.1% without SH13
Eye ball rotation		0 - 10.3%	-	
Corneal reflex		22.2% - 100%	=/-	26.3% – 100% without SH7
« Inspire »		10% - 85%	-	

We can just underline that SH7 (Dhabiha inverted) and SH12 for adults (Shechita inverted) were both characterised by:

- Low number of cuts, 100% of both carotids severed, 0% of “Impeded flow”,
- Quick decrease or low frequency of animals exhibiting corneal reflex (in particular SH7)

This result suggests that it is possible to hasten the loss of consciousness by good practice and bleeding efficiency but further investigations are necessary to better understand what the factors are that could explain these results.

However, overall, our results may be considered as a framework of course of signs of consciousness/unconsciousness after the cut. We summarized in **Table 37** the range of the frequency measured according to the delay after the cut.

This table suggests a two-step evolution which is coherent with the literature mentioned above. During the first 30 s, spontaneous eye movements and the ability to maintain posture are decreasing dramatically. We can also assume that, during this period, struggle is interpreted, as intended movements and therefore follows the same pattern as posture. Frequency of eye ball rotation also decreased. At the end of this first step, during the 30s – 45s period, most of these signs have disappeared and we usually observe animals that have fixed open eyes with no attempt to struggle. These events take place while an increase of frequency of the animals that are exhibiting “attempt to inspire” behaviour takes place. Most of the animals have corneal reflex at 30s or 45s.

After 45s, with caution because of the reduced number of animals, we mainly observed a decrease in the frequency of animals that express “attempt to Inspire” and a decrease of animals that have a corneal reflex. The decrease of frequency of “attempt to Inspire” behaviour seems to occur concomitantly with an increase of the delay between two “inspirations”.

These data could provide slaughterhouses with guidance to manage the restraining of the animals during the bleeding period, taking into account that it is compulsory to restrain the animals until the loss of consciousness. In practice, we can suggest that animals should be restrained in the device for at least 45s before checking that they will not exhibit sign of eyes movements, signs of maintained posture or intentional struggle (also head righting when it can be observed). If these signs are absent, the animal may be released out of the restraint device and then further process (in particular dressing) should not be carried out before the loss of corneal reflex and the end of attempt to “inspire”. A similar strategy may be applied for calves as it appeared the same trends in our results.

CONCLUSION AND RECOMMENDATIONS

CONCLUSION

This study was an opportunity to collect numerous data about restraining and bleeding practices in European slaughterhouses where bovine animals are slaughtered without prior-cut stunning.

According to the literature, the position of the animals in the restraint device may have an effect on the stress and welfare of bovine animals. The longer is the duration of restraint and unnatural position, the higher is the risk of impaired welfare.

Taking into account all the results obtained, it did not appear that the position of the animals at the time of bleeding was the main factor that can explain the variability of the durations of restraint or the cutting practices observed between slaughterhouses and slaughter men. For most of the variables, the ranges of the averages obtained in the three positions (inverted, lateral, upright) were similar. At first, a reduction of duration of immobilisation before the cut was expected with upright devices but this was not confirmed by the observations in commercial conditions. We also expected differences in the ease of cut that could be estimated by the number of cuts (higher for upright position) and the quality of bleeding (lower for upright position). Our results showed some differences but most of them could be associated with some particularities of the design of the device, the quality of the head restraint and the skill of the operators.

Due to the large variability of the design of the slaughterhouses (layout of the corridor, layout of the restraining and bleeding area, design of the restraining device, etc) and skills and capabilities of the slaughter men observed during this study, it was not possible to take into account and analyse all the factors. Based on the initial surveys (see section 4), it was estimated that 70% to 80% of the bovine animals are slaughtered in the lateral or inverted position. Upright restraint devices are mainly used in the UK where they are mandatory. Therefore, although attempts were made in other countries to include this type of device in the sample, the number of slaughterhouses with upright restraint visited in the present study was, at the end, very limited.

However, in order to identify what could be the best observed practices in this sample, four experts of the consortium were asked to classify slaughterhouses of adult bovine animals for each variable measured, to judge the relevance of this variable regarding animal welfare and to propose ranges for “best observed practices” and “alarms”. In this case, “best observed practices” shall not be interpreted as an absolute but as a “state of art” for continuous improvement in slaughterhouses.

The output of their assessment was used to propose a list of key points regarding animal welfare (see below for details and synthesis in **Annex 10**) for slaughter without stunning, part of them also for slaughter with stunning. These results could be used, for example, by animal welfare officers in slaughterhouses to design standard operating procedures, monitoring tools and/or implement an improvement action plan. According to Regulation (EC) No 1099/2009, training is compulsory and operators shall hold a certificate of competence. Competences are precisely described in the EU legislation. In our view, training should be regularly reinforced and updated. However the modalities for training the personnel are defined and implemented by the competent authorities of Member States and various approaches have been taken. Consequently, we consider that these recommendations could also be used as objectives for deepening training of the operators and we emphasize some key points. At last, these recommendations are expected to provide manufacturers with guidance for developing their devices and improving the designs of existing models.

RECOMMENDATIONS AND BEST OBSERVED PRACTICES FOR ADULT BOVINE ANIMALS

ENTRANCE IN THE RESTRAINING SYSTEM - ALL DEVICES

- The **layout of the end of the corridor and the device** should be designed to minimize difficulties for the animals to enter the restraining device. Adequate number of operators, anti-backward systems, lighting of the bleeding area and avoidance of distractions or source of fear should also be considered
- **Corridor and restraining system** should have a non-slippery floor surface
- **Operators** must be trained for the handling of the bovine animals (legal requirement)

Monitoring and best observed practices

- *The **monitoring of the use of electric prod** may be used as an indicator of good practice. The “best observed practice» in the present sample was a mean use on less than 20% of the animals (with maximum number per animal of 3 or 4). Human-animal interactions may also be monitored but it is needed to distinguish between neutral (gently touching an animal) and negative (e.g. kicking). These last ones should be considered as if they were use of an electric prod.*
- ***Behavioural indicators of stress** are the result of several factors including the emotional status of the animals, the transport, the handling in the lairage and in the corridor. In the best situation, behavioural indicators of stress other than vocalisation should be expressed by less than 10% of the bovine animals. No slips and falls should be observed and a frequency higher than 10% should induce urgent corrective measures. **Vocalizations** are one of the best indicators of stress because this behaviour is not restricted by the device. The frequency of vocalizations should be less than 10% and frequency higher than 20% needs urgent corrective actions.*
- *Duration of time needed to introduce the animal in the device is not an issue from a welfare point of view. However, taking into account behaviours of both the operators and the animals, this measure could provide the animal welfare officer with additional information. For instance, short periods may be linked to an abusive use of the electric prod in the corridor. On the contrary, long durations may be linked to obstruction or distraction.*

RESTRAINING PROCEDURE - ALL DEVICES

- Restraining can be a stressful and painful procedure for bovine animals. **Total restraint duration before the cut should be limited as far as possible.** This implies that restraint should not start without verifying that the cut could be performed without any delay (Regulation EC No 1099/2009).
- **Operators must be trained** for the handling of the bovine animals and the functioning of the device (legal requirement).
- Operators should **be able to monitor the quality of restraint and the behaviour** of the animals by direct observation and/or by communication with other operators.
- The different **operations should be successively carried out without any delay** and taking into account the manufacturers' recommendations and user guide that must be provided to the operators (Regulation EC No 1099/2009).
- **Hyperextension of the neck must not be performed.**
All other restraining equipment (back pusher, side plates, neck yoke) must not use excessive pressure that causes injury, pain or distress (vocalizations, struggling, etc) .
- **The cut should be carried out without any delay** after the head restraint.
- If for whatever reason (personal or mechanical) there is a **delay in the slaughter process** when the animal is restrained, it must be **immediately stunned** with a penetrative captive bolt.

Monitoring and best observed practices

- *Considering a **normal smooth restraining procedure (ie happening without any sudden change or interruption)**, the duration of restraint before the cut should be on average less than 30s (with a maximum up to 60s).*
- *The **delay between the end of the restraining procedure and the cut** may be minimized, with an average of less than 5s (maximum of no more than 10s). This delay includes washing of the neck when it is performed.*
- ***Vocalization** could be used as a monitoring tool of the quality of restraint even if this behaviour also depends on previous events and handling. The frequency of animals vocalizing should be less than 5% and a proportion of higher than 10% requires urgent correction action plan.*
- ***Quality of head restraint** is one of the key parameter regarding the performance of the cut and the risk of pain for the animals. However, it may be difficult to assess because of the risk of hyperextension and the differences of morphology of the neck and head of the different categories of animals. Therefore slaughterhouses should focus on reducing as much as possible the incidents, in particular those linked to inadequate application of operating procedure. .*
- *Modification of the design of the chin lift, layout of the area or optical system to allow the operators to observe head and behavioural reactions of the animals, communication between operators (the one who is driving the head restrainer and the one who will carry out the bleeding) are some examples of measures that can be taken to improve the quality of head restraint.*

RESTRAINING PROCEDURE - UPRIGHT SYSTEM:

- Animals must not be lifted off the ground with the belly plate (i.e. legs no longer significantly supporting weight of the animal)
Restraint must have a recessed belly plate (otherwise it can cause balking, obstructions and falls)

RESTRAINING PROCEDURE - ROTATING SYSTEM

- Rotation should start immediately after the restraint of the animals , and should be as smoothly as possible i.e. without any sudden changes or interruptions

Monitoring and best observed practices

- *The duration of the rotation is mainly depending on the device, the angle of rotation and the efficiency of the initial restraint. **Duration of rotation** may be on average less than 15s (with a maximum up to 30 s) when the animals are fully inverted. This duration should be reduced in other final positions.*

CUT AND BLEEDING EFFICIENCY - ALL SYSTEMS

- Cut should be **performed in order to maximize bleeding**. Many factors such as category of animals, quality of head restraint, position of the cut, sharpness of the knife are influencing the quality of the cut. **The skill and capability of the operator should be such that they know these potential risks** and are able to manage them as much as possible.

MONITORING AND BEST OBSERVED PRACTICES

- **The number of cuts** may be a good indicator of the capability of the slaughtermen. However, the number of the cuts also depends on religious prescriptions. Our observations suggest that the number of the cuts can be, on average, less than 4 (with a maximum up to 6) but this is based mainly on the Dhabiha method. Multiple saw movements require the implementation of urgent corrective actions including practical training of the operators.
- It may happen that **both carotids** are not cut but this should be monitored by the operator who will take immediate corrective action. In case of repetitive miss-cuts, an action plan should be implemented.
- **Impeded flow** may be primarily linked to the formation of blood clots, the design of the device or the post-cut management of the head restraint. The mechanism underlying the formation of blood clot is not yet fully understood but is related to the operator practice and the animal. Slaughterhouses are encouraged to monitor the formation of blood clots. Whatever the case, our observations suggest that it is possible to reach a frequency of impeded flow of 0% and that a frequency higher than 10% need corrective action plan.

6. SOCIO-ECONOMIC IMPLICATIONS OF THE USE OF THE DIFFERENT RESTRAINT SYSTEMS FOR SLAUGHTERING BOVINE ANIMALS WITHOUT STUNNING

Task leader: Willy Baltussen (LEI-WUR)

INTRODUCTION

The goal of this third part of the study was to determine the socio-economic implications of the different restraint practices for slaughtering bovine animals without stunning with special attention to:

- Economics of slaughtering, competitiveness and trade aspects (imports to and exports from EU and intra-trade among EU Member States);
- Religious expectation and freedom of religion;
- Working condition and safety of operators in the bleeding area of the slaughterhouse.



Figure 19 : Research design for socio-economic research
(Source: BoRest study “Socio-economic implications”)

Table 38 : Assessed indicators per judgement area for the SWOT analysis of different types of restraining devices for slaughtering bovine animals without stunning
(Source: BoRest study “Socio-economic implications”)

Judgement area	Assessed indicators
Economic costs	total investment restraining system (€) investment restraining system (% of total investment slaughter line) maintenance costs (€ per year) total costs (€ per year) lifetime restraining system (years) line speed (animals per hour)
Religious Acceptability	Requirements for Jewish religion Requirements for Muslim religion Religious education slaughterman
Work safety	Number of accidents in 2012 Frequency of accidents (number per year) Type of injuries Impact of injuries Experience of slaughterman Education of slaughterman
Intra-EU trade and trade with third countries	Origin of meat Destination of meat Share cattle slaughtered without stunning (%) Meat sold as halal/ kosher (% of total)
Animal welfare	Duration of introduction in the restraint device, handling and behaviour of the animals Duration of restraint before the cut and behaviour of the animals Duration of rotation and inverted position and behaviour of the animals Number of cuts and “Quality of bleeding” indirectly assessed by presence of blood clots/impaired flow, presence of signs of consciousness at different time after the cut

OBJECTIVES AND SCOPE OF THE STUDY

OBJECTIVES AND SCOPE

The objectives of the socio-economic research were twofold:

1. A comparison between the upright and the rotating restraint system by a SWOT analyses on the aspects of costs, acceptability by religious representatives, Intra–EU trade of meat and trade of meat with third countries, work safety of the slaughtermen and animal welfare.
2. Impact of different scenarios of the European policy on the use of the different types of restraint systems used for bovine animals slaughtered without stunning (adult cattle and calves) regarding costs, acceptability by religious representatives, intra EU-trade of meat and trade of meat with third countries, work safety of slaughtermen and animal welfare.

The research is based on data of:

- a. Restraint systems used for bovine animals in slaughterhouses in six EU Member States (Belgium, France, Italy, Spain, The Netherlands, The United Kingdom) representing 97% of bovine animals slaughtered without stunning;
- b. Stakeholders' information collected in 18 slaughterhouses visited and a limited number of responses from other stakeholders such as manufacturers of slaughterline system and wholesalers of halal or kosher meat.

The limited number of visits and response per group of stakeholders can be explained by different reasons. The first reason is that for this project, 25 visits at slaughterhouses were planned. Some of the slaughterhouses refused to cooperate to measure the animal welfare of animals slaughtered without stunning. Not all staff members in the slaughterhouse were willing to have an interview with the researchers. Animal welfare and work safety officers were not always present in small slaughterhouses and were not always willing to answer the questions. Others like insurance companies, manufacturers and wholesale traders were called several times and invited to answer the questions by phone but refused or were not able to cooperate.

METHOD

The main principle of this socio-economic research was to qualify and if possible to quantify different scenarios for future policy options in comparison with a baseline scenario. These scenarios were developed based upon input mainly from interviews with several stakeholders, meetings with religious representatives and a SWOT analysis of the two types of restraint system and to a lesser degree from results of other work packages (**Figure 19**).

Table 39 : Research topics in the questionnaires per interviewee
(Source: BoRest study “Socio-economic implications”)

Interviewee	Topics in the questionnaire				
	Economic costs	Acceptability by religion	Work safety	Animal welfare ^a	Trade
Director of slaughterhouse	X		X		
Insurance companies			X		
Manufacturers of slaughter line	X				
Animal welfare officer				X	
Work safety officer			X		
Slaughter men	X	X	X	X	
Wholesaler					X
Meeting with religious authorities		X			

^a part of the animal welfare indicators have been calculated from the research described in section 5.

Table 40 : Number of responses per stakeholder group
(Source: BoRest study “Socio-economic implications”)

Interviewee	Number of respondents/ meetings
Director of slaughterhouse	12 respondents
Insurance companies	0 ^a
Manufacturers of slaughter line	2 respondents
Animal welfare officer	11 respondents
Work safety officer	8 respondents
Slaughter men	14 respondents
Wholesaler	1 respondent
Jewish religious representatives ^b	5 meetings
Muslim religious representatives ^b	5 meetings

^aThis stakeholder group has been approached but is not able to provide such (specific) data

^bIn Italy the meeting with Jewish authorities and in France the meeting with Muslim authorities was declined.

To cover the different judgment areas of the scenario i.e. economics, religious acceptability, work safety, intra-EU trade and trade with third countries and animal welfare indicators were determined. In **Table 38**, the assessed indicators are listed per judgement area. Data have been collected in order to qualify or quantify the different indicators per restraint systems according to a SWOT analysis. For example, information from the first work package: description of the current situation has been used to estimate the share of cattle slaughtered without stunning in the judgement area 'Trade'. Indicators of the economic costs or work safety have been obtained by interviewees at slaughterhouses carried out during the visits for assessing the animal welfare indicators or by interviews with others stakeholders, for example manufacturers of slaughter lines or the religious representatives by separate meetings. Animal welfare has been assessed by observations in slaughterhouses. Religious acceptability has been analysed thanks to interviewees of slaughtermen and meetings with religious representatives.

QUESTIONNAIRES STAKEHOLDERS

For the socio-economic research seven questionnaires (see **Annex 8**) have been developed to interview seven groups of stakeholders:

- Survey 1: directors of slaughterhouses,
- Survey 2: slaughtermen,
- Survey 3: animal welfare officer at slaughterhouse,
- Survey 4: work safety officer at slaughterhouse,
- Survey 5: insurance companies,
- Survey 6: manufactures of restraint systems,
- Survey 7: wholesale traders,

To be able to determine the socio-economic implications of the different restraint procedures, the judgement areas formed the backbone of the questionnaires. All the questionnaires focused on slaughter without stunning, but post-cut stunning was not excluded since the main objective of the project is to compare the types of restraint system used for animals which are conscious at the moment of cutting. Therefore, situations with post-cut stunning were relevant. But the questionnaires differed per stakeholder group. In **Table 39** an overview of the topics in the questionnaire is given per group of stakeholders.

Meetings with religious representatives were dedicated to the religious acceptability of the two different restraint systems. They aimed to collect the set of religious arguments used to support the refusal or the acceptance of the different restraint systems observed⁶.

The acceptability of the restraint system have been investigated for the two communities who perform slaughter without stunning in Europe: the Jewish community and the Muslim community.

The opinion were collected by interviewing and discussing, in local languages, with religious representatives during meetings (**Table 40**).

We have considered the certification bodies to be *market actors* not religious actors. We considered as being representative the religious authorities involved in the definition and /or application of religious directives, and/ or who are regular interlocutor of the Member States, and /or who are involved in the selection and/or accreditation of the religious slaughtermen. We have selected them using experts' knowledge, using religious sociological literature and European religious boards' advices. Some are state recognized religious body (such as Executif des Musulmans de Belgique, Consistoire Israélite de France), some are regional authorities (such as Rabbi of Barcelona of Catalunya).

It should be noticed and we were aware that the opinions of selected religious representatives may not represent the majority of opinions of the different religious trends. This also holds for the opinions of other stakeholders, for example the manufacturers and wholesalers. This is a limit to the findings that could not be avoided for such a limited size project.

Details about the methodology are given in **Annex 9**.

PROCESS

The development of the questionnaires went in stages. In spring 2013 a draft version of all the questionnaires was developed. This draft was discussed during the project team meeting in April 2013. Based on the comments a second draft was developed and distributed among the team members. In June 2013 the final questionnaires were distributed among the team members.

Most questionnaires were face to face interviews. The interviews with manufacturers and wholesalers have been executed by making an appointment, sending the questionnaire followed by an interview by phone.

⁶ The goal of this study is to assess the current situation and not to reach the acceptance of one or the other restraining technique.

Data were collected from June 2013 to March 2014. In total, 48 responses have been received (**Table 40**). From insurance companies no response was gathered, while only one wholesaler in the Netherlands was willing to respond to the questionnaire.

Meetings with religious representatives were held in the period from October 2013 till March 2014.

SCENARIOS

The last part of the research focused on scenarios. In order to develop these scenarios the following basic assumptions were set in consultation with DG SANTE and taking into account results from initial surveys carried out during this project in the different Member States.

Basic assumptions for developing the scenarios were:

- In practice a 78% of slaughterhouses use a rotating restraint system (**Table 9**, p40). On one hand, a few manufacturers represent more than 50% of market share and, on the other hand, there are more than 20 different restraining systems mentioned in practice (see above, **Table 14**, p58).
- There is also a high variation in how frequently a restraint system is used for cutting bovine animals without stunning. Some slaughterhouse / slaughtermen are more or less continuously using the system while others only use it during short periods per year (special events).
- From animal welfare experts' point of view, based on observations realised in slaughterhouses, operating procedures appeared to be more important than the system of restraining bovine animals to ensure animal welfare. In other words different restraint system may be acceptable if used in the right way by the users and if users are knowledgeable about animal behaviour, animal welfare and work safety. So scenarios should emphasize the proper use of a restraint system.
- Per scenario indicators are compared with the baseline scenario. Weighting the different indicators is fairly impossible (i.e. how to weight better animal welfare with religious acceptability).

Moreover, a PEST (Political, Economic, Social, Technical) analysis was executed to provide a better understanding of the context of restraining of bovine animals during slaughtering without stunning.

In socio-economic research we emphasize the internal factors, the pros and cons of restraint system with a special attention to costs and economic drivers for the different restraint systems, religious acceptability, work safety of operators and animal welfare. These indicators were, for the intended scenarios, compared with the baseline scenario (no change in EU-policy regarding restraining of bovine animals during slaughtering without stunning).

Table 41 : Summary of the valuation of indicators to compare upright with rotating restraining systems

(Source: BoRest study “Socio-economic implications”-Data: 2013-2014)

JUDGEMENT AREAS	RESTRAINT SYSTEM FOR BOVINE ANIMALS (<i>upright versus rotating</i>)
Economic costs	<p>Compared to a rotating system the upright restraint system:</p> <ul style="list-style-type: none"> - Is cheaper (50% of the investment cost); - Has a longer lifetime (30-50 rather than 14-25 years). Lifetime is longer in case the restraint system is not used full time; - Needs less maintenance (less than half the maintenance costs). <p>Next to this, a wide spread of line speed (animals/hour) is observed; it varies from 10 to 80 animals per hour. The variation is observed for both systems. For both systems the average line speed is 28 to 30 animals per hour.</p> <p>Conclusions: 1. Restraint systems are neither decisive for the line speed nor for the slaughter costs per animal if more than 10.000 slaughtering without stunning take place per year; 2. The upright system is less costly than the rotating restraint system.</p>
Religious aspects	<p>For the Jewish communities, inverted position was preferred in all cases in comparison to upright position.</p> <p>For the Muslim communities, rotating system is often preferred, but the upright position may be acceptable if correctly adapted and if the slaughterman is experienced.</p>
Work safety	<p>No clear difference is observed between the two restraint systems. There are some minor incidents reported. In some of these cases slaughtermen were not able to work for a few days.</p>
Intra-EU trade and trade with third countries	<p>Few information is available. In some countries most of halal or kosher beef meat is for the home market and therefore the acceptability will depend on the religious representatives' opinion.</p> <p>Exports of beef meat to Jewish and Muslim Mediterranean countries are low compared to other countries and vary according to the economic context. Trade figures can change quickly and figures from the past are not always a good indicator for the future.</p>
Animal Welfare	<p>In slaughterhouses under practical conditions the expected differences between restraint systems (duration, number of cuts) are not observed (see section 5). Other factors like layout of the bleeding area, design of the restraint system, organisation of the procedures and skills and capabilities of the operators have far more impact on animal welfare than the type of restraint system.</p> <p>For both types of restraint system good and bad examples regarding animal welfare have been observed. Given the small sample of slaughterhouses no estimates can be given about the state of animal welfare of the total population of bovine animals slaughtered without pre-stunning.</p> <p>According to the answers to the questionnaires, incidents with animals are reported only twice. Most animal welfare officer respondents were not able or refused to report and no difference can be made between the two systems of restraining.</p>

In the Terms of References (n° SANCO/2012/10357) no indication was given about the policy scenarios that should be taken into account. During the first meeting of the steering committee in January 2013 it was decided that the work package leader would make a proposal for scenarios to be discussed during the second meeting of the steering committee in November 2013. Based on this discussion and bilateral contacts between project team and DG SANCO two scenarios were developed.

After defining the scenarios, an assessment of the impact of scenarios was carried out.

Table 42: Total costs (in euro per year) for upright and rotating restraining systems

(Source: BoRest study “Socio-economic implications”-Data: 2013-2014)

Type of costs	Upright restraint system	Rotating restraint system
Total investment costs	4,300	12,600
-of which		
a. depreciation costs	1,250	5,000
Total investment	50,000 euro	100,000 euro
Lifetime ^a :	40 years	20 years
b. maintenance costs	1,800	5,100
(mean costs from questionnaires)		
c. interest costs		
(5% over half of the investment amount)	1,250	2,500
Operational costs bleeding area ^b		
Labour cost per hour (3 people working in the bleeding area for 25 euro per hour)	75 euro	75 euro
Per animal (given a line speed of 30 animals per hour)	2.50 euro	2.50 euro

^a In the calculations mean (rounded) lifetimes of the systems have been used. As such, 40 years for upright system instead of 30-50 years and 20 years for rotating system instead of 14-25 years.

^b Other operational costs like energy, water, removal of waste are not estimated because they are relatively low compared to the investment and labour costs.

SOCIO-ECONOMIC IMPLICATIONS OF THE DIFFERENT RESTRAINT SYSTEMS

To meet the first objective of this socio-economic part of the research all the indicators per judgement area were valued based on the results of questionnaires, interviews and results of meetings with religious representatives and to a lesser degree from results of other work packages. As mentioned in **Table 40**, the number of responses to the questionnaires was limited (per stakeholder 0 to 14 responses). The consequence is that many of the indicators are based on scattered information. This makes it difficult to draw straight conclusions for all the judgement areas.

In **Table 41** a summary is given of the SWOT analysis between the upright versus the rotating restraint system for bovine animals during slaughtering per judgement area (see also **Annex 11**).

ECONOMIC COSTS

Upright restraint systems are systematically cheaper than the rotating ones on all aspects: investment, maintenance and lifetime (**Table 42**). The total costs for an upright restraint system are estimated at about 4,300 euro per year (investment of 50,000 euro and annual costs of 8.6%) and for a rotating restraint system at 12,600 euro (investment of 100,000 euro and 12.6% annual costs). So the rotating system is 2 to 3 times as expensive as the upright system. However it should be remembered that costs in the bleeding area are only a small part of the total slaughtering costs. For example, rotating restraint system investment represent less than 7% of the investment cost for the total slaughter line (excluding cold storage room) according to one of our respondent. According to other respondents, labour cost represents more than half of the cost of slaughtering. Also FCEC (2007) concludes that “The cost of stunning and killing is not seen as being significant ... (in the context of the competitive position of the EU cattle and sheep sector)”.

The line speed in number of animals slaughtered per hour differed between slaughterhouses. For example, within the slaughterhouses visited, it varied from 10 to 48 adult bovine animals per hour and from 12 to 80 calves per hour (**Table 16**, p64) and the line speed did not differ between the upright and rotating system. In both cases, on average, about 28 to 30 animals were slaughtered per hour. The actual line speed at a specific slaughterhouse has a far bigger impact on the cost per slaughtered animals than the type of restraint system.

Table 43: Costs per animal in the restraining area for upright and rotating systems for different line speeds

(Source: BoRest study "Socio-economic implications"-Data: 2013-2014)

Line speed (number of animals per hour)	10	30	50
labour costs per animal	7.5	2.5	1.5
investment costs			
Upright	4,300	4,300	4,300
Rotating	12,600	12,600	12,600
costs restraining area per animal (euro per animal)			
Upright	7.93	2.93	1.93
Rotating	8.76	3.76	2.76

Own calculations based on questionnaires in this study

Table 44: Costs per animal in the restraining area for upright and rotating systems for different quantities of annual slaughterings (in euro)

(Source: BoRest study "Socio-economic implications"-Data: 2013-2014)

Number of animals slaughtering per year	1000	10,000	45,000
labour costs (euro per animal)	2,5	2,5	2,5
investment costs (annual costs)			
Upright	4,300	4,300	4,300
Rotating	12,600	12,600	12,600
costs per animal (in euro per animal)			
Upright	6.80	2.93	2.60
Rotating	15.10	3.76	2.78

Own calculations based on questionnaires in this study

In **Table 43** the costs per animal slaughtered have been calculated for three different line speeds: 10, 30 and 50 animals per hour. The costs in the bleeding area per animal vary from almost 8 euro to 2 euro for line speeds of, respectively, 10 and 50 animals per hour. The cost difference between the upright and rotating systems is 83 eurocents. Other factors like organisation of the work in the bleeding area are more decisive for the line speed than the type of restraint system.

Also the number of animals slaughtered per year has a huge impact on the costs per animal slaughtered (**Table 44**). The cost per animal slaughtered varies from almost 7 euro per animal for 1000 animals slaughtered per year in an upright system to 2.60 per animal if 45,000 animals are slaughtered. For the rotating systems these figures are 15 euro and 2.80 euro per animal. The calculations in Tables 43 and 44 also explain why slaughterhouse managers mention total slaughter costs between 25 and 100 euro per animal. The difference in slaughter costs per animal can be explained by:

- a. The lack of definition of slaughter costs. This depends on whether the slaughtering includes cooling / freezing;
- b. The line speed (see the calculations in **table 43**);
- c. The number of animals slaughtered per year or the size of the batch (see calculations in table 44);
- d. The variability of labour costs vary between Member States from less than 4 euro per hour in Bulgaria to more than 40 euro per hour in Sweden. (http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Wages_and_labour_costs)

The slaughterhouse managers also stated that the slaughtering of animals without stunning in total costs 10 to 15% more than slaughtering of animals with pre-stunning.

According to slaughterhouse managers investment decision regarding restraint systems are guided by four criteria, by order of priority:

1. religious requirements;
2. total investment of the restraint system;
3. work safety of people working in the bleeding area;
4. animal welfare.

Taking into account that upright system are compulsory in the UK, no difference could be observed in priority between the upright and rotating restraint systems.

RELIGIOUS ASPECTS

For the Jewish communities, inverted position was preferred in all the cases in comparison to upright position. However, the UK Jewish representatives believed that the slaughter with an inverted position could be improved.

The preference of the Jewish clerics for an inverted position was supported by religious requirements such as "Derasah", i.e. the Jewish slaughterman (Schochet) must not apply pressure with the knife at the throat of the animals and "Halada" i.e. the knife must be visible and not be buried by fur.

For the Muslim communities, a rotating device is often preferred, but the upright position may be acceptable if correctly adapted and if the slaughterman is experienced. All interviewees emphasized that the efficiency of the cut is the main objective. Full rotation was not strictly approved by some representatives interviewed. From their point of view, an angle should be respected imitating the laying of the animal on his (left) side.

At last, a good head restraint, that keeps the head of the bovine animal in a fixed position without hurting the animal, is a concern for most of our interlocutors in terms of welfare, bleeding efficiency and practices regardless of the final position of the bovine animals.

However, it should be borne in mind that the opinions were given on the basis of two ideal scenarios (in video) of Dhabaha cut (for the production of halal meat). No video of Shechita cut (for the production of kosher meat) was available due to limitation from slaughterhouses which does not allow to record and show videos. Some of our interlocutors knew little about the way slaughtering of bovine animals is routinely performed.

Furthermore, there is a high degree of distrust between the operators and religious authorities, in particular regarding the question of stunning. Despite that we excluded it from the present study, the issue of stunning, and its political framing was in the mind of the religious authorities interviewed. Some were reluctant to give an official statement on this aspect of religious slaughter considering that this statement could have an impact later on the legal framework and indirectly on stunning (in The Netherlands, France, Italy).

WORK SAFETY

The **Work safety officers** report almost no incidents. One work safety officer reported in total two incidents in one slaughterhouse. Two recommendations were given by the work safety officers regarding the work safety of people working in the bleeding area:

1. Allow post-cut stun if possible;
2. Increase the available working space for the slaughter man.

With one exception all slaughtermen interviewed answered that they have less than 1 incident per year. One slaughterman reported 1 to 5 incidents per year. Reported incidents are mainly 'cuts' and all the slaughtermen were still able to continue working. No differences can be seen between upright and rotating systems. Also no difference exists between slaughtermen cutting according the Jewish rites and slaughtermen cutting according the Muslim rites (the number of observations are however limited). Slaughtermen indicate that they see no possibility to increase work safety by changing the restraint system.

We also tried to estimate the working conditions of the slaughtermen but there were clear limitations in the answers because they are generally only familiar with one system (upright or rotating). The working conditions for slaughtermen was rated 2.3 for physical conditions and 2.9 for mental conditions by the slaughtermen themselves on a scale from 1 (no stress) to 5 (stressful). No comparison can be made between the two restraining systems because only two observations are available for the upright restraint system. The level of education of slaughtermen was mostly basic or middle, about 20% was highly educated. No clear differences can be found between the restraint systems.

Work safety plays an important role in the decision of slaughterhouse managers to choose a restraint system. They rank work safety as third after total investment. They see the hoisting of the animal as the most dangerous 'task' in the bleeding area compared to other tasks like 'entering the animal in the restraint system', 'restrain the animal', 'cut the animal' and 'release the animal from the restraint system'.

These data do not allow to draw a firm conclusion on the effect of the position during the cut but they suggest that the restraint system per se is not a major concern regarding work safety. The major risks in terms of work safety are indeed linked to the unexpected movements of the animals after releasing them from the restraint system and while hoisting. This risk increases if the space for the slaughterman to perform the cut is restricted and/or the area is poorly designed. So the layout of the bleeding area is probably more relevant in terms of work safety than the type of restraint system.

INTRA-EU TRADE AND TRADE WITH THIRD COUNTRIES

Neither Eurostat statistics on trade in meat nor national statistics offer any information on intra-EU trade and trade with third countries in halal and kosher meat. An additional statistical problem is that part of the meat slaughtered according to religious prescription is sold on the secular market.

In the European Union, the percentage of adult bovines and calves slaughtered without stunning (2012) varies a lot between 1% in Italy to 24% in France according to data provided by competent authorities. In the Netherlands, most of the halal beef meat is for the Dutch market (85%), the rest goes mainly as halal meat to other EU countries. In the case of kosher slaughtering only the forequarter is used by the Jewish community. The hindquarter is sold on the secular market. As such, the Jewish community uses only a part of the carcass due to religious reasons whereas the Islamic community can use the whole carcass. Meat not sold on the local market is mainly sold as halal or kosher meat in other EU countries. For example, we have been informed of flows of halal meat from Ireland, the United Kingdom and Eastern countries to France.

Based on Eurostat data 2009-2103, exports of beef meat from EU to third countries predominantly Muslim or Jewish around the Mediterranean sea are very low (in most years less than 15, 000 tonnes carcass weight) compared to the overall export of beef from the EU to third countries (138,000 and 400,000 tonnes per year). The export to Muslim neighbour countries like Tunisia, Algeria, Lebanon, Morocco, Egypt and Libya varies from 4,500 to 14,200 tonnes in 2009-2013. The export to Turkey increases from 300 tonnes in 2009 to 112.000 tonnes in 2011 and decrease to 300 tonnes in 2013. Exports from EU to Israel is also low (about 200 to 280 tonnes annually). The export figures to Turkey shows that trade between EU and third countries can change quickly (in positive and negative way). This makes it difficult to use figures from the past to estimate the future trade.

These data suggest that, even if it is important for the EU industry to be present in these countries, other factors than the restraint system will impact much more the international competitiveness. However, although the total amount is low, we were said by some slaughterhouses that it is an important market for them as individual companies. Therefore, taken into account the opinion of Jewish representatives, it may be important that restraint systems by inversion can still be used in the future.

ANIMAL WELFARE

In spite of many attempts in different countries to visit slaughterhouses that were using upright restraint system, it shall be noticed that only 3 groups of animals outside the UK were assessed.

The results obtained during the visits in slaughterhouse suggest that:

- handling and operating procedure will primarily affect animal welfare. Differences in duration of restraint between upright and inverted position are rather limited. Operating procedure may vary a lot from one slaughterhouse to another;
- poor designed system (rotating or upright) will also have a detrimental effect.

Regarding the system used in slaughterhouses, based on data collected in section 4, it should be noticed that France represents almost 59% of the bovine animals slaughtered without stunning (2012) and that rotating system used in France come from a small number of manufacturers (three of them have 80% of the “market” in our survey) who all produce the same kind of modern rotating system (“Facomia like”). Among the other manufacturers, we also know that, at least, three or four of them which are specialised in slaughterhouse system are also producing the same kind of system. Consequently, probably more than 90% of the French slaughterhouses are equipped with modern designed rotating system, independently of the size of the slaughterhouses.

These systems are also used in other countries like The Netherlands, Spain and Belgium in our sample. Altogether these four countries represent more than 85% of the bovine animals slaughtered without stunning in the EU. Consequently, if we assume that, on average, the proportion of the different system used is the same in these countries as observed in France, we can first hypothesize that, at least, more than 75% of the bovine animals are slaughtered in the EU by using this modern rotating restraint system that are supposed to be well-designed. Finally, by adding other countries (Italy, Ireland), we can estimate, with a relative high probability, that more than 80% of the animals are slaughtered in these conditions. This assumption is also coherent with the fact that, according to our result, 67% of the slaughterhouses are equipped with restraint system of less than 10 years old and that less than 15% of the slaughterhouses had invested in restraint system before 1990.

Regarding the use of upright systems, we should distinguish between UK which represents approximately one third of the animal slaughtered in upright position and the other countries. In UK, restraint systems used are submitted to an agreement by the Minister and are based on ASPCA design. Then it can be hypothesized that the restraint system used already fulfils minimum requirements. In other countries, different cases can be encountered, from the use of modern rotating devices used in upright position to the use of simple concrete systems which may be considered as poorly designed (e.g. those we observed during the visits in slaughterhouses). However, due to the limitations induced to line speed by such system and based on the answers to the questionnaire of the slaughterhouses survey, it is expected that this kind of systems are present in a small number of slaughterhouses which are slaughtering few animals, less than 1000 per year (and probably limited to some hundreds - see also section 4 and 5 for example in Italy).

Consequently, even if our data do not allow having an exhaustive view, we do not expect that animals slaughtered in poorly designed restraint, represent a high number of animals in Europe. Maybe, this accounts for a maximum of 1 to 3% of the bovine animals slaughtered in 5 to 10% of the slaughterhouses. In terms of number of slaughterhouses, it is probably the use of rudimentary upright system in very small slaughterhouses that constitutes a major risk factor.

However, as we underlined previously, whatever the restraint system used, handling of the animals and, more generally speaking, poor operating procedure, are the major risk factors. Based on our experience, part of the problems encountered can be solved by the management of operators and the implementation of improved operating procedures. For instance, duration in inverted position, cut (number, position, ...), minimum duration of restraint after the cut could be addressed rather easily by defining precise objectives, by training and by monitoring. Others, like handling of the animals at the entry of the system or assessment of loss of consciousness, are more difficult to address because they are depending on the animals (including previous handling), the design in particular the layout of the corridor and the restraint system, the skill of the operators, the procedure and, finally, the current state of knowledge available. During the last five years, research has been stimulated by the new regulation and has allowed identifying some of the key issues. Implementation of the regulation is an ongoing process that is progressively and diversely disseminating the first results of the research depending of the Member States. Therefore we can consider that only a few slaughterhouses in the EU have already addressed most of the risks. In some Member States (e.g. United Kingdom, France and the Netherlands), national specific rules or industry commitment may have speeded up the process but, even in these countries, some issues still remain.

DISCUSSION AND CONCLUSION

The results may be surprising on some points as it appears that rotating restraint systems are more expensive without obvious advantages on line speed, work safety or animal welfare which are three of the main drivers for the slaughterhouses management. However, rotating systems are the most familiar restraint systems within the EU (see Section 4).

To interpret these results, it is necessary to take into account what happened during the last 30 years (see also Section 3). In France, the first design of the modern rotating system was introduced by Facomia in 1979. At this time, it differed from the Weinberg pen which was observed by Dun et al. (1990) by the introduction of a back door, a back pusher and hydraulic restraint system. This initial design was progressively refined during the following years with success and progressively adopted by the main manufacturers of slaughterhouse system (Warin-Ramette, 2010).

At the same time, from the religious representatives point of view and in particular from the Jewish community, there was a strong requirement to carry out the slaughtering not in upright position, but in the same way as “traditional” slaughtering in Jewish and Muslim communities. In France, furthermore, one of the main non-governmental animal welfare organisation encouraged also slaughterhouses to use this rotating restraint system. In this context, following the adoption of Directive 93/119/EC, it was observed a generalization of the use of mechanical modern rotating restraint system for religious slaughtered bovine animals with a speed up before the new regulation was adopted. The French situation may probably also apply to other Member States where rotating restraint systems are permitted.

During the same period, in the United Kingdom, the adoption of the same EC Directive induced a development in an opposite direction. Following several reports and recommendations from the Farm Animal Welfare Council (FAWC) that emphasized the advantage of ASPCA design of upright restraint system compared with the Weinberg system, the British government finally banned the rotating system.

Results obtained should be therefore interpreted in these two divergent contexts. Also it should be taken into account that the lay out of the bleeding area and the operating procedure have been progressively optimised over the last 30 years for the use of either a rotating system or an upright one. The background was different and most of the answers from food business operators need to be interpreted within a category of restraint systems. Therefore, for most of the directors of the slaughterhouse, comparisons are made within a category of restraint systems.

In conclusion, **religious expectation is the main driver** for the choice of rotating system and inverted or lateral position at the time of the cut. Consequently, during the last 30 years, except in the United Kingdom, most of the slaughterhouses in the EU have invested in a rotating system and have optimised the procedures accordingly.

Upright systems are less costly than rotating ones but the investment and cost linked to the bleeding area is low compared to overall investment in a slaughter line or compared to the labour cost in a slaughterhouse.

The **choice of the restraint system has a minor impact on competitiveness** of the European slaughterhouses compared to main exporting countries of meat of bovine animals cut without stunning.

Where using modern systems, work safety is more linked to the layout of bleeding and hoisting area than to the design of the restraint system.

Available data from this study indicate that no more than 1 to 3% of the bovine animals are slaughtered within restrain systems that have a bad design. Given these figures a poor design of the restraining system has a quantitative limited effect on animal welfare compared to non-optimised operating procedures. But in this last case, the impact of the on-going implementation of Regulation (EC) No 1099/2009 need to be further investigated in the next years.

Table 45: Result of a PEST analysis regarding restraint of bovine animals during slaughtering without stunning

(Source: BoRest study “Socio-economic implications”-Data: 2014)

PEST analysis: Starting position for the purpose of all scenarios

Political

- There will be continuous opposition from animal welfare organizations to the slaughter of bovine animals without stunning. Opinion regarding rotating bovine animals before cutting depends on organization and their experience in the field. These opinions do not result in a lively societal discussion on the subject as long as restraint in itself is performed.
- For halal, ongoing debates about the acceptability of pre or post-cut stunning or thoracic sticking after the cut may result in national regulation or local agreements with slaughterhouses but it is not expected to become a European policy.
- At an international level OIE standards (<http://www.oie.int/animal-welfare/animal-welfare-key-themes/>) on animal welfare may be refined due to ongoing concern in some parts of the world. But, so far, advantages and disadvantages of the different restraining systems are still under discussion and, whatever the case, implementing restraining procedures is the priority.

Economic

- The number of locations for slaughter will decrease. Especially small regional slaughterhouses will close down in e.g. France, Spain and Italy. Currently slaughter of bovine animals without stunning takes place in many of these small slaughterhouses. As a consequence the number of slaughtered bovine animals without stunning per slaughterhouse will increase and, extremely, some slaughterhouses may specialise in slaughtering without stunning depending on the social acceptability of such an evolution. The current number of 434 slaughterhouses slaughtering bovine animals without stunning is expected to decrease till 300. This expectation is based on expert knowledge.
- No major change is envisaged in the export of meat of slaughtered bovine animals without stunning. Export increased significantly to the Middle East in recent years but also strongly fluctuates at a low level; export figures show that trade can change quickly in both positive and negative way. It is known that export to these countries vary quickly and significantly according to the economic conditions.

Social

- The Muslim population in the EU will grow (<http://siteresources.worldbank.org/INTEAPREGTOPRURDEV/Resources/Cedomir-Nestorovic.pdf>) From this follows an increased demand for halal meat. In Halal Food Market in Europe 2014-2018 (May 2014) the growth of the Halal Food market in Europe is supported by several drivers, one of which is an increase in the Muslim population in Europe, especially in Russia. Consumption of halal food products is directly proportional to the Muslim population. The high standard of living in Europe is another major driver of the market. Another factor influencing the demand of halal meat is the acceptability of stunning by the Muslim Community. We assumed that for the next 15 years the acceptability, in particular pre-cut stun, will not change.
- Both types of restraining systems (upright and rotating devices) will be used in the EU. However, the general expectation is that the proportion will undergo an alteration. So far, it is highly unpredictable in some cases, for example in France, where different trends are observed (upright to inverted, inverted to lateral recumbence and inverted to upright) while a shift is estimated from inverted to upright in other countries (e.g. the Netherlands). These processes go slowly because the lifetime of restraining devices is at least 15 years (daily use and rotating) or much longer (incidental use and/or the upright system). It depends also on the type of animals (adult cattle vs. calves).
- No major change is envisaged in the pattern of numbers of slaughtered animals during a year. A certain basic level will be performed throughout the year with additional peaks just before certain religious celebrations.

Technological

- The basic upright and rotating systems will remain. There will be no radical change in restraining system used. Existing systems will be gradually improved (more use of oil pressure; ...).
- The cutting and slaughtering of bovine animals will remain to be performed by human beings; technique will not be a substitute in this matter.

SCENARIOS FOR IMPLEMENTING TECHNICAL RECOMMENDATIONS

Relevant for the development of the scenarios and the PEST analysis is the period which has to be taken into consideration. For this, we took the minimum period for the depreciation of restraint system. Therefore we allowed for a horizon of 15 years. A PEST analysis based on expert judgement for this period has been executed. A PEST analysis identifies the underlying trends which have an impact on the development of restraint systems for slaughtering bovine animals without stunning. This gives a better understanding of the context of restraining of bovine animals during slaughtering without stunning and results in a starting position for all scenarios. The main findings of the PEST analysis are presented in **Table 45.**

For the socio-economic impact assessment, three scenarios were defined and are discussed below.

DESCRIPTION OF THE SCENARIOS

SCENARIO 1: BASELINE - NO CHANGE IN EU POLICY

This scenario means no policy change at EU level regarding slaughter without stunning and with the use of the different restraint systems. Present EU policies regarding restraining bovine animals during slaughter without stunning will remain the same for the next 15 years.

However, due to the implementation of Regulation (EC) No 1099/2009, business operators will adopt standard operating procedures and may refine them based on national Guides to Good Practices, national specific requirements or European guidelines. This may change practices. The Food and Veterinarian Office, for example, audited EU regulation in several Member States (The Netherlands in 2006 (2006-8041), France (2007-7330), The United Kingdom (2007-7337), Italy (2008-7691), Spain (2012-6373) and Estonia (2013-6825)). Their comments aim at improving processes within the bleeding area, and not so much the system itself.

We take an annually growth of the number of animals slaughtered without stunning (+1%) for granted. We expect 80% of animals will be slaughtered by 20% of the slaughterhouses (from now on: large slaughterhouses). The other 20% of the animals will be processed by the other 80% of the slaughterhouses (from now on: small slaughterhouses). This also applies for scenario 2 and 3.

In addition to this, we assume in each country, where slaughtering without stunning is allowed, half of the larger slaughterhouses will actively implement standard operating procedures excluding France. For France we expect that all small and big slaughterhouses participate in the existing voluntary program (also officially recognised by the competent authority) to improve the standard operating procedures and to train and to educate all operators.

SCENARIO 2: NON-BINDING SUPPORT MEASURES

In this scenario the EU will initiate non-binding support measures to improve the quality of slaughtering in terms of animal welfare and work safety.

In this scenario the Commission would design and implement the following support measures specifically aimed at restraining bovine animals when they are slaughtered without stunning:

- 1) Development and implementation of templates for improved standard operating procedures;
- 2) Design and dissemination of educational and training materials in several EU languages;
- 3) Provide technical recommendations on restraint systems as a prerequisite for the derogation from the obligation to stun animals before slaughter;
- 4) Realisation of technical studies to refine existing systems and processes.

Improved standard operating procedures, including management of emergency situations, will be developed with EU financial support. Such procedures include, for example, additional requirements and objectives on the duration of each step of the slaughtering process and indicators for the monitoring of animal welfare (see the recommendations of Section 5). These procedures could be drafted on the basis of output of the present study, existing Guides to Good Practices and scientific opinions. This measure will also include translation/dissemination of the templates of the improved procedures. These improved operating procedures can be used as a basis for deepening the training of slaughtermen, animal welfare officers, work safety officers and veterinary services.

Based on the first results of the assessment of animal welfare in this study and project team discussions, some basics of these improved operating procedure are described in **Annex 10**.

In this scenario the design and dissemination of **educational and training materials** in several EU languages will be supported by the EU. Because training is compulsory and should have been performed already (in 2013 or in 2015 depending on previous experience of slaughtermen), these training materials can be used to deepen and update the practical skill of the operators compared with training requirements for the certificate of competence. For example, in France, all operators shall be trained every 5 years in order to keep their knowledge and skill up to date and this can take place during the next session. Training materials could be designed for animal welfare officers as well as for slaughtermen, making educational supports adapted to the audience (more theoretical for animal welfare officers, more practical and interactive for slaughtermen) and inciting interactions between them.

Besides the aforementioned measures **technical recommendations on restraint systems** could be provided by the EU as prerequisite for the derogation from stunning animals or for the improved standard operating procedures. These recommendations would be addressed to the competent authorities of the Member States who are responsible for granting and checking the implementation of the derogation from stunning animals.

Such technical recommendations could improve animal welfare and work safety and could emphasize, for example, the need of:

1. A visual system to monitor the duration of the different steps of the process;
2. Recommendation for the layout of the entrance into the restraint system;
3. Organisation of the bleeding area with particular attention paid to the possibility of the operator to monitor (directly or at least by the use of optical system) the behaviour of the animals during restraining and to be in the best position for doing the cut and monitoring the bleeding.
4. Mobile front of the system to access the head of the animal when the animal falls down;
5. Stun system for emergency cases.

These different pieces of equipment may also be considered as prerequisite for the implementation of high-level animal welfare standard operating procedures in application of the Annex II point 3 of Regulation (EC) No 1099/2009.

Finally, this scenario could also include a **series of technical studies** to refine existing systems and processes, such as systems to monitor pressure, to reduce noise and to develop new designs of chin-lift and head-restraint system for different categories of animals. Such studies would apply to both upright and rotating restraint system.

The feasibility of this scenario is relatively high. There are expectations from this study that improving the procedure in the bleeding area will improve animal welfare and work safety of the people.

Even though further research is still needed, some good practices can already be implemented rather easily. From the answers of the stakeholders it can be concluded that work safety and animal welfare are two important aspects regarding the restraining of animals during slaughtering. Because scenario 2 is voluntary, the support of almost all stakeholders is needed to get the maximum impact. Therefore one of the key elements could be to draw a clear and stable perspective that could help to enhance trust between stakeholders. It is also important that this approach is implemented, taking into account the different initial contexts in order to provide slaughterhouses the maximum added value. It means that a “gap analysis” between recommendations and local situations is probably needed and that training should be adapted to the national context.

This scenario means a policy change at EU level and therefore some additional budgets for implementing this scenario are required in order to maximise the participation of stakeholders. First estimates show a total amount of 1 million Euros⁷.

Finally, we assume that in each country, where slaughtering without stunning is allowed, all large slaughterhouses will join this scenario plus half of the small ones. In addition to this, we have made the calculations without taking France into consideration because this scenario is already implemented in France through the national guideline and training program that we assume it can also be updated according to new scientific evidence.

SCENARIO 3: MINIMUM REQUIREMENTS FOR RESTRAINT DEVICE

In this scenario the Commission will prepare a legislative proposal for further mandatory minimum requirements for restraint systems used for bovine animals in the context of slaughter without stunning. This means upright and rotating restraint systems will continue to be allowed but additional minimum requirements will have to be met. Eventually this would possibly lead to phasing out unacceptable systems over time in the EU or adaptation of these systems.

⁷ Based on following assumptions made: 400,000 euro for developing and disseminating of templates for standard operation procedures and the training and educational materials in the EU (without France) and 600,000 euro for additional research.

Requirements regarding restraint systems may be included in point 3 of the Annex II of the Regulation (EC) No 1099/2009. For example, a point 3.3 may be added, dedicated to the restraint system used for slaughtering bovine animals according to Article 4: “the system shall be designed in order to minimize restraint duration in particular to carry out a smooth quick rotation according to best practices available, allow a visual monitoring of animals behaviour during restraint and bleeding, allow a secure access to the head of the animals in case of emergency, “ In this way the requirements become compulsory for slaughterhouses performing slaughter without stunning.

The consequences of the implementation of this scenario should be further checked. Annex II of the Regulation can be adapted if there is scientific or technical progress and after an advice from EFSA to do so (see Article 14.3). The same holds for Annex III of the Regulation (see Article 15. 4). By following the procedures in Article 25 adaptations can be implemented through the comitology procedure.

Finally, we assume that in each country 5 – 10% of the smaller slaughterhouses will be impacted by this scenario. For these slaughterhouses, we assumed that they will cease production instead of investing in a new restraint system.

ASSESSMENT OF THE IMPACT OF THE DIFFERENT SCENARIOS

The impact assessment per scenario is structured in the same way as the comparison of the upright and rotating restraint system: economic aspects, religious aspects, work safety, intra-EU trade and trade with third countries and animal welfare.

SCENARIO 1: BASELINE

Economic costs

As described in the PEST analysis, it is expected that the number of bovine animals slaughtered without stunning will increase slightly in the EU, mainly because the Muslim population is expected to grow. In addition to this, Research and Markets (2014) forecasts the European halal food market to grow annually with about 2% between 2013 and 2018. We assumed a growth of 16% between 2014 and 2029 for the number of bovine animals slaughtered without stunning.

434 slaughterhouses were allowed to perform slaughtering without pre-stunning in the EU in 2012. Not all of these were operational or actually performing slaughter without stunning. For example, approximately 40 were not operational in Italy and the United Kingdom according to partners.

Furthermore, in France, almost one third of slaughterhouses were closed between 2002 and 2010 (Ravaux, 2011). These data should be interpreted with caution because several factors are at play (for instance, food safety, territorial development and strong interest in local food supply chain, transport, regional and national legislation) and because it was a non-linear trend. Yet, this trend probably also occurs in other countries, particularly where there are large numbers of small slaughterhouses (e.g. Italy, Spain). On the other hand, slaughter without stunning may rise in other countries, for instance in Eastern Europe. However, the numbers in these countries were very low in 2012 and even a doubling would not significantly affect the overall results of the scenarios.

Altogether, it is expected that in 15 years there will be an overall decrease from 434 to 300⁸ slaughterhouses which are allowed to perform slaughter without stunning of bovine animals with the closure of smaller, financially unviable, slaughterhouses.. This means also a significant increase in the number of bovines slaughtered per slaughterhouse.

⁸ All calculations in this section are based on the last year of the scope of this analysis, the 15th year.

As follows from **table 44** slaughtering costs per animal will decline if the total number of bovine animals slaughtered increases.

With respect to variation in annual number of animals slaughtered without stunning in slaughterhouses we expect the most inefficient slaughterhouses with low line speed to close down, as they will experience difficulties in maintaining economical viable production (high costs and low numbers of animal slaughtered). However, some of these small regional slaughterhouses could survive by concentrating their activities on seasonal peak times and religious festivals where demand for halal and kosher meat is higher and customers are willing to pay higher prices.

Given the long lifespan of restraint system (14 to 25 years for rotating systems and 30 to 50 years for upright systems) and because of recent investments in slaughterhouses (see **Figure 12**, p54), no big shifts are expected in this system in slaughterhouses compared with the data reported in Section 4. In case of replacement, the choice of the type of system will be influenced by national regulations (for example, the ban on rotating systems in the United Kingdom) and religious acceptability. Within a certain type of restraint system, slaughterhouse managers look at total investment cost, commercial relations with the manufacturer, animal welfare and work safety for the selection of a certain system.

To conclude on economic costs, due to the overall structural evolution towards bigger slaughterhouses, and therefore economies of scale, economic costs related to slaughter without stunning bovine animals are likely to decrease, whatever the restraining system considered.

Religious aspects

Regulation (EC) No 1099/2009 respects freedom of religion through a derogation from stunning animals.

Regarding the religious expectations in terms of the restraint system, the results of the interviews show that Jewish religious representatives prefer to continue their interpretation of the rites i.e. inverted position is strongly recommended. The opinion of Muslim representatives is less firm and may evolve as it appears today that some of them think that bovine animals should be restrained in lateral recumbency on the left side. Even if they are more flexible, this interpretation will promote the use of rotating restraint systems.

However, it should be taken into account, that in most countries, there are recurrent concerns about stunning or labelling. This may also have a technical impact. For example, post-cut stunning favours restraining in an upright or lateral position. These topics were not in the scope of this study but may impact future decisions on the choice of the restraint system.

In the overall, we do not expect major changes in the religious expectations which could substantially affect the type of restraining systems for cattle.

Work safety

In the baseline scenario the present EU policy regarding restraint bovine animals during slaughter without stunning will remain. This research shows that work safety plays an important role in the decision for slaughterhouse managers to choose a restraint system. Findings of this research also show that regarding the system which is currently in use, only a few incidents are reported with minor impacts for the health of slaughter men – they were still able to continue working. In addition, based on the data provided, no clear difference between the two types of system has been identified regarding their work safety performances. Moreover and as we mentioned earlier, according to respondents to our study, the main risk for workers is the hoisting of the animals. Taken into account that the implementation of the new regulation will generalize the obligation of checking unconsciousness before releasing the animals from restraint, we can expect fewer incidents in relation with struggling, for example, in this area.

Compulsory training will also help to improve the skills of the slaughtermen in particular regarding their ability to better analyse and anticipate the behaviour of the bovine animals. This will normally lead to reduced work safety risks.

Altogether, it is assumed that an improvement of work safety will happen in this scenario even if it is not possible to quantify the decrease of risk of incidents nor the severity of incidents.

Intra-EU trade and trade with third countries

No specific developments are expected for the baseline scenario. Intra-EU trade and trade with third countries in halal and kosher meat are both small and there are no signs that these trade volumes will change significantly in the near future. Moreover, the risk of banning slaughter without stunning in the main countries (France, the Netherlands, Spain, UK and Belgium) is negligible. A significant shift in production and/or trade flows within EU is not foreseen because the majority of production is for local markets.

The cost of slaughtering depends mainly on line speed and labour costs. Restraint systems are only a minor part of the total capital investment and of the total slaughter costs for bovine animals. Based on our results in Section 5, the restraint system has also a minor effect on line speed because most time is spent in handling the animals and not in restraining them before the cut.

Therefore, the competitiveness of slaughterhouses will depend on other factors than the restraint system.

Animal welfare

Due to Regulation (EC) No 1099/2009, standard operating procedures (including emergency plans) will be implemented in slaughterhouses.

Where slaughter without stunning is allowed, we have identified 3 cases: countries without any additional conditions, countries where specific conditions are in force and countries where a post-cut stun is compulsory. However, authorization with specific conditions applies to almost all the main countries. Therefore we do not expect in the next years a ban on upright or rotating restraint systems.

Implementation of standard operating procedures may vary significantly between countries. In France, for example, standard operating procedures should be based on the national Guide to Good Practices which was primarily designed by the industry with the support of scientists, then reviewed by the Ministry and by the French food safety authority before being officially recognised. Animal welfare organizations and representatives from religious communities were also consulted. Finally the guide was endorsed by all the stakeholders and each slaughterhouse should refer to it when implementing its own standard operating procedures. The certificate of competence is given to the different operators based on training and their knowledge of the national guide to good practice.

In the UK and the Netherlands, on the other hand, the competent authorities have adopted some legal requirements, but each slaughterhouse is required to individually and separately implement its own standard operating procedures. There currently appears to be a general reluctance in these countries to enter into a process of jointly designing guidelines.

In Spain, the situation differs between regions (*Comunidades Autónomas*), but in general, and especially in high-capacity slaughterhouses, veterinary officials ensure that operators do not keep the animals in the restraint system for too long. Some slaughterhouses manage the situation by introducing a waiting area of hoisted animals already (or almost) dead, so as not to affect line speed. In other cases, they apply post-cut stunning. So, although restraining is being included in the standard operating procedures of each slaughterhouse, there is no uniformity and little communication between slaughterhouses to harmonize minimum requirements.

Lastly, in Italy there is a wide variety of approved systems and rules due to the fact that the responsibility is assumed by numerous local authorities who have different interpretations of the regulation. The national reference centre for animal welfare just published a guideline for the implementation of the Regulation (June 2014). Training, however, is carried out by a single institution and dedicated to selected personnel from the competent authority. The limited number of personnel trained may slower the dissemination of good practices in Italy.

France represents almost 60% of all bovine slaughter without stunning in the EU (see “competent authorities survey”-2012). Therefore, the progressive dissemination of the Guide to Good Practices and implementation of standard operating procedures will have a significant impact on bovine animals welfare. It is also expected that the Guide to Good Practices will be continuously updated to include new technical and scientific developments. So far, some major requirements (e.g. duration of restraint after the cut) have already been implemented in most slaughterhouses. All slaughtermen involved in slaughter without stunning have undergone training since the end of 2013 and they should be retrained every 5 years.

In other countries, some additional legal requirements will have the same effect, for example in the United Kingdom, The Netherlands and Spain. The situation may however be slightly different from France because it seems that there is limited trust between the different stakeholders and reluctance to collaborate in certain cases.

On the basis of these developments, we may expect that a significant part of the bovine animals slaughtered without stunning in the EU will benefit from improved standard operating procedures over the next 15 years. Of the 2,400,000 bovine animals slaughtered without stunning in 2029, it is therefore expected that 1,600,000 animals (or 64% of the animals) will benefit from improved standard operating procedures related to the implementation of Regulation (EC) No 1099/2009).

However, even though improvements in animal welfare may be expected, there are some limitations:

- The impact of improved standard operating procedures on animal welfare will depend on the targets stated therein (e.g. threshold for monitoring, duration of restraint);
- Research is still needed to improve the handling of the animals at the entrance of the restraint device or to better understand the factors that affect loss of consciousness after the cut.
- There may be a lack of harmonization between countries as is presently the case for the restraint system. For example, the Italian guideline allows the use of rope for head restraint when the body of the animal is mechanically immobilized. On the contrary, the use of rope is forbidden in France.
- There may be a focus on some part of the process (for example restraint duration after the cut) and less attention paid to restraint in itself.
- Some difficulties may appear because of distrust between the stakeholders or because of lack of references.

Table 46 : Comparison of scenario 2 “Non-binding support measures” with the baseline scenario on the different judgement areas.

(Source: BoRest study “Socio-economic implications”)

Judgement area	Scenario 2*	Differences compared to baseline scenario
Economic costs	-	Small investments in add on’s Time for education and training
Religious acceptability	0	No differences: all types of restraint systems are allowed
Work safety	++	Better processes with less incidents and/or less severe incidents.
Intra-EU Trade and trade with third countries	0	No change in production nor in Intra-EU trade and trade with third countries
Animal welfare	+++	Improved processes in the bleeding area, with better welfare for bovine animals slaughtered without stunning.

**For each judgement area a qualitative label is provided indicating whether the area is improving (+) or not (-) and how much in comparison with the baseline situation.*

SCENARIO 2: NON-BINDING SUPPORT MEASURES

Compared to the baseline scenario some impacts can be expected. Firstly, these impacts are summarized in **table 46** followed by an explanation beneath that. From this we can conclude that in comparison with the baseline, improved animal welfare is at the top in scenario 2 followed by better work conditions at minimal cost. All these evolutions will have an additional cost for the EU and for the slaughterhouse in the short run.

Economic costs

In this scenario the course of the number of slaughterhouses and animals slaughtered without stunning is comparable with that expected in the baseline.

In comparison with the baseline, this scenario will increase costs for slaughterhouses. Some investments are needed in add-on's to better monitor the process and animal welfare during restraining. However, in general the costs will be marginal while quality improvement can be realised with small investment in add-ons of restraining system, without changing the line speed and without additional man power. So we foresee hardly any obstacle from this point of view. Of course, as in every sector, for individual companies costs can turn out to be higher than the average that we forecast.

Moreover, the costs per adult cattle slaughtered for both restraint systems will not change significantly, given the fact that line speed is decisive for the slaughter costs.

For slaughterhouses and slaughtermen this scenario will in the short run cost time for training and implementation of the improved standard operating procedures. Part of the improved standard operating procedures will focus both on the monitoring of animal welfare and work safety. These costs can be minimized if the training and implementation is part of a 'normal' training program. As such, this scenario will first increase costs but can generate benefits if the process in the bleeding area can be optimized and e.g. the line speed can be increased. In addition, the technical and scientific studies to refine existing systems and operating procedures can support an increase in the quality of the processes of the bleeding area.

In short, the costs of implementing this scenario primarily consist of developing improved standard operating procedures and disseminating them. For developing the procedures the technical recommendations from the present study can be used, in conjunction with information on existing procedures like the French guide to good practice.

For this, this judgement area is scored with a small minus because of the cost increases in the short run.

Religious aspects

Within this scenario all religious wishes are expected to be fulfilled, like in the baseline scenario. So for this, no change is expected.

Workers' safety

The support measures in this scenario are improving process quality and hereby worker's safety is one of the benefitting areas. A better organisation of the working area is foreseen while knowledge and practise are deepened. A significant positive impact can be expected if measures are implemented by slaughterhouses, slaughtermen and national authorities because the interaction between animals, people and equipment is improved.

By improving the standard operating procedures, by additional education and training of the slaughtermen, and by improving the restraint systems simultaneously, work safety can be increased. Results of this research show that directors of slaughterhouses are highly interested in improving work safety. Based on the arguments it can be expected that the majority of slaughterhouses and slaughtermen are willing to join the program for improving the quality of the processes. The drawback is that such a program is already implemented on national scale in France. Therefore we leave France out of the calculations for this part. As a result, in 60% of the other slaughterhouses (all slaughterhouses excluding France) the operators will benefit⁹. For this, this area is scored with two plusses.

Intra-EU trade and trade with third countries

No major change in slaughter costs is forecasted in this scenario. This implies that the competitiveness of slaughterhouses will not be affected by this nor the trade flows of meat from bovine animals slaughtered without stunning. Competiveness of slaughterhouses will depend on other factors than the implementation of improved standard operation procedures, for example entrepreneurship. For this, no change is expected.

⁹ At least one team of operators is active in the restraining area, but common practice is the presence of more teams.

Animal Welfare

In this scenario support measures are introduced and aiming at accelerating the improvement of the quality of the slaughtering process in terms of animal welfare and work safety. Improved standard operating procedures, better trained operators and improved equipment are input and, when applied correctly, key output will be an improved interaction between people, animals and restraint system. Adding the focus on animal welfare (e.g. optimized and monitored restraining method, limited duration of restraint or improved design of the head restrainer) positive effects on animal welfare are expected for this scenario. This holds for both types of restraint systems.

Slaughtering is not a fully mechanized operation, so the well-being of the animals partly depends on the work and the skills of the personnel. This scenario will increase the knowledge of slaughter men regarding animal behaviour. This will positively impact on animal welfare. Operators will become more adequately trained to recognise animals' behaviour and intervene whenever necessary to reduce for example stress. On the basis of these developments, we may expect that annually some 800,000 animals slaughtered without stunning in the EU will benefit from improved standard operating procedures over the next 15 years (33% of the animals slaughtered in 2029). For this, this judgement area is score with three plusses.

Table 47 : Comparison of scenario 3 : “legal minimum requirements for restraint system” with the baseline scenario on the different judgement areas

(Source: BoRest study “Socio-economic implications”)

Judgement area	Scenario 3*	Differences compared to baseline scenario
Economic costs	-	15 to 32 slaughterhouse will cease slaughtering bovine animals without stunning. A small part of the restraint system will not be fully depreciated.
Religious acceptability	0	Both types of restraint systems (upright and rotating) are permitted
Work safety	+	By phasing out the inferior restraint system also some dangerous work conditions will disappear and work safety will be increased for few workers
Intra-EU Trade and trade with third countries	0	No change in production nor in Intra-EU Trade and trade with third countries
Animal welfare	+	Better welfare for 1 to 3% of the animals slaughtered without stunning

**The judgement areas are compared to the baseline scenario. For each area a qualitative label is provided indicating whether the area is improving (+) or not (-) in comparison with the base line situation.*

SCENARIO 3: MINIMUM REQUIREMENTS FOR RESTRAINT SYSTEM

Compared to the baseline scenario some impacts can be expected by implementing minimum requirements for restraint systems. Firstly, these are summarized in **table 47** followed by an explanation beneath that. From this we can conclude that in comparison with the baseline scenario, animal welfare will be improved in scenario 3 followed by slightly better work conditions at minimal cost.

Economic costs

Restraint systems should meet minimum requirements in this scenario. In general, no costs are foreseen other than costs to check if the present restraint systems meet the minimum requirements. Only for a small part of slaughterhouses in EU this scenario could add costs in the bleeding area to adapt the present system to meet the minimum requirements. Based on expert judgement we assume that improving the system currently in use is hardly likely. As such, present restraint systems will not be adjusted and systems will not be replaced either. Instead these slaughterhouses will cease slaughtering without stunning, or even cease production altogether. All slaughterhouses with poorly designed systems will be affected since the minimum requirements are mandatory. As we hypothesized above, not more than 5 to 10% of the slaughterhouses use poorly designed system (15-32 slaughterhouses). It is difficult to predict the precise number of slaughterhouses which may be affected; this will need further investigations because it will also depend on the level of the minimum standards required. No essential differences or shift between upright and rotating system are expected. For this, this judgement area is scored with a minus.

Religious aspects

The modifications are such that all religious wishes will be fulfilled, like in the baseline scenario. For this, no change is expected.

Worker's safety

By phasing out the restraint systems that do not meet the minimum requirements work safety will be improved. So the number of scarce incidents, which we assume to be related with inferior restraining systems, will be further reduced. The uniqueness of the cases makes it impossible to calculate the number of operators that will be affected by this scenario. For this, we expect the work safety conditions for a few operators in the bleeding area to improve which is scored with a plus.

Intra EU trade and trade with third countries

No change in slaughter costs and in demand and supply of meat from bovine animals slaughtered without stunning is forecasted in this scenario compared to the baseline scenario. This also means that competition among slaughterhouses will not be affected and sub consequently the trade flow of meat from bovine animals slaughtered without stunning. For this, no change is expected.

Animal Welfare

By phasing out the restraint systems that do not meet the minimum requirements animal welfare will be improved. It is assumed that the restraint systems that hurt the animal welfare the most will be banned in the future.

As most of the existing restraint systems will meet the minimum requirements the animal welfare will not change in many slaughterhouses. Annually around 30,000 – 70,000 animals will benefit (1-3%).

For this, this judgement area is scored with a plus.

Table 48 : Comparison of the different scenario with the baseline on all judgement areas.**(Source: BoRest study “Socio-economic implications”)**

Judgement area	Baseline	Scenario 2 : Non-binding support measures	Scenario 3 :Minimum requirements for restraining systems
Economic costs	0	- No additional adjustment cost as all expenses for the measures are voluntary and financially supported by EU Additional training and advice through support measures will be more valuable for small and medium enterprise where staff is limited	- Almost negligible increase in cost; a few slaughterhouse probably close down because restraint system does not meet minimum requirements
Religious acceptability	0	0 No change compared to the baseline	0 No change compared to the baseline
Work safety	0	++ If a slaughterhouse decides to take up the gauntlet, scenario 2 deals with an integrated approach. Key output will be an improved interaction between people, animals and restraint system and better work safety.	+ One element of the process is positively influenced: the system. But it is only one element, other variables are not directly impacted by this scenario, so small positive impact on work safety
Intra EU trade and trade with third countries	0	0 No change compared to the baseline	0 No change compared to the baseline
Animal welfare	0	+++ If a slaughterhouse decides to take up the gauntlet, scenario 2 deals with an integrated approach. Key output will be an improved interaction between people, animals and restraint system. This scenario 2 will lead to a more deep-rooted improvement of animal welfare	+ By phasing out the restraint systems that do not meet the minimum requirements animal welfare will be improved. As most of the existing restraint system will meet the minimum requirement; in many slaughterhouses the animal welfare will not change.

COMPARING THE SCENARIOS

The main results are summarized in **table 48**.

The biggest impact in the near future on animal welfare and work safety is expected for the baseline scenario. The reason is that in France, with estimated almost 60% of all slaughtered animal without stunning in the EU (2012), a voluntary program is running where improved standard operating procedures are implemented in the slaughterhouses with the involvement and approval of all stakeholders. Such program is lacking in other Member States with a substantial number of bovine animals slaughtered without stunning, The Netherlands, Spain, United Kingdom and Belgium.

In comparison with the baseline scenario, both alternative scenarios will positively contribute to animal welfare and work safety. Especially in scenario 2 bovine animals and operators will benefit more than in scenario 3. Economic cost score a small minus in both alternative scenarios while the other judgement areas are not affected compared to the baseline.

In the baseline scenario the conditions for the majority of bovine animals and a lot of workers is already improved. Scenario 2 would add to this, but contribution of scenario 3 is relatively marginal. For example in the baseline 64% of the animals slaughtered will have better welfare conditions in the bleeding area and scenario 2 and 3 will add a maximum of 33% and 3% to that figure. If a slaughterhouse decides to take up the gauntlet, scenario 2 deals with a more integrated approach, while in scenario 3 animal welfare will be improved by phasing out restraint systems that do not meet the minimum requirements. As such the expected impact on animal welfare and work safety in scenario 3 is far less than the expected impact of scenario 2.

Some remarks have to be made with respect to the impact of scenario 2: there will be a split between slaughterhouses voluntary introducing improved standard operating procedures and train their people and slaughterhouses not changing anything. Though part of the optimisation of the slaughter process in the bleeding area (= scenario 2) can be financially supported by the EU through dissemination, training and advice program by local experts these support measures are voluntary. Therefore this scenario runs the risk that many small slaughterhouses performing the slaughter of bovine animals without stunning only in peak periods will not make use of these voluntary measures. Also slaughterhouses that have plans to stop their activities will probably not use the support measures (this is only a temporary problem). On the other hand, financial support can stimulate a collective approach in other countries like in France. We may expect that incentives from the European level may help to disseminate the information and share experience and, consequently, induce improvement and harmonisation.

INDICATORS FOR MONITORING AND EVALUATION

The terms of references requests for core progress indicators of a possible EU intervention. However, the possible interventions with regard to restraint systems are limited to:

- a. non-binding support measures;
- b. defining minimum requirements for restraint systems.

For all the scenarios upright restraint systems and rotating restraint systems are allowed at EU level. Therefore we focus on indicators for monitoring the evolution of the future situation under Regulation (EC) No 1099/ 2009.

In line with the “study on various methods of stunning for poultry” (FCEC, 2012) we note that general monitoring of the legislation on animal welfare is included in Regulation (EC) No 882/2004 on official controls on feed and food. What is required for the restraint system is the gathering of specific figures to get an overview of the developments in:

- number of slaughterhouses performing slaughter without stunning (number of authorizations);
- the number of (bovine) animals cut without stunning;
- type of restraining system used;
- presence of standard operating procedures.

These figures of the *context* should be collected annually or bi-annually to see the progress made. Member States, where slaughtering of bovine animals without pre-stunning is allowed, should be requested to provide this information to the Commission in a standard format. This study shows that in 2013 not all national governments have a central list of these figures. Two main countries with regard to bovine animals slaughtered without stunning are among them France and the United Kingdom. The study also shows that Member States who have such lists are not always able to give the updated information.

If it is fairly impossible to gather these data by these Member States, or this system is deemed to be too much a burden on Member States or slaughterhouses, a periodic survey can be carried out like was done in this study. A survey can be combined with visits to slaughterhouses. In that case also some output indicators can be gathered like number of training executed and certificates for slaughtermen, welfare officers and work safety officers. In this case also indicators related to animal welfare or work safety (see **annex 10** for possible indicators) can be gathered.

CONCLUSION ON THE SOCIO-ECONOMIC IMPLICATIONS

Religious acceptability is the most important factor for the choice of a type of restraint system. A general preference for rotating system is expressed by religious representatives of the Jewish and Muslim community in all countries.

The differences between the upright and rotating restraint system regarding other socio-economic aspects are small. The upright restraint system is cheaper in use than the rotating system (less than 1 euro per bovine animal for regular use of the system) but other factors like numbers of animals slaughtered and line speed are far more decisive for the slaughter costs.

The choice of the restraint system has a minor impact on competitiveness of the European slaughterhouses compared to main exporting countries of meat of bovine animals cut without stunning.

Where using a modern restraining system, work safety is more linked to the layout of bleeding/hoisting areas and the operating procedures than to the type of restraining system used.

Although the information is scattered it can be assumed that at least 80% of the bovine animals slaughtered without stunning are slaughtered with a modern restraining system in the EU. If these systems are used in the right way neither animal welfare nor work safety should be unduly endangered. However, in practice the process from entering the animal in the bleeding area till hoisting the animal is often not optimal, and this leads to situations in which animal welfare is endangered. In the 18 slaughterhouses visited, there were some possible improvement at different stage of the process.

Besides the suboptimal slaughtering process there is also a small minority (estimated at 5 to 10%) of restraint systems that don't meet the minimum requirements (according to the judgement of the experts involved in this project) to slaughter bovine animals without stunning under optimal conditions for the welfare of the animals.

The different scenarios will not impact the use of the type of restraint systems in practice. Upright and rotating systems are allowed in all scenarios.

Opting for no additional EU action (baseline scenario) will increase animal welfare and work safety in many slaughterhouses. In France (which represents nearly 60% of the bovine animals slaughtered without stunning in the EU), a national voluntary program for developing and implementing standard operating procedures and educating and training of people involved in the bleeding area is implemented. Such a program is still lacking in some other Member States where many bovine animals are slaughtered without stunning.

Opting for non-binding support measures will speed up the improvement of animal welfare during slaughtering without stunning, especially in other Member States than France. Experiences from France show that commitment, trust and cooperation of government, slaughterhouses managers and religious representatives is needed to develop and implement such a programme.

One important condition exists at this moment. All stakeholders interviewed are willing to enhance animal welfare and the work safety of the people working in the bleeding area. However, mutual trust among stakeholders is not present in all EU Member States and this might limit the efficiency of such option. In addition, this option has two negative aspects: firstly, it involves for the EU budget one-off costs of around 1 million Euros to develop and implement improved standard operating programmes and research program. Secondly, differences within countries and slaughterhouses who participate and who do not may increase.

Opting for minimum requirements for restraint system has as advantage that almost no costs or investments are involved (only for 15 to 32 slaughterhouses not meeting the minimum requirements). The disadvantage is that this scenario will have less additional impact on animal welfare and work safety as only slaughterhouses not meeting the minimum requirements are affected. The main drawback of this scenario, compared to the second one, is that we expect that only a few restraining devices will be banned and most slaughterhouses will not be affected at all. As such the impact on animal welfare and work safety in scenario 3 is far less than the impact of scenario 2.

7. GENERAL CONCLUSION

CONTEXT OF THE STUDY

In slaughterhouses, bovine are restrained in upright position in a box before being stunned, mainly by a penetrating captive bolt. However, the EU legislation (Regulation (EC) No 1099/2009 *on the protection of animals at the time of killing*) also allows the **possibility to derogate from stunning animals in the case of religious slaughter** (Jewish and Muslim methods of slaughter).

For that purpose, specific restraining systems have been designed **to reverse the animal upside down** or on its side in order to facilitate the cutting by the slaughterman (**rotating system**). However, during the process of adoption of Regulation (EC) No 1099/2009, there was a debate on the welfare aspects of such rotating restraining system.

As a result, this regulation requires the Commission to submit to the European Parliament and the Council **a report on systems restraining bovine animals** by inversion or any unnatural position.

The purpose of the present study was therefore to collect the relevant information for the preparation of the above mentioned Commission report. Here below are the main findings of the study.

The study exclusively refers to the slaughter without stunning of bovine animals and conclusions are limited to this scope. The study does not aim at questioning the legitimacy of slaughter without stunning for religious reasons.

RESTRAINT PRACTICES OF BOVINE ANIMALS SLAUGHTERED WITHOUT STUNNING

No more than **8% of bovine animals were slaughtered without stunning in the EU** in 2012, most of them (84%) in only **four Member States** (France, The Netherlands, Spain and United Kingdom) involving approximately 400 slaughterhouses.

Almost **80% of these animals are slaughtered in a rotating device** and the remaining 20% in an upright device. Within the main Member States that perform slaughtering without stunning, the **use of the rotating device is not permitted only in the United Kingdom**. Through a survey carried out in 116 slaughterhouses, it was estimated that approximately 60% of the bovine animals are slaughtered without stunning in inverted position, 17-18% of the animals in upright position and 15% in lateral position.

More than 30 manufacturers/models have been identified for the restraint of cattle for slaughter without stunning. However, no more than seven manufacturers of rotating restraint devices are present in more than half of the slaughterhouses or in large scale slaughterhouses. This contrasts with a large diversity of the origin of the equipment, mainly from local manufacturers, in the other slaughterhouses. Overall, 67% of the restraint devices were less than 10 years old.

Slaughterhouse operators primarily choose their restraining system for slaughter without stunning to meet the religious expectations of their customers. Religious representatives from **Muslim and Jewish communities confirmed that inverted or lateral position is the preferred position**. Consequently, during the last 30 years, except in the United Kingdom where inverted systems were banned, most of the slaughterhouses in the EU have invested in rotating system and have optimised their procedure accordingly.

However, upright devices are cheaper than rotating ones both in terms of investments and operating costs but these costs are low compared to the costs of the overall slaughter line. These costs do not play a significant role for the competitiveness of business operators. Labour cost, the line speed or the number of animal slaughtered per year are factors far more economically important for the competitiveness of a slaughterhouse than the type of restraining system.

Little information is available on trade of halal or kosher bovine meat within the EU or with third countries. Exports to third countries (Israel or predominantly Muslim countries) over the last years are very low and variable according to political agreements (e.g. Turkey). Intra-EU trade does not appear to be very significant and most of the meat is sold locally.

Where using modern restraining devices, **work safety** is more linked to the layout of the bleeding and hoisting area rather than the type of restraining device itself. Releasing and hoisting the animals represent a major risk for the safety of workers and this applies to both restraining systems.

WELFARE OF ANIMALS AND RESTRAINT DEVICES/PRACTICES

In terms of animal welfare, both rotating and upright restraint systems have strengths and weaknesses. Specific animal welfare concerns of rotating systems are delays in operation between entry and slaughter, and pain/stress/distress from being restrained in an unnatural position. Upright restraints can cause pain and distress to the animal if excessive pressure is applied on the body or the head during restraint, and more skill is required to perform a successful neck cut than inverted or lateral restraints.

From our observations on various animal welfare criteria carried out on more than 1000 animals observed from entry into to the device to post bleeding period in commercial slaughterhouses, **no conclusive findings could be established in favour of one of the two types of restraining systems**. More than 20 variables were analysed. The ranges of the duration of restraint, the operator or animal behaviour, the cut and the course of loss of consciousness after the cut were similar in the different positions. Most of the extreme values observed or deficiencies could be explained by inefficient operating procedure or poor skill of operators, on one hand, or improper layout of the bleeding area or design of the restraint device, on the other hand. This applied to both restraining system, rotating and upright.

Based on these observations and experts' opinions, we suggest **recommendations to improve the welfare of animals and workers' safety**. Quantitative objective based on best practices observed (e. g. duration of restraint in inverted position, number of cuts) are provided for animal welfare officer to monitor the efficiency of their procedure (see section 5).

SCENARIOS FOR FUTURE EU POLICIES

In addition, **the study explored three options for possible future EU initiative**: (1) no EU action (baseline), (2) non-binding measures and (3) minimum requirements for restraining devices.

Regulation (EC) No 1099/2009 applies from January 2013 and its implementation by the European meat industry is still ongoing on several aspects in particular the development of good practices.

In the next 15 years, the number of bovine animals slaughtered without stunning is expected to slightly increased in the EU (due to the growth of the Muslim population) while the number of slaughterhouses is expected to decrease. Based on previous trends, we expect that 300 slaughterhouses will perform slaughter without stunning at the end of this period. This will increase the number of animals slaughtered per slaughterhouse and slightly decrease the slaughter costs. No major change is expected in terms of restraining systems used or in trade of such meat (intra-EU or with third countries).

Without any new EU initiative, we still expect **an improvement of animal welfare and work safety for the slaughter of bovine animals without stunning**. This is mainly due to the proactive strategy developed in France (guidelines and training) where more than 50% of the slaughter of bovine animals without stunning of the EU took place (based on 2012 estimation).

Compared to this baseline, the option of “**non-binding support measures**” **would have clear positive impacts on animal welfare** and work safety, especially in other countries than France (approximately **one third of the animals** slaughtered without stunning) without major negative effect on costs, religious acceptability or trade. This scenario is based on the development of EU guidelines for improved procedures, additional training, promotion of additional prerequisites and technical/pilot studies.

Experiences from France show that commitment, trust and cooperation between public authorities, the meat industry and religious representatives are needed to develop and implement such programmes. We consider that in the rest of the EU these conditions are also met since **most EU stakeholders are committed to improve animal welfare and workers' safety**. However, this voluntary approach involves a cost for the EU budget and the process will not lead to a more harmonized set of rules within European Union since it is likely that few operators will ignore the proposed measures.

The option of setting up **minimum requirements for restraint device** by amending the legislation has the advantage of generating almost no costs or investments (only for slaughterhouses not meeting the minimum requirements). However, our observations have showed that, in terms of quantitative effect, improvements on animal welfare and work safety largely depend on the progress realised on operating procedures and skills of the personnel rather than by changing or upgrading pieces of equipment. Therefore, this scenario will have much less positive impact on animal welfare and work safety than the previous option since few slaughterhouses are likely to be concerned (expected to account for less than 30).

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10. ANNEXES

ANNEX 1 : SURVEY OF RESTRAINING SYSTEMS CURRENTLY USED FOR CATTLE AT THE TIME OF KILLING

*This questionnaire applies **ONLY TO CATTLE**.*

Please try to answer by using the data of 2012. If not, specify the year.

1. INTRODUCTION

Current EU legislation gives a dispensation from stunning animals for religious slaughter (Jewish and Muslim methods of slaughter). It is a requirement in the legislation that animals are immobilized until the loss of consciousness. In commercial slaughterhouses in Europe, bovines are currently being restrained in the upright position or inverted (or restrained laterally) in a rotating box.

During the EC Council debate that led to the adoption of Regulation 1099/2009, some delegates expressed concerns about the impact on animal welfare of the use of rotating box, while others argued that these systems have some advantages for slaughter without stunning. It was settled, that the Commission would submit a report to the European Parliament and the Council, the report will be based on the results of a scientific study, which will investigate the animal welfare aspects and socio-economic implications of different restraint systems.

A consortium of scientists, economic experts and sociologists originating from 6 EU Member States and one non-EU country will perform the study that will be used for the evaluation of policy options by DG SANCO (http://ec.europa.eu/food/animal/welfare/financing/docs/call_2012_10357_tor_rotating_box_en.pdf).

The initial phase of the study will collect information on the current practices in terms of restraining systems in Member States and some third countries. The objectives are to get information on restraining practices used for slaughter without stunning.

In the first step, competent authorities are contacted to provide an overview of the situation in their country, and provide information on slaughterhouses which have a derogation to slaughter bovines without stunning. In the second step, slaughterhouses will be individually contacted for further information on the restraining systems currently in operation and their operating procedures. An animal welfare assessment and an evaluation of economic and work safety implications will be performed at a later stage in the project in a sub-sample of European slaughterhouses.

Overall the study aims to analyze the welfare of bovines in during slaughter without prior stunning in different restraining systems and to evaluate the range of relevant improvements that could be made in terms of equipment and practices. The study will also take into account socio-economic implications and stakeholders acceptability.

In [country], the investigation is being conducted by (name BOREST partner).

We would be grateful if you could please spare a few minutes to answer the surveys questions. Any information provided will be treated in the strictest confidence and no individual organization/slaughterhouse/companies will be named. We also like to emphasize that the aim of this survey is to obtain reliable and up to date data. So where possible please use real data, however if an estimate is provide, please indicate.

2. GENERAL INFORMATION

Country: _____

Please identify your organization (name of organization): _____

Questionnaire completed by:

Name: _____

Email: _____

Phone number: _____

3. CATTLE SLAUGHTERED

3.1 Annual numbers of cattle slaughtered in your country from 2007 to 2012

If available, please specify data for adult cattle and calves. If the numbers of cattle slaughtered is not available, please indicate volume of beef produced (in tons of carcass weight equivalent)

	NUMBER	UNIT	ADULT CATTLE	CALVES
2007				
2008				

2009				
2010				
2011				
2012				

3.2 Number of religiously slaughtered cattle in 2012

Please estimate the percentage of cattle religiously slaughtered in 2012 by Dhabiha or Shechita methods (if figures are unavailable for the previous year please estimated using 2011 figures).

Year of the data :	Bovine animal
Dhabiha	
Shechita	

3.3 Please estimate the amount of meat (in tons) obtained from cattle slaughtered without stunning (according to Art. 4 regulation 1099/2009) that is :

- Imported to your country
Please indicate the main country of origin: _____
- Exported from your country
Please indicate the main country of origin: _____
- Tick here if you don't have this information

3.4 What percentage of cattle slaughtered in your country are restrained with the following restraint systems :

- Rotating pen : _____%
- Upright pen : _____%

3.5 Percentage of cattle slaughtered per category in 2012

If 2012 is not available, please present the most recent data and indicate the year

Year :		Dhabiha	Shechita
Methods	No stun applied		
	Pre-cut stun (stun applied prior to cut/bleeding)		
	Post-cut stun applied (stun after the cut/bleeding)		
TOTAL		100%	100%

3.6 In the next 5 years, do you expect the number of animals slaughtered without any form of stunning to :

Please estimate the percentage in the case of increase or decrease

- Increase (_____%)
- Decrease (_____%)
- Remain stable

4. SLAUGHTERHOUSES AND LEGISLATION

4.1 What is the number of slaughterhouses that :

- Are officially registered in your country or approved by the competent authority according to regulation N°853/2004 for slaughtering cattle? _____

If data are available only for red meat as a whole, please specify

- Have an exemption to slaughter cattle without stunning according to Regulation N°1099/2009 in your country? _____

If data are available only for red meat as a whole, please specify

4.2 Enforcement of regulation 1099/2009 on the protection of animals at the time of killing

4.2.1 Have additional rules been implemented in your country concerning religious slaughter since the adoption of regulation N°1099/2009 in the protection of animals at the time of killing?

- Yes
- No

4.2.2 If yes, what do they specify concerning :

Stunning	
Animal position	
Slaughtermen training	
Traceability system for incoming and outgoing orders of meat obtained from animals religiously slaughtered	
Duration of restraining	
Minimum time between bleeding and the beginning of the processing	
Other	

4.2.3 How is it currently ensured in your country that slaughterhouse employees dealing with live animals are competent regarding animal welfare?

- Training
- Licensing
- Animal welfare officer (local or central government)
- Other (please specify) :
- Nothing

4.3 How many slaughtermen were registered in your country in 2012?

Please indicate the number of slaughtermen who had a license certifying their competence to perform.

Dhabiha slaughter	
Shechita slaughter	

4.4 Licensing requirements for slaughtermen involved in slaughter without stunning in your country.

4.4.1 *Is there any specific license for slaughtermen performing religious slaughter without stunning?*

- Yes
 No

4.4.2 *If yes, does the license include an approval or authorization of a religious community or a religious institution?*

- Yes
 No

4.4.3 If yes, please name the relevant religious institution/authorities who give approval for licensing religious slaughtermen:

Dhabiha slaughter	
Shechita slaughter	

4.5 Please provide a list of slaughterhouses that are licensed to perform slaughter without stunning of cattle (only for 7 selected Member States : FR, BE, IT, ES, NL, GB, IRE)

If possible, please indicate for each plant:

- *Name*
- *Location*
- *Estimation of the number of cattle slaughtered without stunning per year*

End. Thank you for your participation.

ANNEX 2 : SURVEY OF RESTRAINING SYSTEMS CURRENTLY USED FOR CATTLE AT THE TIME OF KILLING

Please complete and return this questionnaire
by email **before** _____

*This questionnaire applies **ONLY ON CATTLE**.*

Please try to answer by using the data of 2012. If not, specify the year.

1. INTRODUCTION

Current EU legislation gives a dispensation from stunning animals for religious slaughter (Jewish and Muslim methods of slaughter). It is a requirement in the legislation that animals are immobilized until the loss of consciousness. In commercial slaughterhouses in Europe, bovines are currently being restrained in the upright position or inverted (or restrained laterally) in a rotating box.

During the EC Council debate that led to the adoption of Regulation 1099/2009, some delegates expressed concerns about the impact on animal welfare of the use of rotating box, while others argued that these systems have some advantages for slaughter without stunning. It was settled, that the Commission would submit a report to the European Parliament and the Council, the report will be based on the results of a scientific study, which will investigate the animal welfare aspects and socio-economic implications of different restraint systems.

A consortium of scientists, economic experts and sociologists originating from 6 EU Member States and one non-EU country will perform the study that will be used for the evaluation of policy options by DG SANCO (http://ec.europa.eu/food/animal/welfare/financing/docs/call_2012_10357_tor_rotating_box_en.pdf).

After having established an overview of the situation of slaughtering bovine without stunning in the EU from competent authority, the present survey focused on the restraining systems currently in operation and their operating procedures in all the slaughterhouses in 7 selected Member States. These data will be used to set a sub-sample of restraining devices and slaughterhouses where an animal welfare assessment and an evaluation of economic and work safety implications will be carried out in a later stage of the project.

Overall the study aims to analyze the welfare of bovines in different restraining systems during slaughter without prior stunning and to evaluate the range of relevant improvements that could be made in terms of equipments and practices; this will take into account socio-economic implications and stakeholders acceptability.

In [country], the investigation is being conducted by (name BOREST partner).

We would be grateful if you could please spare a few minutes to answer the surveys questions. Any information provided will be treated in the strictest confidence and no individual organization/slaughterhouse/companies will be named. We also like to emphasize that the aim of this survey is to obtain reliable and up to date data. So where possible please use real data, however if an estimate is provide, please indicate.

2. LOCATION DATA

Country: _____

Slaughterhouse's name: _____

Slaughterhouse's address: _____

Identification code for your slaughterhouse: _____

Questionnaire completed by: _____

Phone number: _____

Email: _____

3. GENERAL INFORMATION

3.1 Please mark the main species slaughtered in your plant (only one answer possible) :

- Calves (up to 8 months)
- Adult cattle
- Sheep

3.2 How many cattle have been slaughtered in your plant in 2012 with following methods?

If exact figures are unavailable for cattle religiously slaughtered, please indicate the total number of cattle slaughtered in your plant and on estimation of the percentage of animals slaughtered by Dhabiha and/or Shechita.

Number of cattle slaughtered		CALVES (up to 8 months)	ADULT CATTLE
METHODS	Conventional		
	Dhabiha		
	Shechita		

3.3 Percentage of cattle slaughtered per category in 2012

		DHABIHA		SHECHITA	
		Calves (< 8 months)	Adult cattle	Calves (< 8 months)	Adult cattle
STUNNING METHODS	No stun applied				
	Post-cut stun applied (stun after the cut/bleeding)				
	Pre-cut stun (stun applied prior to cut/bleeding)				
	TOTAL	100%	100%	100%	100%

3.4 Is slaughter without stunning :

- A predominant (majority of animals) practice in your plant?
- A punctual activity (some categories of cattle or in relation with some customers)?

3.5 What is the average line capacity in your plant when slaughtering cattle without stunning?

	Number / hour
Processing speed in calves per hour for slaughter without stunning	
Processing speed in adult cattle per hour for slaughter without stunning	
Processing speed in calves per hour for slaughter with stunning	
Processing speed in adult cattle per hour for slaughter with stunning	

4. TECHNICAL ASPECTS OF THE RESTRAINING DEVICE USED FOR THE SLAUGHTER OF CATTLE

4.1 What type of restraining system is currently in use in your plant to perform slaughter of cattle without stunning?

- Rotating pen
- Upright pen

4.2 Concerning the restraining device used in your plant to perform slaughter without prior stunning, please indicate :

- The manufacturer :
- The model :
- The year of construction :
- The category of cattle :

If you use more than one restraining device, please indicate for the others:

- The manufacturer :
- The model :
- The year of construction :
- The category of cattle :

4.3 Have major modifications ever been made to the restraining system?

- Yes
 No

4.4 If yes, can you describe these modifications and the reasons for:**5. HANDLING AND RESTRAINING METHODS****5.1 Percentage of cattle slaughtered per category in 2012**

For religiously slaughtered cattle can you please estimate the percentage of animals slaughtered with these methods and corresponding restraint systems.

		RESTRAINING METHOD				
		POSITION OF THE ANIMAL AT THE TIME OF BLEEDING				
		Upright position	Rotation 45°	Rotation 90° (turned on the side)	Rotation 180° (turned on the back)	Other (specify)
STUNNING METHOD	No stun applied					
	Post-cut stun					

6. POST-CUT MANAGEMENT**6.1 Is post-cut stunning performed in your plant?**

- Yes
 No
 Only as welfare intervention (poor bleeders, animal deemed unacceptable for religious purposes during and after the cut)

IF YES**6.2 Is that practice performed :**

- Systematically (on every cattle religiously slaughtered)
 Only in specific cases (client wishers)

6.3 Is post-cut stunning performed :

- Immediately after the neck cut?
 After a determined time after the cut or before the opening of the pen?

6.4 Which method is used :

- Penetrating captive bolt
- Non-penetrating captive bolt
- Other (specify) : _____

End. Thank you for your participation!

**ANNEX 3 : LIST OF MANUFACTURERS AND NUMBER OF DEVICES PER
SELECTED COUNTRY**

Country	Manufacturer	Number of devices	
Belgium	Baeten	2	
	J&W Services	1	
	Nawi	2	
	Norman	1	
	Self made	1	
France	AVI SILVA	1	
	BAERT	1	
	BANSS	1	
	BEMO	1	
	BSM IA	1	
	COMAZZI	1	
	Couedic Madoré	9	
	Facomia	24	
	Norman	1	
	SIBEMIA	1	
	STORK	2	
	SUCMANU	1	
	Vendramini	7	
	Italy	Bulgarelli Engineering & Trade SRL	1
		G &G MANTOVA	1
Innonceti e Cipollini		1	
Nuova Innocenti e Cipollini		1	
ROVANI		1	
SLAUGHTERING SERVICE		1	
Self made		2	
Tonon Attrezzaure Per Mattatoi		1	
VITELLI / VITELLONI MASCHI E FEMMINE		1	
NL		Nawi	1
	Self made	6	
Spain	BANSS	3	
	BERMEJO	2	
	CTM-LORCA	1	
	Couedic Madoré	4	
	Emme	4	
	GUITERA	1	
	MECÁNICAS GARROTXA	1	
	Self made	1	
	TAESA	1	
	UK	Bob Snarr	1

ANNEX 4 : EQUIPMENT AND ORGANIZATION OF THE WORKING AREA

Identification	Name Number of cattle slaughtered per year by Dhabiha and/or Shechita General line speed (without pre-cut stun) or standard operating procedures (without pre-cut stun) Line speed during observation day
Corridor	Length of corridor Number of animals put in the corridor Duration of queuing Time needed to empty corridor Use of anti-back-up devices Physical aspects of corridor: light/light contrasts presence of sharp corners presence of noise presence of obstacles Specific aspects of the floor of the corridor slippery yes/no slopes anti-slip steps
Restraint device	Manufacturer/Model Physical aspects of the box while taking into account the animals visual perspective light conditions obstacles /gaps noise floor surface Degrees of rotation Frequency of cleaning of the box Restraining system of the box which body parts fixed in which order and in how many stages animal properly restrained yes/no position of animal with respect to the box at the end of rotation Chin lift produce picture or drawing does it hamper the cut e.g. knife potentially in contact with the chin lift
Release area	Release of the animal from the box: How When rotation of the box at that point in time Difficulties and interventions of the operator to release the animal Blood management in the area (cleanliness high medium, low)
Equipment	Knife Description Size Its use (reciprocal, one way, perpendicular) Key indicators that the operator uses to identify the cut location
Operators	Position and number of operators Ways of communication between operators Can he see the head of the animal, directly or via mirrors? Risks for the operators in the area
Slaughter men	Number of slaughter men Their roles (introduction animal, cut, restraining, monitoring consciousness, hoisting) Give a rating of the reliability of the information you obtained

ANNEX 5 : DEFINITION OF OPERATING PROCEDURE AND BEHAVIORAL ITEMS

Operating procedure	Definition
head entrance	nostrils not visible
head out of box	ears (and horns) visible outside of the box (until start head contention)
start contention belly/back	press on button by operator
start contention head	press on button by operator
start rotation	direct observation of box or press on button by operator
end rotation	direct observation of box or press on button by operator
time start cut	first contact between blade and neck: cutting tissue
number of cuts	number of movements (total of backwards and forwards) of the blade while in contact with the neck tissue
bleeding quality	impeded flow, yes/no; both sides: yes/no; visible blood clot: yes/no. If needed, check before or after hoisting
secondary interventions (removal blood clot)	operator takes carotid and removes blood clot. Any other type of secondary intervention needs to be mentioned and described
time end of bleeding	no longer pulsing if normal blood flow
start re-positioning rotating box	direct observation of box or press on button by operator
end-re-positioning rotating box	direct observation of box or press on button by operator
opening side of box	direct observation of box or press on button by operator
animal released from box	animal out of the box
stimulation of the wound	box side is between caudal and rostral part of the neck cut while in contact with sectioned tissue or any other stimulation

Item	Definition
<i>Operators behaviour</i>	
voice speak	operator speaks loud to make animal move
voice shout	operator shouts to make animal move
Noise	clapping hands, banging on fittings
Hand	slap with hand on animal
stick	stick on animal
Prod	prod in contact with animal
tail twist	twisting tail on back
door on back	closing door of the box on the back of the animal (or on the animal following the first)
Other	any other activity not mentioned above
<i>Animal behaviour</i>	
walk forwards	at least 3 legs put forward
walk backwards	at least 3 legs put backward
Slips	at least 1 leg sliding over floor
Falls	any part of the body apart from the legs touching the floor (unintentionally)
is walked on	at least one other animal having at least 2 feet on the observed animal on the floor
vocalises	vocal sound intentionally expressed by the animal
is compressed	animal physically compressed by two other animals or by one animal and a solid wall
compresses	animal physically compressing another animal
is mounted	animal mounted by another animal
mounts	animal mounting another animal
struggles (before or after cut)	movements involving the whole body, legs and possible head with the intention to escape from the situation
eye pursuit or eye tracking (after cut)	looking intentionally at the surroundings

eyes convulsing	eye white visible, eyes turning inwards
spontaneous movements of the eye lids	eyelids closing without previous pressure on the cornea
head rising (after cut)	intentional neck moving upwards
loss of posture	animal sitting or lying down. Apparent loss of posture: animals seems not to carry its weight but is carried by the restraining system.
body rising	movement of the whole body aiming (intentionally) to orient the sternum in the horizontal plane
guttural sound (after cut)	unintentional audible sound arising from the throat
attempt to inspire	successful or unsuccessful inspiration movement discontinued with guttural sound
Tongxit	Tensed tongue out of the mouth (ended when withdrawal of tongue or relaxed tongue
other	any behavior not mentioned above
loss of corneal reflex	absence of eye closure after a LIGHT touch on the canthus of the eye (brush fixed on a stick)

ANNEX 6 : “BEHAVIORIAL” AND OPERATING PROCEDURE OBSERVATION

IN CORRIDOR AND IN RESTRAINING SYSTEM	
OPERATOR BEHAVIOUR	voice, hand, stick, prod, tail twist, door on back, other, objective of the operator (all behaviors are event)
ANIMAL BEHAVIOUR	walks forwards, walks backwards, is compressed, compresses, mounts/is mounted, slips, falls, is walked on, struggle, vocalization (all behaviors are event)
DEVICE OPERATINGS PROCEDURE	Head entrance, Head out of box, door closing (event) Start/End : belly plate, back/lateral pusher, neck/head restraint, rotation
BLEEDING AND POST-CUT PRACTICES : OPERATOR	
CUT	Number of cuts: number of movements (total of backwards and forwards) of the blade while in contact with the neck tissue Multiple small movements (saw): yes/no Operator blood covered : yes/no Vocalisation during cut: yes/no
BLEEDING QUALITY	Both carotids cut: yes/no Impeded flow: yes/no Both sides: yes/no Visible blood clot: yes/no. Secondary intervention: yes/no Regurgitation of fluid : yes/no Time end of bleeding: no longer pulsing if normal blood flow
POST-CUT STUN	Stunning : Yes/no Quality of stunning: well/bad due to clear difficulties/bad due to other reasons Why stunning is not performed

RELEASING	Start re-positioning rotating box End re-positioning rotating box Releasing head restraint Releasing neck restraint Release from body restraint Animal released from box Start hoisting
BLEEDING AND POST-CUT PRACTICES: ANIMAL BEHAVIOUR	
POSTURE	Loss of posture or apparent loss of posture: animal sitting or lying down (event) Struggle (event) head/body movement (intentionally-event)
EYES	Spontaneous movements of the eye lids, blinking (event) Eyes convulsing (start/end) Loss of corneal reflex (light touch with small paintbrush). Scan every 15 seconds
HEAD	Guttural sound (event) Rhythmic breathing (start/end) Attempt to inspire (event) Tongue exit (start/end)

Comment: *Regarding the signs of consciousness, there is a general behavioral pattern that could be observed following the cut in many animals. A first short period of head movements and eyes blinking occurred followed by eye rotation. When in upright position, loss of posture took place during this first phase. Then animals generally seem in tetanic phase with fixed eyes. Later inspiration/expiration (not a rhythmic breathing) attempt with tongue exit and characteristic vocalization start while bleeding become more and more contractile. It is not really known, so far, when the loss of consciousness takes place during these different phases. Based on previous study, we know that, where it is possible to observe, loss of posture which is generally considered to be the first sign of loss of consciousness, takes place*

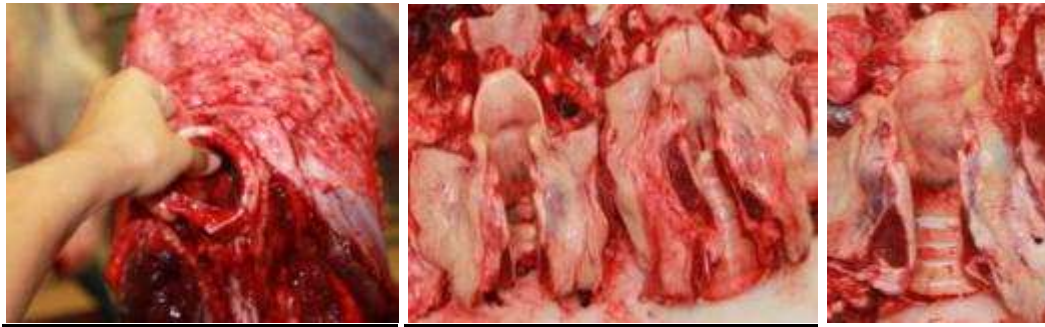
before eye rotation (Michard and Mirabito, unpublished). Furthermore, we also know that corneal reflex or reflex to threatening, for instance, are not testable during some of the phases.

Taking into account all these parameters and also the different situations of observation, it was agreed between partners then to focus on continuous behavioral observations after bleeding (except corneal reflex) with an analysis/interpretation of the data post hoc. Loss of posture or orientated raising attempt will however be observed only when the position of the animal and/or the restraining practice allow.

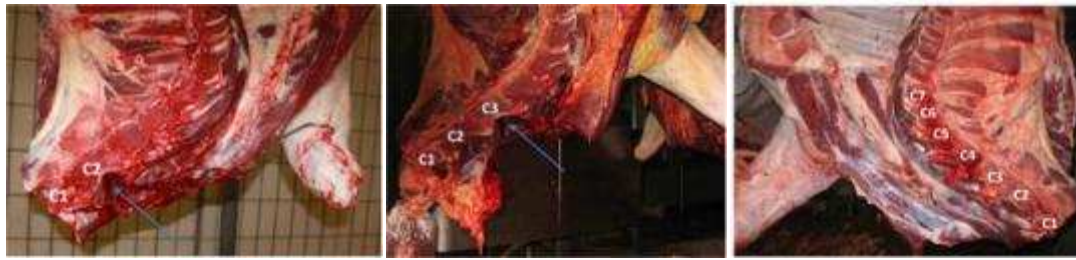
BLEEDING AND POST-CUT PRACTICES: ANIMAL BEHAVIOUR	
POSITION OF THE CUT	In a subsample of 20 animals, the position of the cut will be checked first by counting the tracheal rings from the larynx to the cut (figure 1) and later, after dressing, considering the cervical vertebra in which the cut was performed (figure 2). Methods used may be updated later depending on feasibility and accuracy.
PRESENCE OF BLOOD IN THE TRACHEA/LUNGS	In a subsample of 20 animals, the presence of blood in the trachea will be assessed by cutting, after dressing the trachea longitudinally and scoring the presence of blood as “present” or “absent” according to the figures below.

Direct observation of the position of the cut will be made. It is important to note that this will be only a rough estimation and depends also on the practice of the slaughter men. In order to have a more reliable estimation, observations could be carried out directly on the animal after the cut by counting the number of tracheal rings from larynges or by observation of the localization of the end point of the cut on carcasses (vertebrae). These two methods will be used as exploratory tools on sub sample of animals when possible (depending on the organization of the slaughterhouse and the acceptability by slaughter men). For the same reason, the presence of blood in trachea/lungs will be estimated in a sub-sample.

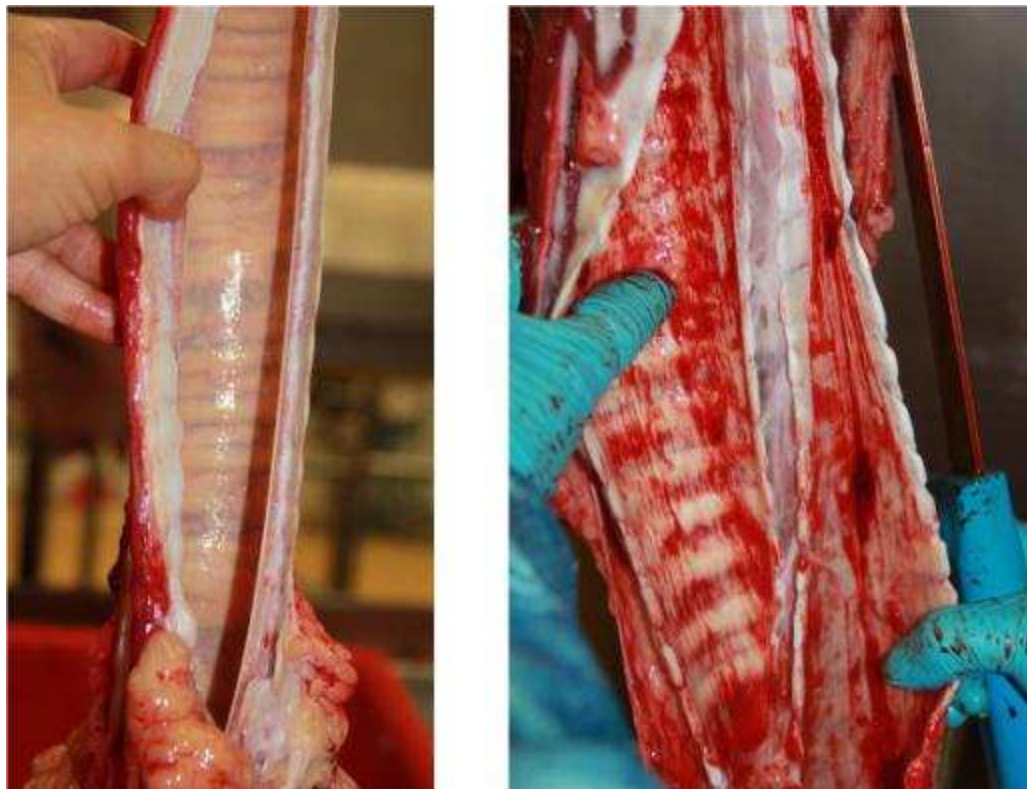
Tracheal rings (Source : Marzin and Ducreux, 2013).



Cervical vertebrae (Source : Marzin and Ducreux, 2013)



Absence and presence of blood in the trachea (Source : Marzin and Ducreux, 2013)



ANNEX 7 : ANIMALS CHARACTERISTICS

SPECIFIC PARAMETERS FOR EACH ANIMAL	Time since the entry of the animal in the walls of the slaughterhouse (Dhabiha or shechita slaughter) : Rest time yes/no
	Post-cut stun
	Degrees of rotation
	Type : Dairy, Meat or mixed
	Sex
	Age (<u>Calves</u> : up to 8 months- <u>Young</u> : from 8 à 24 months - <u>Adult</u> : more than 24 months)
	Carcass weight (kg)

ANNEX 8: QUESTIONNAIRES FOR DATA COLLECTION (SOCIO-ECONOMIC IMPLICATIONS)

Survey | WP3 | Questions for Directors of slaughter plant

The questionnaires should focus on slaughtering without stunning or post-cut stunning (only).

1. Slaughter men and their knowledge

1.1. How many slaughtermen with a license to slaughter cattle without stunning, perform that work in your plant?? (total number, so employees on your payroll and those who are not). Please specify if they are on your pay roll or outsourced

Dhabiha: _____ payroll outsourced

Kosher: _____ payroll outsourced

1.2 Does this task provide work for 100% of their time:

- Yes, fully at my plant
- Yes, fully but only partial at my plant
- No, namely....% of their time

1.3 What is the level of experience of the slaughtermen? And do they have any certificates?

Years of experience: years

Certificated: yes no

1.4 How do you ensure that the slaughtermen are informed about animal welfare?

2. Work safety of Slaughtermen

2.1. Please indicate the number of incidents with slaughtermen per year and per 1000 cattle slaughtered in your plant and related to the restraining area in 2012?

Number of incidents in 2012 with unstunned slaughter of cattle in restraining area

Number of incidents with unstunned slaughter
In the restraining area per 1000 cattle slaughtered:

2.2. Severity of injuries

Please indicate the type of impact and the frequency of the incidents on slaughtermen in the restraining areas.

Type of injury	Type of impact (delete as appropriate)	Frequency / year
Brushes	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	
Illness	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	
Muscle pull or strain	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	
Cuts	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	
Got hit by ...	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	
Break a leg / arm / ...	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	
Breathing problems	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	
Others, ...	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	

2.3 If it's up to you, with regard to improving workers safety.... what would you alter first at the restrainer used in your plant?

3. Economic aspects of the restraining device

3.1. Please indicate the year of investment? _____ Year:

3.2. What is the amount of total investment of the restraining device, including modifications of the plant? _____ Euro

And what are the annually maintenance costs? euro/year

3.3. Why has this restraining system been chosen?

Please number in sequence the motives given below if applicable in your opinion (1= most important argument; 2= second most important argument etc...).

- Total investment (price of the restraining system)
- Possibilities for negotiations concerning price
- Work safety of slaughtermen
- Animal welfare
- Familiarity with supplier
- Existing business relation
- Maintenance costs
- Breakdowns
- Religious requirements
- Others.....

3.4. Would the same decision have been taken today? Yes/No
 If no, what choice would be made? And please explain why.

.....

3.5. If you want to replace your existing restraining device by another system, how would this influence your restraining area in terms of investments? Does this affect more than the investments of the restraining device only or should you alter more in the slaughter line?

Investments are needed for:

- only the restraining device
- more than the restraining device, additional investments are Euro.

3.6. What is the expected life time of the restrainer in the case of normal maintenance: Years:....

3.7. Can you estimate the labour costs *in* the restraining area per slaughtered adult cattle. You only have to include the direct personnel costs, no worries about other costs like maintenance, depreciation, electricity and so on.

..... euro/adult cattle (*if more people in restraining area, please add costs of all attended people and note per 1 bovine*)

3.8. How many people are active in the neighborhood of the restrainer and what are their roles?

- ___a. _____ people with role ...
- ___b. _____ people with role ...
- ___c. _____ people with role ...

___d. _____ people with role ...

3.9. What is the time needed to slaughter an adult cattle: number of animals slaughtered per hour
.....

3.10. How long do the animals stay in the restrain device? (Please state the average time.) Average time in seconds.....

3.11. What are the total costs of slaughtering an adult cattle under different conditions? (e.g. labour, maintenance, electricity, depreciation)

Conditions	Euro per adult cattle
Conventional	
Dhabiha	
Kosher	

3.12. In the next 5 years, do you expect the number of animals slaughtered without any form of stunning in your plant to :

Please estimate the percentage in the case of increase or decrease

Increase (%)

Decrease (%)

Remain stable

Survey WP3 Questions for Animal welfare officer at slaughter plant

The questionnaires should focus on slaughtering without stunning or post-cut stunning (only).

Animal welfare

1. Please indicate the number of incidents with animals (animal welfare is harmed) per year and per 1000 cattle slaughtered in your plant in the restraining area in 2012? This only relates to animals slaughtered unstunned before killing.

Incidents in 2012
 Incidents per 1000 cattle slaughtered unstunned

2. Where did offences of animal welfare take place (% of total)?

a. During lairage	%
b. During restraining	%
c. Not killed properly	%
d. Bleeding	%
Total	100

3. In your opinion, does the type of restrainer (rotatory or upright) influence the incidents related to animal welfare? Yes /no

Please explain:

4. In your opinion, can improvement of animal welfare be realised by adapting the restrainer? Yes /no

Please explain:

5. In your opinion, which type of restrainer is best for animal welfare?

- Upright
- Rotating
- The position of the animal makes no difference

6. If it's up to you, with regard to improving animal welfare.... what would you alter first at the restrainer used in your plant?

Survey WP3 Questions for Work Safety Officer at slaughter plant
--

The questionnaires should focus on slaughtering without stunning or post-cut stunning (only).

Work safety of slaughter men

1. Please indicate the number of incidents with slaughtermen per year and per 1000 cattle slaughtered in your plant in the restraining area in 2012?

2. Severity of injuries

Please indicate the type of impact and the frequency of the incidents on slaughtermen in the restraining areas.

Type of injury	Type of impact (delete as appropriate)	Frequency / year
Brushes	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	
Illness	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	
Muscle pull or strain	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	
Cuts	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	
Got hit by ...	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	
Break a leg / arm / ...	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	
Breathing problems	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	
Others, ...	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	

3. If it's up to you, with regard to improving workers safety.... what would you alter first at the restrainer used in your plant?

Survey | WP3 | Question for slaughtermen

The questionnaires should focus on slaughtering without stunning or post-cut stunning (only).

General

11. Slaughter plant training, if yes, what, how long? no/yes, if yes for years
12. religious training, if yes, what, how long, where ? no/yes, if yes for years

Status

13. **How is your employment arranged? Are you on the payroll of the slaughter house, of a certification agency or do you work for yourself (independent/freelance)?**

- Employee at slaughterhouse
- Employee at certification agency
- Independent

14. Do you have a religious license for ritual slaughter? yes/ no
- 14b. If yes, did you ask for it or did your employer ask it for you? I did/ Employer did
15. Is there any link with a certification agency? yes/ no
- 15b. If yes, please specify the certification agency

Religious activities

14. Where did you got your religious education?
- family
 - self-educated,
 - association,
 - Muslim / Jewish school
 - Mosque/ Synagogue frequentation : which one, frequencytimes per week
15. Please specify your religious activities:
16. Please specify two or three reference books about Islam/ Judaism if any:

Work safety

17. How do you judge your working conditions?
- a. physical (stressful = 5.....no stress =1) :
 - b. mentally (stressful=5.... no stress =1) :
18. How often did you get injured during job time?
- (less than once a year (=1); annually 1-5 times (=2); annually > 5 times (3).
19. Type of injuries and frequency

Type of injury	Type of impact (delete as appropriate)	Frequency / year
Brushes	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a	

	<input type="checkbox"/> <i>day / some days</i> <input type="checkbox"/> <i>Not able to work anymore</i>	
Illness	<input type="checkbox"/> <i>Still able to work</i> <input type="checkbox"/> <i>Not able to work for a moment / a day / some days</i> <input type="checkbox"/> <i>Not able to work anymore</i>	
Muscle pull or strain	<input type="checkbox"/> <i>Still able to work</i> <input type="checkbox"/> <i>Not able to work for a moment / a day / some days</i> <input type="checkbox"/> <i>Not able to work anymore</i>	
Cuts	<input type="checkbox"/> <i>Still able to work</i> <input type="checkbox"/> <i>Not able to work for a moment / a day / some days</i> <input type="checkbox"/> <i>Not able to work anymore</i>	
Got hit by ...	<input type="checkbox"/> <i>Still able to work</i> <input type="checkbox"/> <i>Not able to work for a moment / a day / some days</i> <input type="checkbox"/> <i>Not able to work anymore</i>	
Break a leg / arm / ...	<input type="checkbox"/> <i>Still able to work</i> <input type="checkbox"/> <i>Not able to work for a moment / a day / some days</i> <input type="checkbox"/> <i>Not able to work anymore</i>	
Breathing problems	<input type="checkbox"/> <i>Still able to work</i> <input type="checkbox"/> <i>Not able to work for a moment / a day / some days</i> <input type="checkbox"/> <i>Not able to work anymore</i>	
Others, ...	<input type="checkbox"/> <i>Still able to work</i> <input type="checkbox"/> <i>Not able to work for a moment / a day / some days</i> <input type="checkbox"/> <i>Not able to work anymore</i>	

20. If it's up to you, with regard to improving workers safety.... what would you alter first at the restrainer used in your plant?

Restraining system

21. Which restraining system do you prefer?

- a. Rotatory restraining device
- b. up right restraining device
- c. another system.....
- d. no experience because I only worked with one system.

22. Why do you prefer a rotatory restraining device or an upright restraining device?

- Work safety
- Costs
- Time needed to sacrifice an animal

- Others

23. Can the current restraining system be improved (by making adaptations) regarding

a. work safety yes/ no

b. animal welfare yes/ no

23b. if yes please describe the kind of adaptation?

.....

Socio economic background

- Age year

- Nationality

- County of birth

- Age arrived in countryyear

- language of the interview

- Highest level of (completed) education basic/ middle/high

- Previous jobs

.....

.....

- Net income / month for slaughter activity (per slaughterhouse if more than one)

..... € net per month

Survey | WP3 | Questions for Insurance companies

1. What is the number of incidents with slaughtermen? In number per full time equivalent per year?
2. What is the type of injury, the type of impact and frequency of the injures per year?

Type of injury	Type of impact (delete as appropriate)	Frequency / year
Brushes	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	
Illness	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	
Muscle pull or strain	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	
Cuts	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	
Got hit by ...	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	
Break a leg / arm / ...	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	
Breathing problems	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	
Others, ...	<input type="checkbox"/> Still able to work <input type="checkbox"/> Not able to work for a moment / a day / some days <input type="checkbox"/> Not able to work anymore	

3. If available, can you mention the incidents for slaughtermen operating in the area where the animals are killed? In number per full time equivalent per year?
4. If available, can you differentiate this number between the incidents for slaughtermen killing the animals unstunned versus stunned? In number per full time equivalent per year?
5. If available, can you mention the incidents for slaughtermen killing the animals unstunned in an upright pen versus a rotatory restraining pen? In number per full time equivalent per year?

Survey WP3 Questions for manufacturers of restrainers

ECONOMIC ASPECTS OF THE RESTRAINING DEVICE**GENERAL**

1. Can you estimate the percentage of the different types of restrainers in EU-27 for slaughterhouses performing unstunned slaughtering?
 - a. No
 - b. Yes :
 - i. ..% rotatory restraining device
 - ii. ..% up right restraining device
 - iii. ..% other
2. What is your market share on the EU market? ..%
3. Can you list your main competitors? Including country of origin
 1. from
 2. from
 3. from
 4. from
 5. from

Costs for restraining systems for ADULT CATTLE

4. If your customers want to replace the existing restraining device by another system, how would this influence the restraining area in terms of investments? Does this affect more than the investments of the restraining device only or should they alter more in the slaughter line? Investments are needed for:
 - only the restraining device
 - more than the restraining device, additional investments are Euro.
5. Rough estimate of the investment of restraining device? (=the purchase of the restraining device and its installation by the manufacturer).
 - a. Rotatory restraining device: euro
 - b. Up right restraining device: euro
6. Can you give a rough estimate about the investments in restraining system compared to the investment of a total slaughter line?

.....% of total costs is intended for the restraining system
7. Rough estimate of the maintenance (as a percentage of the investment) of the restraining system?
 - a. Rotatory restraining device: %
 - b. Up right restraining device: %

8. What is the expected life time of restraining system?
- a. Rotatory restraining device: years
 - b. Up right restraining device: years
9. Do you have any insight in important and deciding buying motives for your customers (the slaughterhouses) when choosing a certain restraining system?
- If so, please number in sequence the motives given below if applicable in your opinion (1= most important argument; 2= second most important argument etc...).
- Total investment (price of the restraining system)
 - Possibilities for negotiations concerning price
 - Work safety of slaughtermen
 - Animal welfare
 - Familiarity with supplier
 - Existing business relation
 - Maintenance costs
 - Breakdowns
 - Religious requirements
 - Others.....
10. Could you please give us the different models you have produced, their characteristic (see table below) and the year of release? (please underline change)

Model	Year of release	Type (upright or rotating)	Type of body restraining device	Type of neck restraining device	If rotating, type of cycle an control	Main changes from previous models	Main specific requirements from customer

11. What are the main requirements for adaptation from your customers?
12. Could you please send us the user guide (also in English if available)?

Survey | WP3 | Questions for other stakeholders: Wholesale

1. Where do you buy (origin of the meat) meat of cattle religious slaughtered?
 - a. In home Market
 - b. Import from (names of countries)
 - i.
 - ii.
 - iii.

2. Where do you sell (destination of the meat) meat of cattle religious slaughtered?
 - a. In home Market
 - b. Export to (names of countries)
 - i.
 - ii.
 - iii.

3. What share of total cattle meat traded is:

a. Religious slaughtered without any stunning	...%
b. Religious slaughtered with stunning before killing%
c. Religious slaughtered with stunning directly after killing%

4. Do you manage to sell the whole carcass as Halal/ Kosher on the home market? Yes/NO

If Not: In which market(s) are the remaining parts sold?

a. Home market as regular meat;%
b. Export market as regular meat:%
c. Export market as religious slaughtered meat:%
Total	100%

Islamic and Jewish Institutions contacted for expressing their opinion on acceptability of the different restraint system (Source: BoRest, "Acceptability by religious communities")

Member States	Islamic institutions	Jewish institutions
United Kingdom	The Muslim Council of Britain	Shechita UK National Council of Shechita Boards
Spain	Comisión Islámica de España Junta Islámica Instituto halal	Principal rabbi of Barcelona and Catalonia and
The Netherlands	The Contactorgaan Moslims en Overheid Contact Groep Islam	
Italy	UCOII Unione delle Comunità Islamiche d'Italia CCII, Centro Culturale Islamico d'Italia (Islamic Cultural Center in Rome)	Grand Rabbin de Roma
France	Le Conseil français de culte musulman Grande Mosquée de Paris Grande Mosquée de Lyon Grande Mosquée d'Evry	Grand Rabin de Metz,
Belgium	L'Executif des Musulmans de Belgique	Belgium ; Grand Rabbin de Bruxelles Synagogue de Bruxelles

ANNEX 9 : METHODOLOGY FOR THE MEETING WITH RELIGIOUS REPRESENTATIVES

The meeting was introduced by a formal presentation from the consortium recalling the aim of the study. It was recalled that it was dealing with restraining device used in case of slaughter without stunning and that the project was not addressing the issue of stunning.

Two videos of upright and rotating devices were shown, allowing identifying precisely the sequence to comment on: from the restraint of the animal until -and including- the cut. In order to trigger precise, detailed and comparable comments, we have shown the same videos in all countries. These videos were taken from one Dhabiha example. Except of the restraining system, the two videos differ (non-intentionally but in relation with the video material available) also by the number of cuts performed by the operator (higher number in the video of upright system).

The religious authorities were invited to give their detailed opinions on each of the methods, their *advantages and disadvantages from a religious point of view*.

Then, the religious authorities were invited to send a written document of their opinions within two weeks after the meeting, especially if they wished to reflect on their opinions within their communities, and give an official statement.

The institutions listed in the table have been contacted.

Separated meeting with Jewish and Muslim authorities took place from November 2013 to March 2014 and were organised in Belgium, France, the UK and Spain.

No meeting could be organised in the Netherlands for both Muslim and Jewish communities, nor in Italy for Jews, and in France for the Muslims, because the religious authorities contacted declined the invitation. In Italy for Muslims, the debate focused rather on bleeding and stunning. Then the data were not fully usable in this report.

ANNEX 10 : PROPOSED BASIS FOR IMPROVED STANDARD OPERATING PROCEDURES AND WORK SAFETY

The present proposal is based on output from “assessment of welfare” and experts’ opinions. Values into brackets referred to best observed practices in the sample and experts’ opinions.

Entry in the restraining system

Animal Welfare:

1. The layout of the end of the corridor and the device should be designed to minimize difficulties for the animals to enter the restraining device
2. Corridor should have a non-slippery floor surface
3. The operators should be trained for the handling of the animals

Examples of monitoring indicators: *use of electric prod, behavioural indicators of stress, vocalizations*

Work Safety:

1. Slaughtermen and restraint operators must have safety access and vision of the animal

Restraining procedure (all device)

Animal Welfare:

1. Restraint device must have a non-slippery floor surface
2. Operators should be trained with their specific restraint device and able to monitor the quality of restraint and the behaviour of the animals
3. The different operations should be carried without any delay e.g. in less than [on average 30 seconds (maximum up to 60 seconds)]
4. Hyperextension of the neck must not be performed with the chin lift.
All other restraining equipment (back pusher, side plates, neck yoke) must not use excessive pressure that causes injury, pain or distress (vocalizations, struggling, etc)
5. Animals must be immediately e.g. less than [on average 5 seconds (maximum up to 10 seconds)] after being fully restrained or restrained and rotated (this includes washing of the neck)
6. If , for whatever reason there is a delay when the animal is restrained, it should be immediately stunned.

Examples of monitoring indicators: *Duration of restraint, Delay between end of head restraint and cut, vocalizations*

Work safety:

1. Layout of the device area should be such that the operators are able to control the device and monitor the animals without having the risk of being in contact with mobile part of the device
2. Layout of the area should allow the restraint operator to see the head of the animal in a safe way. Where needed, mirror or other vision system should be installed
3. Device should allow a safe access to the animals (body and head) in particular in case of welfare emergency

Restraining procedure (Upright system):

Animal Welfare:

4. Animals must not be lifted off the ground with the belly plate (i.e. legs no longer significantly supporting weight of the animal)
Restraint must have a recessed belly plate (can cause bulking, obstructions and falls)

Restraining procedure (Rotating system)

Animal Welfare:

1. Animals must be securely restrained without causing injury, pain, distress prior and during rotation e.g. use the animals must be well positioned before immobilisation and operators should monitor the behaviour of the animals during the restraining process.
2. Rotation should start immediately after the restraint of the animals, should be as smooth as possible and should not last more than [on average 15 seconds (maximum up to 30 seconds)];

Example of monitoring indicators: Duration of rotation

Bleeding

Animal Welfare:

5. Many factors such as category of animals, quality of head restraint, position of the cut, sharpness of the knife are influencing quality of the cut. The skill and capability of the operator should be such as they know these potential risks and are able to manage them as far as possible.
6. The number of cuts depends on religious prescription. As far as possible, it should be minimized
7. Animals must be checked for signs of sensibility before removal from the restraint, at least, not before [45 seconds] after the cut. If signs of consciousness are still present, the animal is to be immediately stunned.
8. The restraint practices must be designed to allow the use of mechanical stun device if required (e. g. obvious prolonged consciousness).
9. All animals must be monitored after removal from the restraint during [45 seconds] for signs of regain consciousness before hoisting.
10. When immediate post-cut stun is performed, the animals may be removed from the restraint device after having been checked for the absence of sign of consciousness.

Example of monitoring indicators: Number of cut, frequency of miss-cuts (i. e. both carotids are not severed), frequency of impeded flow, frequency of signs of consciousness at the end of the periods

Work Safety:

2. Layout of the bleeding area should be such as to minimize the risk of the operator to be hurt by the head of the animals or any other mobile equipment
3. Operators must be positioned comfortably using safe equipment (e. g. fixed equipment)
4. Slaughtermen must have good access and vision of the animal's head, neck and cut.
5. Animals should be restrained until insensible to minimise the likelihood of worker injuries during shackling and hoisting.
6. During removal from the restraint sufficient space should be allowed in case of swinging of the animals, convulsive hind leg kicking and the potential of the animals falling off the shackle.
7. Protected area for operators (e.g. for when an animal stands up after being released from the restrainer)
8. Attachment of hind leg after removal from the restraint device as soon as possible
9. When the bovine animals show obvious signs of consciousness that require corrective action, the stunning of the animal should be performed unless it does endanger the operator.
10. Pre or immediate post-cut stun is performed, when accepted by religious authorities, to minimize the risk for workers.

ANNEX 11: VALUATION OF THE INDICATORS PER JUDGEMENT AREA TO COMPARE THE UPRIGHT AND ROTATING RESTRAINING SYSTEM

INDICATOR	UPRIGHT POSITION	ROTATING
Economic costs		
A. Total investment	30-60,000 pound= 36-72,000 euro (mean : 50.000 euro)	100,000 euro
B. Restrainer as% of total investment slaughter line	About 7%	About 10%
C. Maintenance costs	1000-2000 pound = 1200-2400 euro per year	3000- 15,300 euro per year
D. Total costs(= investment + maintenance + interest)	4,300 euro per year	12,600 euro per year
E. Lifetime restrainer	30-50 years	14-25 years
F. Line speed (see part 3) (animals per hour)	30 (variation 10-80 animals per hour)	28 (variation 10-80 animals per hour)
Religious aspects		
A. Requirements from Jewish religion	Inverted	
B. Requirements from Muslim religion	Rotating preference	
C. Religious education of slaughter man	Jewish :no info Halal: Muslim school (1)/ Mosque (2)	Jewish : Jewish School and Synagogue Halal: all Mosque and some Muslim school
Work safety		
A. Number of accidents	2 incidents recorded in 2012	3 incidents recorded in 2012
B. Frequency of accidents	No information	No information
C. Type of injuries	Brushes + hit by	Cuts+ 2 break a leg/arm
D. Impact of injuries	None/ still able to work	None + few days off
E. Experience of slaughter man	Except one all are working full time (one person works part time; 0.5 week). Working experience 5-23 years	All are working full time Working experience 2-20 years
F. Education of slaughter man	Basic to middle education ; Further trained on the spot	Basis to middle Mainly further trained on the spot and sometimes external courses

Trade		
A. Origin of meat	n.a.	n.a.
B. Destination meat	No information	Mainly for home market as religious meat (80%) European market as religious meat (20%) European market as regular meat (1%)
C. Share cattle slaughtered without stunning	495.000 of 15.6 million animals slaughtered (=3%)	1.584.000 of the 15.6 million slaughtered cattle (=10%)
D. % sold as halal/ kosher		=99% sold as halal meat No info on Kosher meat
Animal Welfare		
AW indicators		
Number of accidents with animals	1 incident reported by 2 respondents	Not willing to respond

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