

# **An analysis of data on accidents on inland waterways: lessons learnt and a possible way forward**

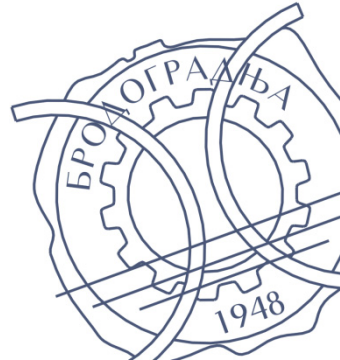
**Igor Bačkalov**

Associate Professor

University of Belgrade · Faculty of Mechanical Engineering

Department of Naval Architecture

Strasbourg · October 12, 2020



# Introduction

- Why the accidents should be investigated?
- How can the accidents be investigated?
- Two possible approaches:
  - *Qualitative*: investigation of specific / major accidents in order to understand the underlying causes, the mechanism and dynamics of an accident, etc.
  - *Quantitative*: data collection from all / as many accidents as possible.
- Major accidents may initiate the introduction / amendment of safety regulations (think Titanic!)
- However, to arrive at more general conclusions, a representative amount of data is required.



Stranded *Tomas* (ex-*Bogdan*), August 2018, photo: <https://udruzenjeladjara.com/>



# NOVIMAR

## VESSELTRAIN

Presentation is based on report prepared for international project NOVIMAR (Novel IWT and Maritime Transport Concepts) funded by Horizon 2020 R&I programme (contract no. 723009) [www.novimar.eu](http://www.novimar.eu).



# Introduction

## Basic information on resources

Austria	Serbia
Austrian federal Ministry of transport, innovation and technology (BMVIT)	Port Authority Belgrade (LKB) Centre for investigation of traffic accidents of Republic of Serbia (CINS)
Austrian part of the Danube (1870 km - 2220 km)	Inland waterways (mostly) in vicinity of Belgrade: Danube, 1170 km Sava, 0 km – 16 km
21.03.2002 – 4.10.2017	9.12.2001 – 26.08.2017
≈ 650 accidents	≈ 150 accidents
Data in a tabular form (excel sheet)	Full reports
584 accidents involving 754 vessels	118 accidents involving 129 vessels

- In total, over 800 accidents were retrieved from two sources, out of which 702 accidents involving at least 883 crafts were selected for the review.
- BMVIT data were anonymized: neither names nor ship registration numbers were known; all personal and sensitive data were left out. For the purpose of the investigation, personal and sensitive information, as well as ship names and registration numbers were omitted from the LKB reports.



### Registered types of accidents

- Allision: a moving ship collides with a fixed object (a bridge, a riverbank, a part of the waterway infrastructure, another ship that was not moving at the time of the accident).
- Collision: two moving ships collide.
- Grounding: a vessel running aground, the contact with waterway bed.
- Hull/machinery/equipment (HME) damage: a malfunction of a system or a device, a structural collapse or a component failure (e.g. breakdown of the main engine, loss of an anchor, crack in the hull, etc.).
- Fire, capsized, shipwreck, foundering.



### Causes

- Human failures (HF):
  - fatigue (a brief sleep or a loss of concentration)
  - failure to follow established procedures
  - abuse of alcohol
  - misunderstanding or lack of communication
  - misjudgment of navigational conditions
  - insufficient situation awareness.
- Technical fault (TF), e.g. a machinery or navigational equipment failure.
- Weather conditions (WEC):
  - gusty wind, fog, precipitation, ice, etc.
  - water level fluctuations (low water periods, high water periods).
- Operational cause (OC):
  - inadequate waterway maintenance (floating debris, an unmarked underwater object or a sandbank that should have been removed)
  - interaction with other craft (waves of passing ships).



### Ship types

- Self-propelled cargo ships, push boats and barges, various convoys, passenger ships, special purpose ships, pleasure craft and small craft (typically fishing boats).
- The accidents which included only pleasure craft or only small craft, or any combination thereof were excluded from the database and omitted from the analysis.

### Cargo

- Mostly solid and liquid bulk cargo (sand and gravel, grain, coal, ore, fertilizers, metal scrap, oil products, bio-diesel).
- To a lesser extent, medium value goods (agricultural and forestry goods, metal products, mineral raw materials and construction materials).
- Machinery, vehicles, and higher value goods in containers are still seldom transported on the Danube.
- Different cargoes may be simultaneously carried in a convoy.
- Transport of dangerous goods was generally registered in the databases (but not the type or quantity).

### Passengers and crew

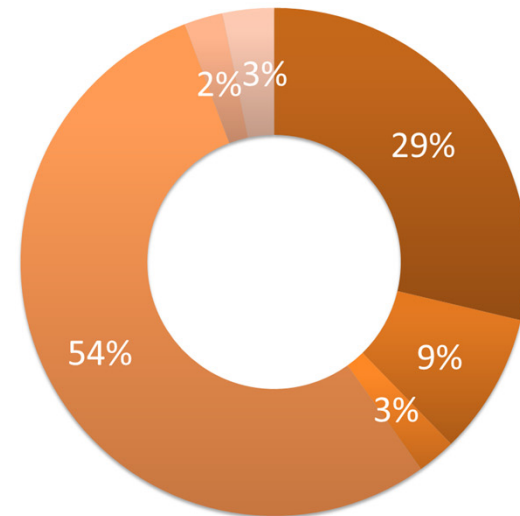
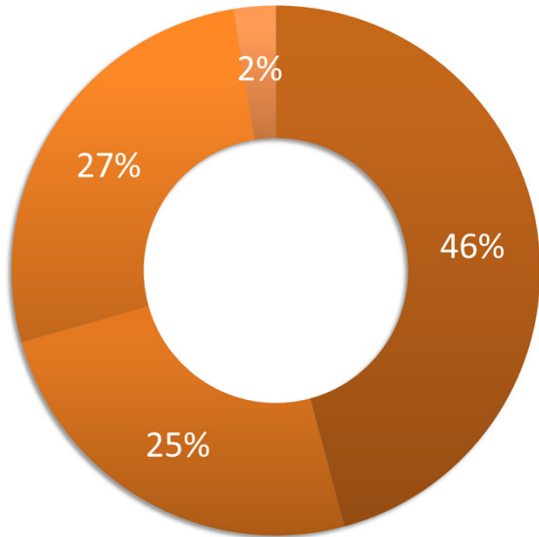
- Exact number of crew and passengers is not systematically provided, neither in Serbian nor in Austrian reports.



# Analysis of available data on accidents

## Breakdown of accident types

Austria		Serbia	
Allision	46%	Allision	29%
Collision	25%	Collision	9%
Grounding	27%	Grounding	3%
HME damage	2%	HME damage	54%
Capsize	-	Capsize	2%
Fire	-	Fire	3%



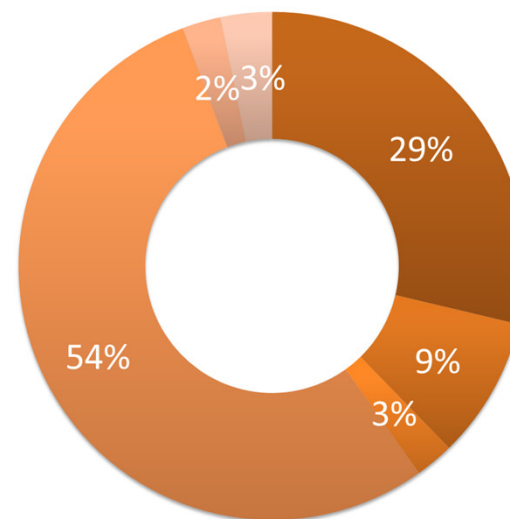
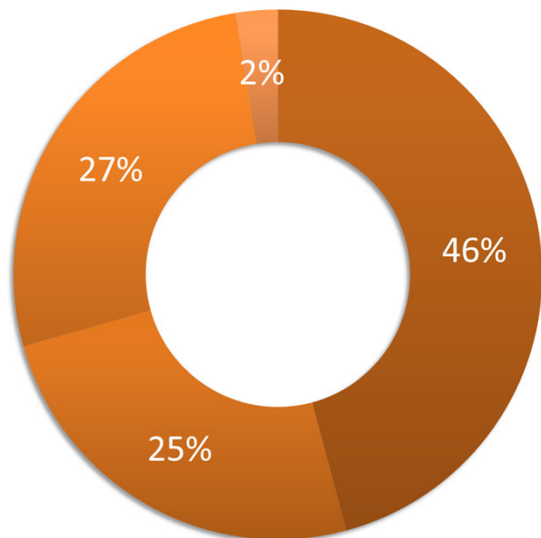
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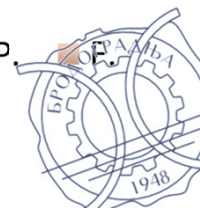
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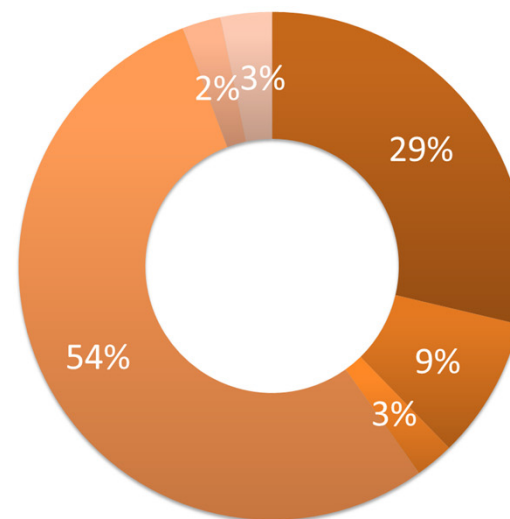
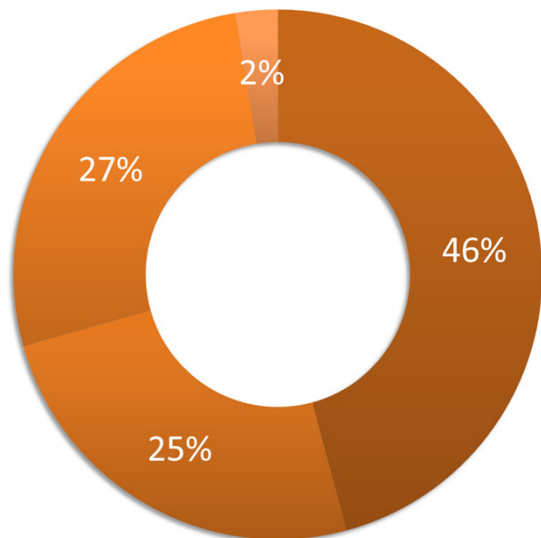
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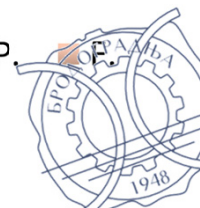
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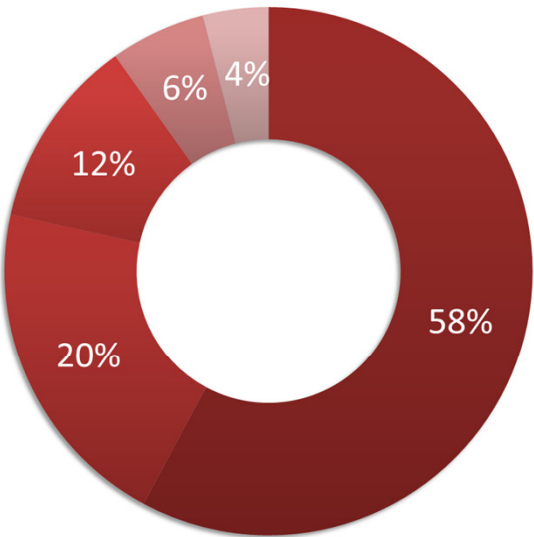
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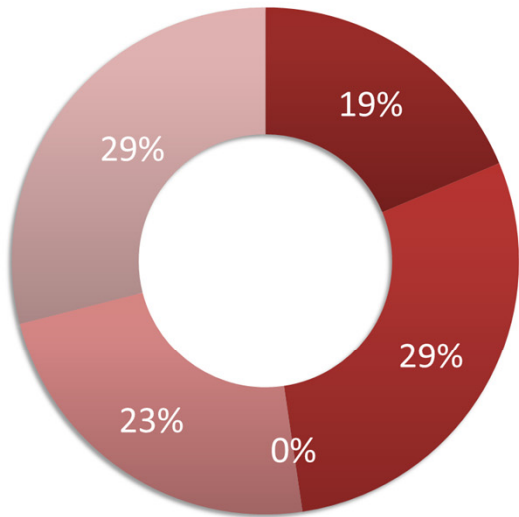
# Analysis of available data on accidents

## Causes of accidents

Austria		Serbia	
Human failure	58%	Human failure	19%
Technical fault	20%	Technical fault	29%
Weather conditions	6%	Weather conditions	23%
Operational cause	4%	Operational cause	29%
Other	12%	Other	-



■ HF   ■ TF   ■ Other   ■ WEC   ■ OC



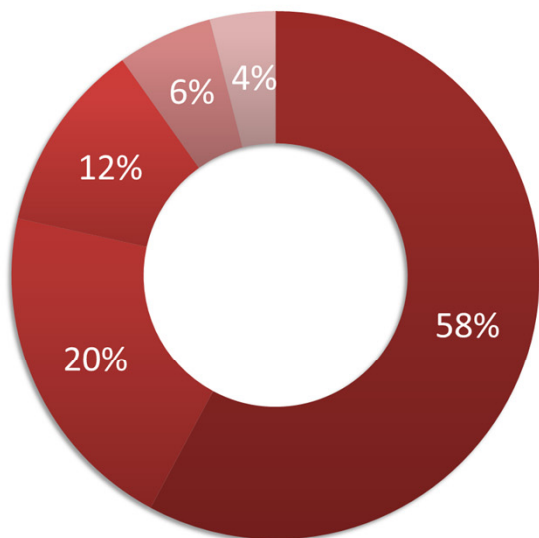
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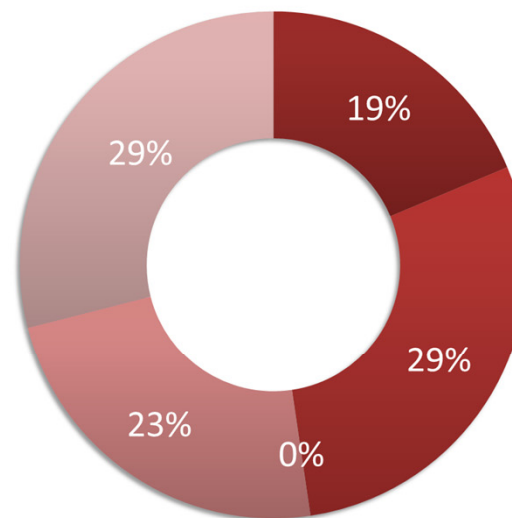
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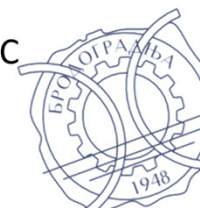
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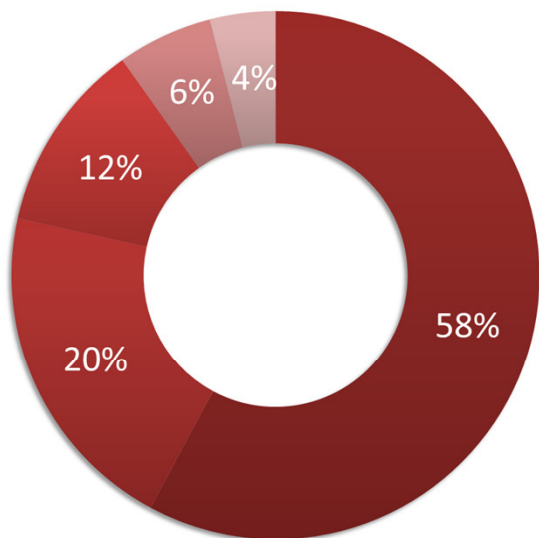
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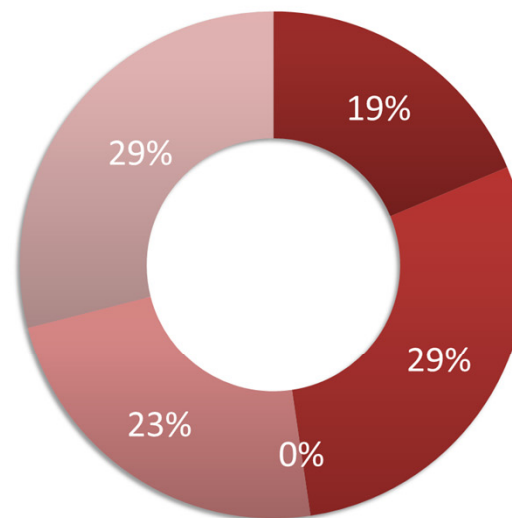
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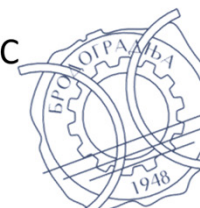
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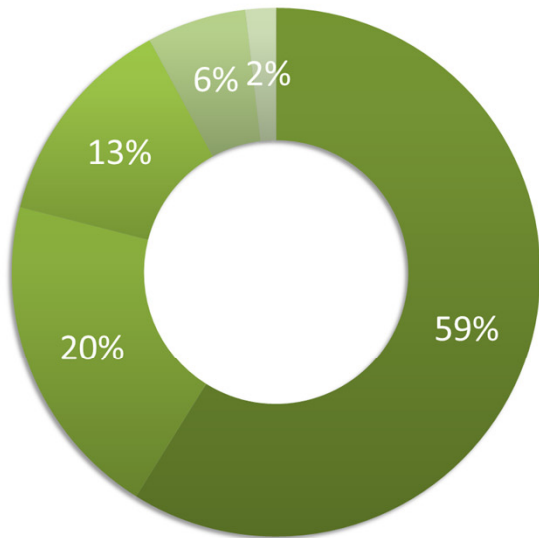
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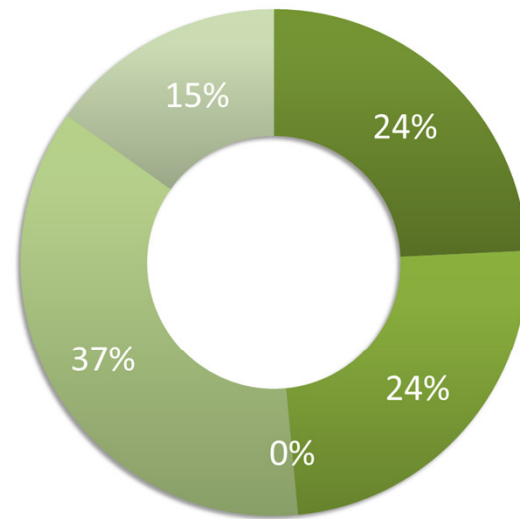
## Analysis of available data on accidents

### Causes of allisions

Austria		Serbia	
Human failure	59%	Human failure	19%
Technical fault	20%	Technical fault	29%
Weather conditions	6%	Weather conditions	37%
Operational cause	2%	Operational cause	29%
Other	13%	Other	-



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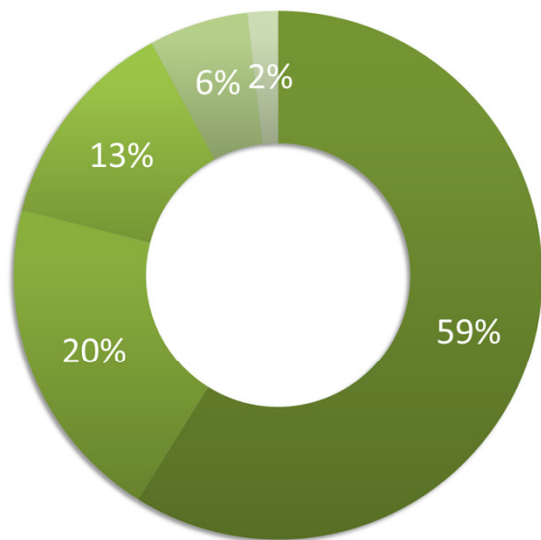
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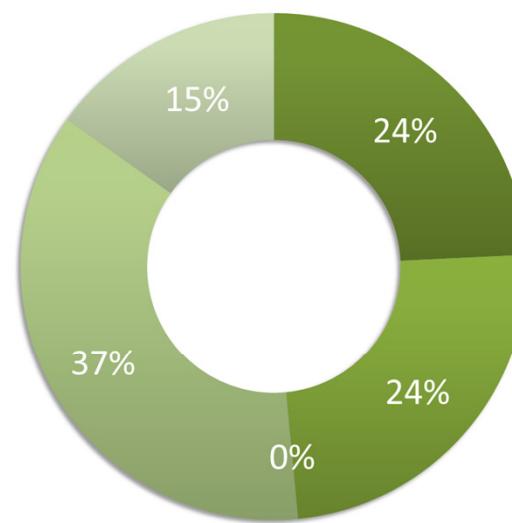
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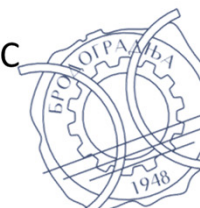
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Human failure	59%	Human failure	24%
Technical fault	20%	Technical fault	24%
Weather conditions	6%	Weather conditions	37%
Operational cause	2%	Operational cause	15%
Other	13%	Other	-



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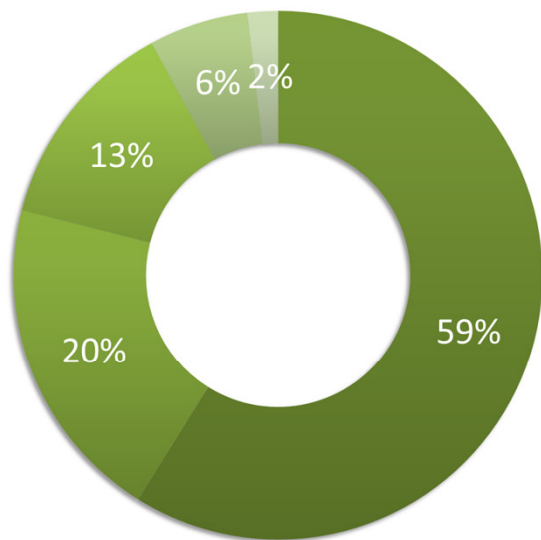
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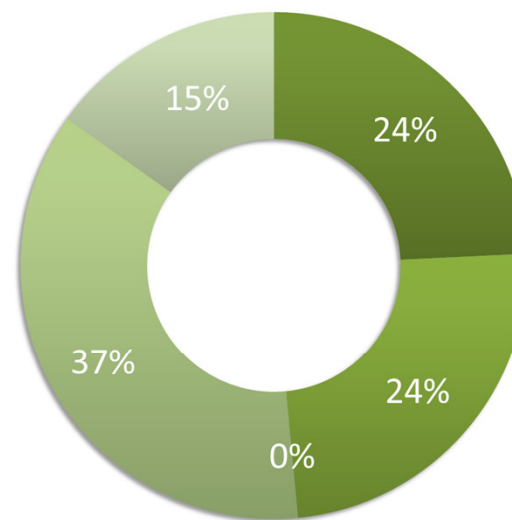
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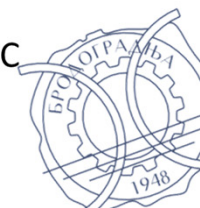
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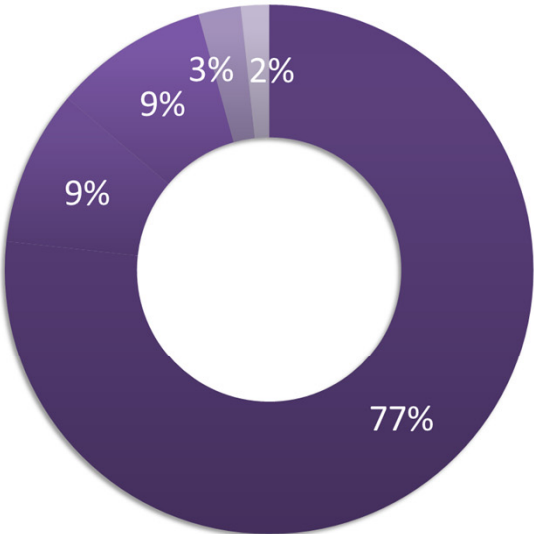
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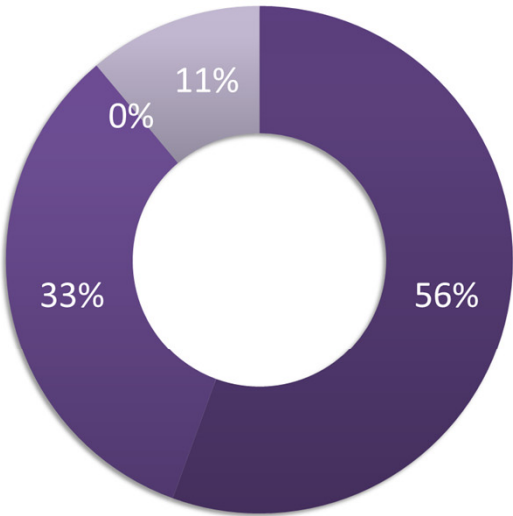
# Analysis of available data on accidents

## Causes of collisions

Austria		Serbia	
Human failure	77%	Human failure	56%
Technical fault	9%	Technical fault	33%
Weather conditions	3%	Weather conditions	-
Operational cause	2%	Operational cause	11%
Other	9%	Other	-



■ HF   ■ TF   ■ Other   ■ WEC   ■ OC



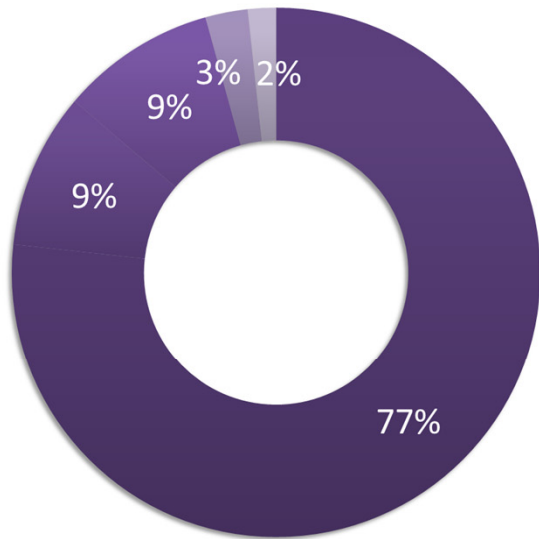
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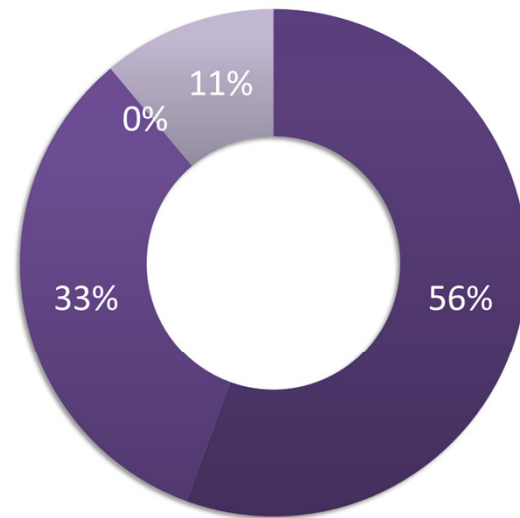
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Austria		Serbia	
Human failure	77%	Human failure	56%
Technical fault	9%	Technical fault	33%
Weather conditions	3%	Weather conditions	-
Operational cause	2%	Operational cause	11%
Other	9%	Other	-



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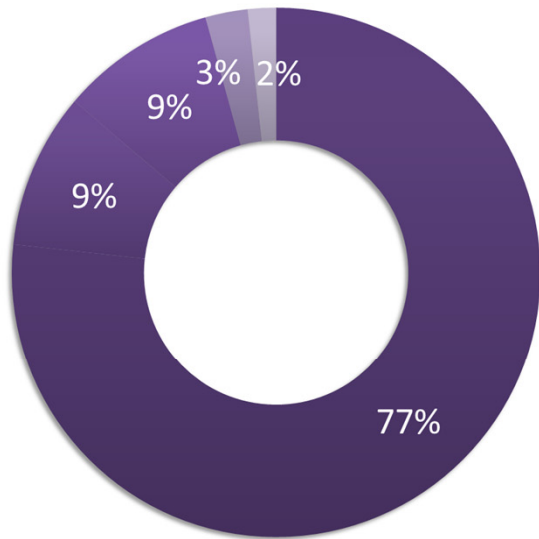
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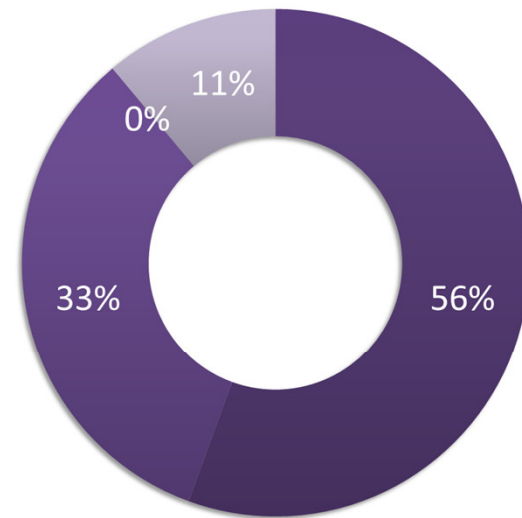
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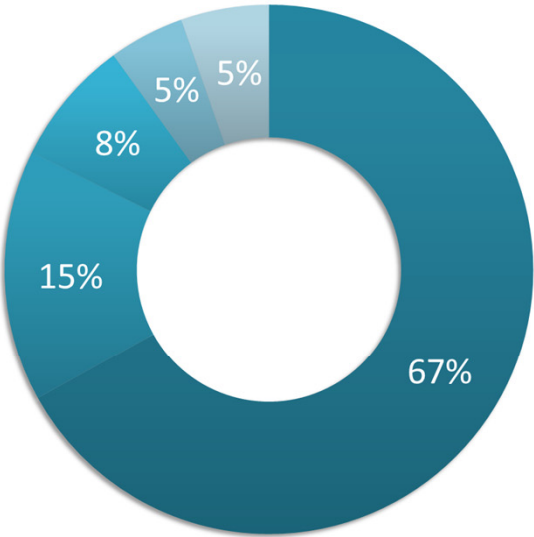
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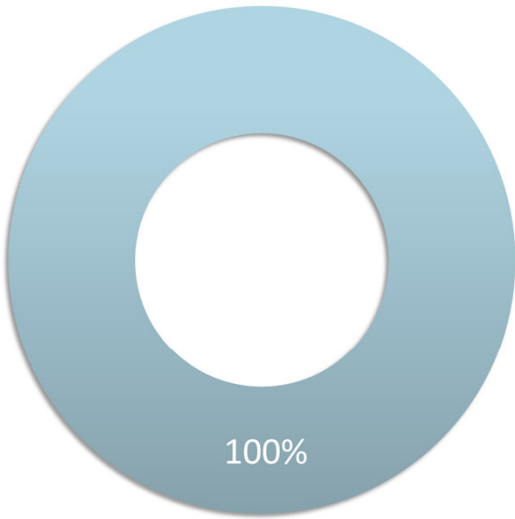
# Analysis of available data on accidents

## Causes of groundings

Austria		Serbia	
Human failure	67%	Human failure	-
Technical fault	15%	Technical fault	-
Weather conditions	5%	Weather conditions	-
Operational cause	5%	Operational cause	100%
Other	8%	Other	-



■ HF   ■ TF   ■ Other   ■ WEC   ■ OC



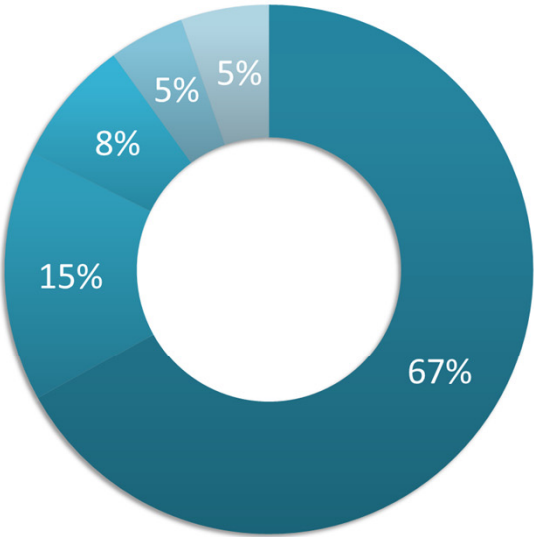
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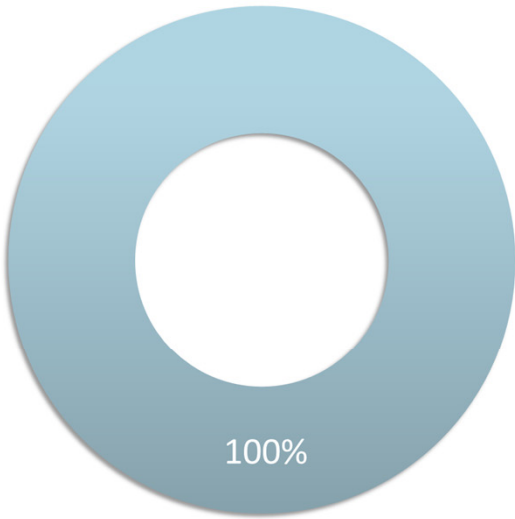
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## Causes of groundings

Austria		Serbia	
Human failure	67%	Human failure	-
Technical fault	15%	Technical fault	-
Weather conditions	5%	Weather conditions	-
Operational cause	5%	Operational cause	100%
Other	8%	Other	-



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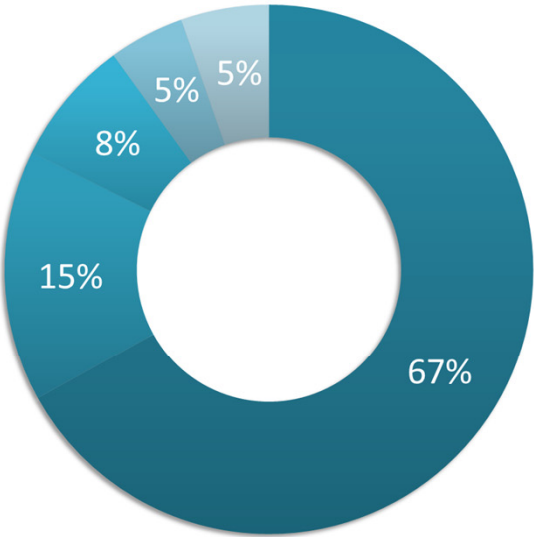
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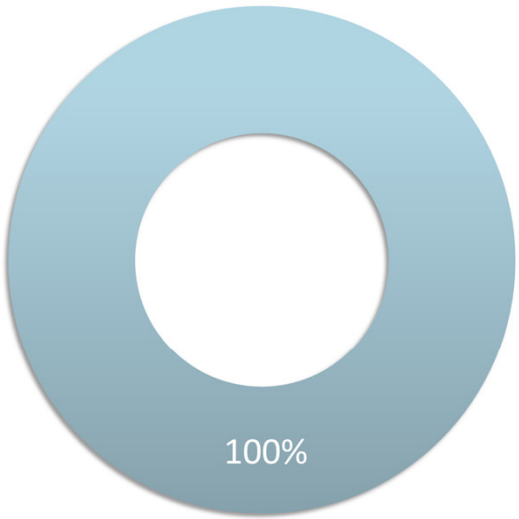
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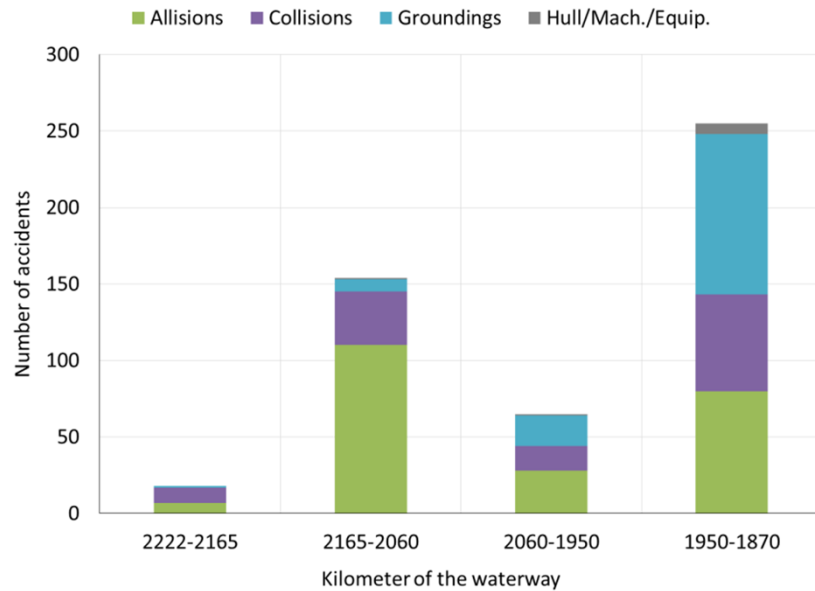
## Summary

Austria	Serbia
2% of accidents comprised HME damage.	54% of accidents comprised HME damage.
25% of accidents were collisions.	9% of accidents were collisions. Lower traffic density, wider fairway and lower current velocities.
27% of accidents were groundings.	3% of accidents were groundings. Greater fairway depth. Contacts with (unmarked) objects rather than ships running aground.
58% of accidents were caused by human failures.	19% of accidents were caused by human failures.
Human failures are the main cause of allisions, collisions and groundings.	Human failures are the main cause of collisions only.
10% of accidents were caused by weather conditions and operational causes.	52% of accidents were caused by weather conditions and operational causes.
20% of accidents were caused by technical faults.	29% of accidents were caused by technical faults.
9% of collisions were caused by technical faults.	42% of HME damages were caused by technical faults. 33% of collisions were caused by technical faults.

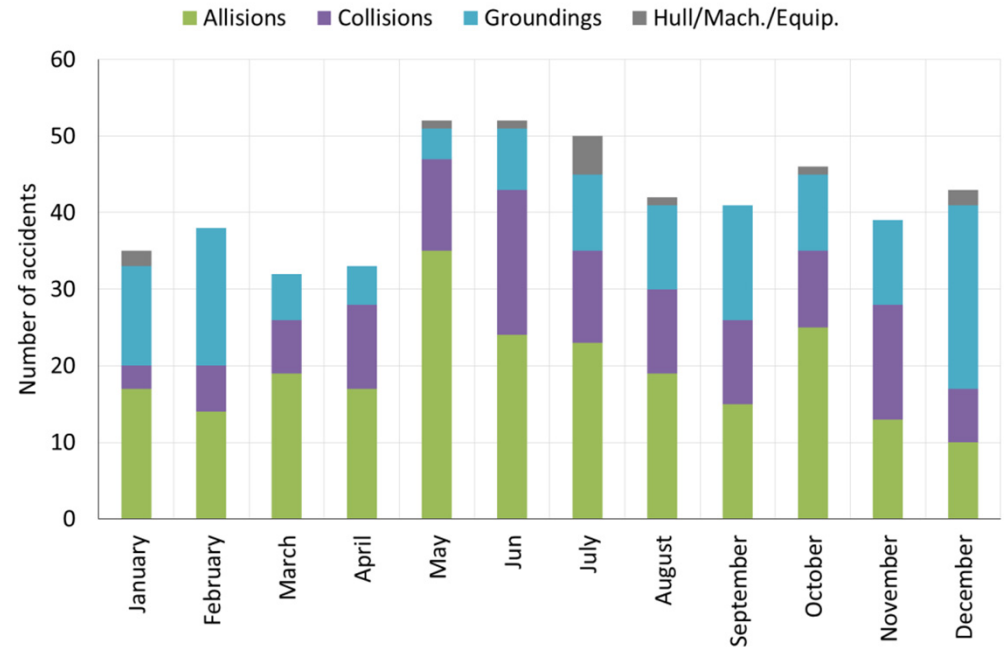


# Analysis of available data on accidents

## Distribution of accidents in space (along the waterway) and time (over the year)



Breakdown of the accidents with respect to the sector of the Danube in Austria



Breakdown of the accidents with respect to month of the year on the Danube in Austria



## Possible improvement of data acquisition

- Improvement of safety analysis would require additional data which are not being reported currently.
- The following data are missing from the BMVIT information:
  - The dimensions of ships and convoys (main particulars, displacement)
  - Location of the hull damage and the hull damage size (length, height, penetration)
  - Age of the vessels
  - Number of passengers and crew
- The following data are missing from the LKB reports:
  - Overall convoy dimensions
  - Ship draught at the time of accident
  - Location of the hull damage and the hull damage size (length, height, penetration)
  - Time of the accident
  - Cargo type and quantity
  - Number of passengers and crew
- Precise information on consequences are non-existent in both of the sources (number of fatalities and casualties, damage to the ship, damage to the waterway infrastructure, environmental damage).
- It is particularly challenging to estimate the size of the fleet exposed to the risks.



## Possible improvement of data acquisition

### Potential benefits of additional data

Additional data	Potential benefit
Main dimensions of the vessels	→ recommendations concerning safety in operation → recommendations concerning waterway design
Cargo type and quantity	→ improved environmental risk assessment
Crew size / number of passengers	→ societal risk (passengers) → individual risk (crew members)
Consequences of accidents	→ improved (more accurate) safety assessment → improved environmental risk assessment
Location and extent of hull damage	→ risk of flooding because of allision, collision and grounding → more efficient subdivision (design) → more rational subdivision and damage stability regulations (regulatory)
Time of the accident	→ the most dangerous time of the day from the point of view of human errors → recommendations concerning safety in operation
Fleet age	→ distribution of accidents (or causes of accidents) as a function of ship age → recommendations concerning ship inspection intervals and frequency
Size of the fleet	→ operational fleet at risk → temporal evolution of risk



## Concluding remarks

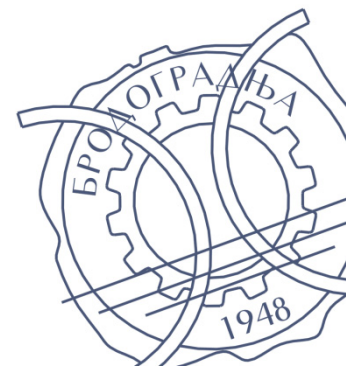
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Actions to be undertaken:

- Systematic organization of existing data on accidents in inland navigation.
- Digitalization of existing data.
- Improvement of reporting forms.
- Europe-wide standardization of reporting forms.
- Encouragement of systematic reporting.
- Trans-national and cross-border cooperation and merging of data.



# Thank you for your attention



## Abbreviations

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BMVIT	Austrian federal Ministry of transport, innovation and technology
CINS	Centre for investigation of traffic accidents of Republic of Serbia
HF	Human failure
HME	Hull/machinery/equipment
LKB	Port Authority Belgrade
OC	Operational cause
TF	Technical fault
WEC	Weather conditions

