

SMS Cost Workshop

Cost Model for the Development,
Maintenance and Day-to-day
Operation of a SMS

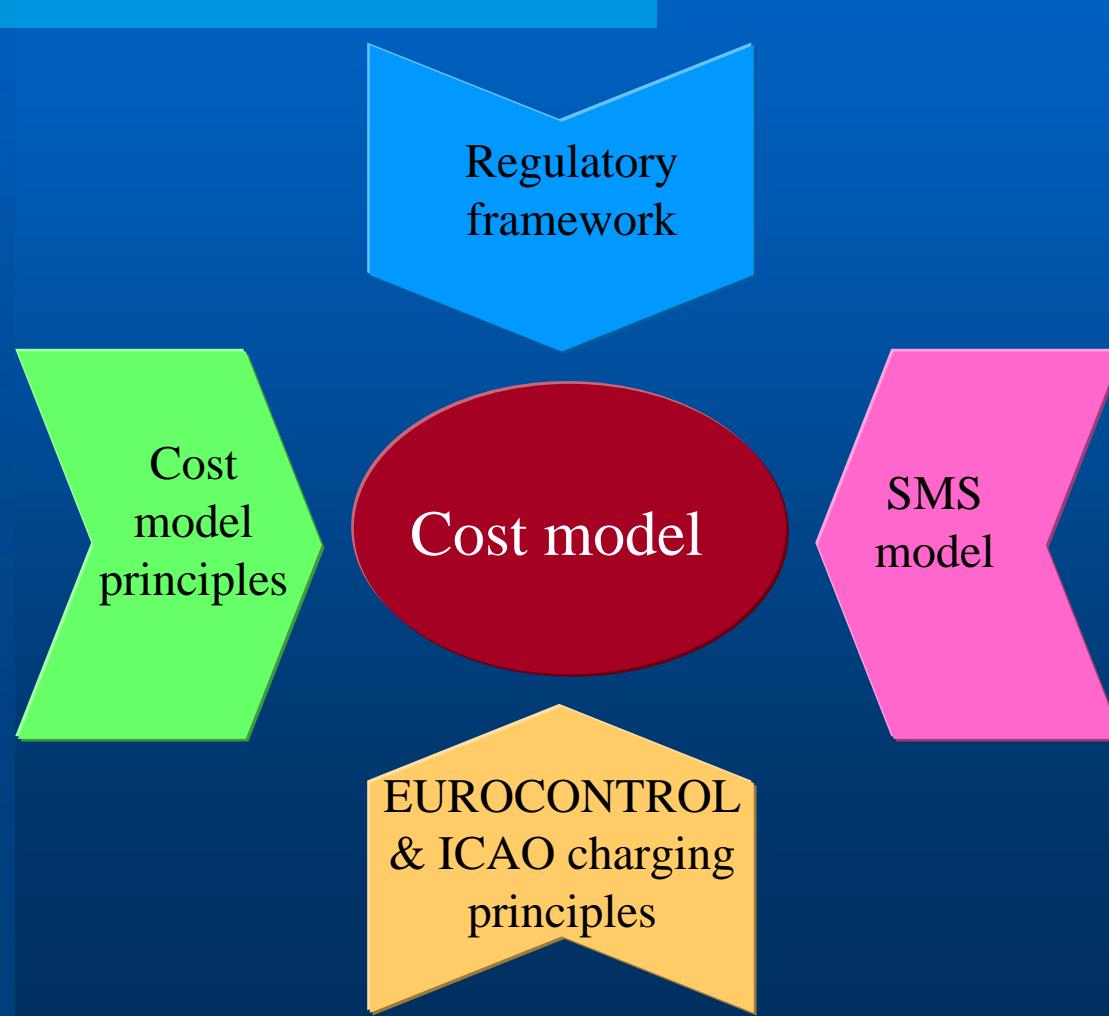
COMPASS IS ®
Vladimir Grigorov

Cost model

Cost Model Overview

Part I

Approach



Regulatory framework



- **EUROCONTROL ESARRs**
- **Commission Regulation 2096/2005**
- **Directive 2006/23/EC on a Community air traffic controller licence**
- **Directive 2003/42/EC on occurrence reporting in civil aviation**
- **Directive 94/56/EC establishing the fundamental principles governing the investigation of civil aviation accidents and incidents**
- **Commission Regulation 1315/2007 on safety oversight in ATM**
- **Commission Regulation 482/2008 on software safety assurance in ATM**

Best practices



- EGSMM
- ESARRs' implementation guidance materials (SRC website)
- ICAO Doc 9859 – Safety Management Manual

SMS model

- Scope of SMS
- Scope of SMS components
- Inventory of SMS cost elements



SMS scope – Safety planning

- **SMS Development and Implementation Plan**
- **Organisation's Safety Policy**
- **Safety Targets and Safety Indicators**



SMS scope – Safety organisation

- **SMS Organisational Structure**
- **Safety Responsibilities and Accountabilities**



SMS scope – Safety achievement

- **SMS Documentation**
- **Competency Assurance**
- **Safety of External Services**
- **Mandatory Reporting System**
- **Voluntary Reporting System**
- **Investigation of Safety Occurrences**
- **Management of Safety Related Changes**
- **Risk Assessment and Mitigation**
- **Software Safety Assurance System**



SMS scope – Safety assurance

- Safety Surveys
- Safety Monitoring
- Safety Records



SMS scope – Safety promotion

- Safety improvement
- Lesson dissemination and safety awareness



Scope of SMS components

- **Definitions for cost of safety management and cost of safety**
- **Decomposition of the safety procedures in terms of:**
 - Objective
 - Input (e.g. regulatory requirements)
 - Activities (tasks)
 - Type of resources used (e.g. OPS, ENG)
 - Infrastructure & equipment
 - Training needs, and
 - Products (output)

Example

Inventory of SMS cost elements (1)

- Establish eligible costs in the ANSP cost base
 - Staff costs
 - Other operating costs
 - Depreciation costs
 - Cost of capital
 - Exceptional (non-recurring costs)

Inventory of SMS cost elements (2)

- **Establish eligible SMS costs**
 - **Investment costs (infrastructure & equipment)**
 - **Training costs**
 - **Human effort costs**
 - **Non-effort costs (e.g. publications, leaflets, production cost of manuals, etc.)**



EUROCONTROL & ICAO charging principles

- **ICAO Manual of Air Navigation Services Economics, Doc. 9082 and Doc. 9161**
- **EUROCONTROL Principles for Establishing the Cost-Base for En-route Charges and the Calculation of the Unit Rates**
- **EUROCONTROL Guidance on the Rules and Procedures of the En-route Charges System**
- **EC Regulation 550/2004 on the provision of air navigation services in the single European sky**
- **EC Regulation 1794/2006 on common charging scheme for air navigation services**

Review

- **Review of management system cost models**
- **Review of cost allocation principles in ANS provision**

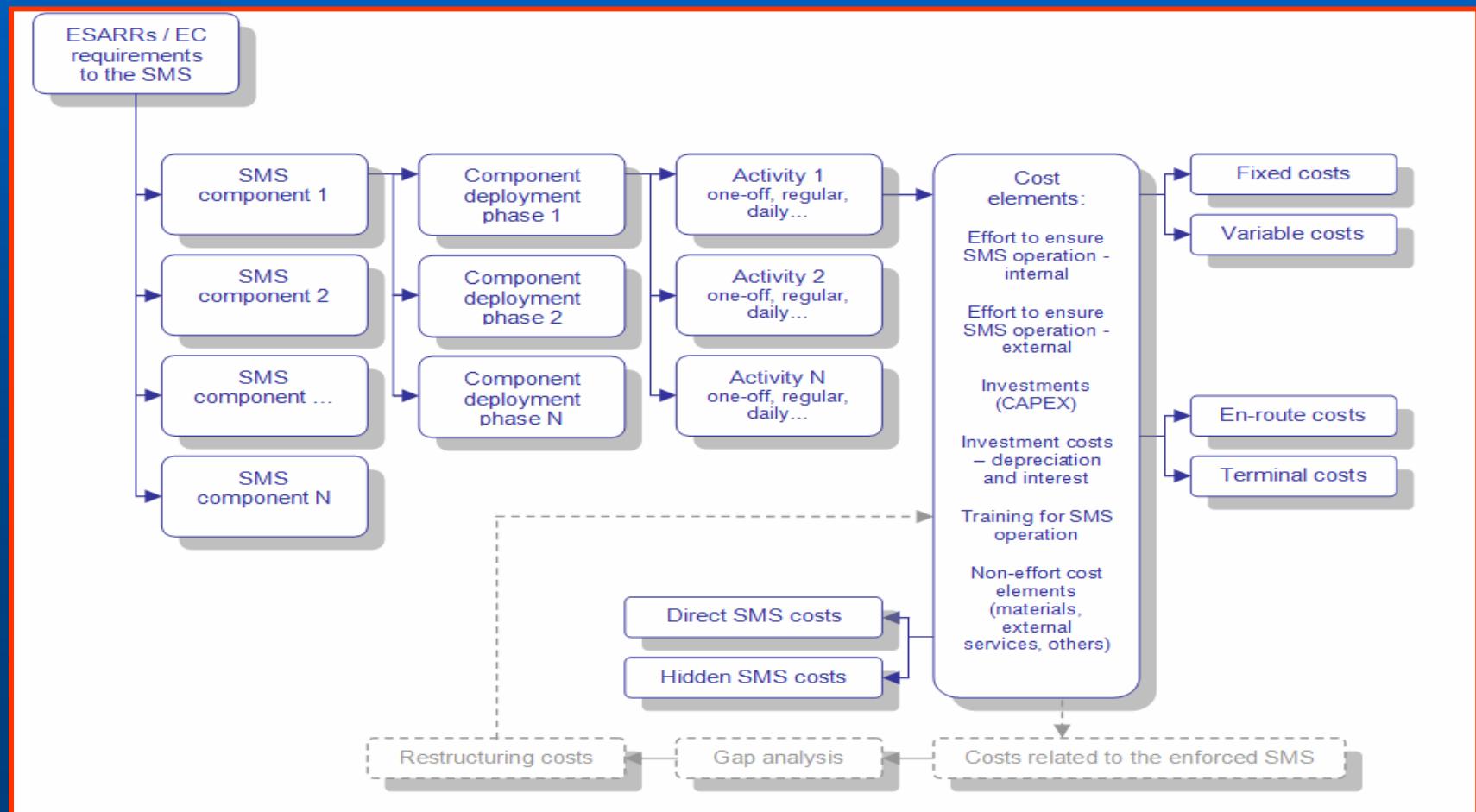


Cost model principles

- Standard cost model
- Activity based
- Quantitative methodology



Outline model structure



SMS procedure cost components

- Human effort
- Training
- Infrastructure & equipment
- Non-effort elements

SMS cost card

Human Effort

Procedure Design

Review applicable regulatory requirements
Review guidelines
available to
Review existing
investigative
practices and
Establish the
procedure.
classifications
schemes

Internal				
SAF [mandays]	OPS [mandays]	ENG [mandays]	MAN [mandays]	ANC [mandays]

Training

course duration [days]	SAF		OPS		
	trainees [number]	total [mandays]	trainees [number]	total [mandays]	
1 ESARR 2 training	<1mand>	<1mand>	0	<1mand>	0
2 Occurrence investigation course - SAF	5	12	60	<1mand>	0
3 Occurrence investigation course - OPS/INT	0.25	<1mand>	0	400	107.5
4 Occurrence analysis methods - SAF	0.5	12	6	<1mand>	0
5 Occurrence analysis methods - OPS/INT	0.25	<1mand>	0	400	107.5
6 Use of recording and playback facilities	0.5	12	6	<1mand>	0
7 Occurrence investigation tools (e.g. TOKAI, HERA) - SAF	5	12	60	<1mand>	0
8 Occurrence investigation tools (e.g. TOKAI, HERA) - ENG	2	<1mand>	0	<1mand>	0
9 None	<1mand>	<1mand>	0	<1mand>	0
10 Other	<1mand>	<1mand>	0	<1mand>	0

Total Training Effort 132 215

Training infrastructure

	Gross balance value [amount]	Expected operating life [years]	Quantity (% for SMS purposes) [%]	
1 Standard office equipment - PC	1,284	15	2.78%	
2 Standard office equipment - 6 PCs, presentation multimedia	8,210€	5	2.78%	272€
3 Venue	39,301,94€	40	0.09%	45,881€
4 None	0	0	0%	0€
5 None	0	0	0%	0€
6 None	0	0	0%	0€
7 None	0	0	0%	0€
8 None	0	0	0%	0€
9 None	0	0	0%	0€
10 Other	0	0	0%	0€

Total Training Infrastructure 46,208 €

Training cost - missions

Total course(s) duration [days]	abroad			domestic				
	trainees [number]	actual mission duration [hours]	cost [per day]	travel cost [per person]	trainees or trainers [number]	actual mission duration [hours]	cost [per day]	travel cost [per person]
1 ESARR 2 training	0							
2 Occurrence investigation course - SAF	10	2	35	465				
3 Occurrence investigation course - OPS/INT								
4 Occurrence analysis methods - SAF								
5 Occurrence analysis methods - OPS/INT								
6 Use of recording and playback facilities								
7 Occurrence investigation tools (e.g. TOKAI, HERA) - SAF								
8 Occurrence investigation tools (e.g. TOKAI, HERA) - ENG								
9 None								
10 Other								

Total Training Missions 2 20 35 465

Effort training elements

Single price [€]	Quantity [#]	Frequency per implementation [#]	
1 Training materials	1	430	2
2 None			
3 None			
4 None			
5 None			
6 None			
7 None			
8 None			
9 None			
10 Other			

Grand Total Training 7 430 2

Infrastructure and Equipment

Gross balance value [amount]	Expected operating life [years]	Quantity (% for SMS purposes) [#]	Cost	
1 Standard office equipment	38,664	5	100.00%	44,236 €
2 Data recording and playback facilities	7,600€	3	100.00%	8,284 €
3 None	0	0	0%	0€
4 None	0	0	0%	0€
5 None	0	0	0%	0€
6 None	0	0	0%	0€
7 None	0	0	0%	0€
8 None	0	0	0%	0€
9 None	0	0	0%	0€
10 Other	0	0	0%	0€

Grand Total Equipment 52,526 €

Non-Effort Elements

Single price [€]	Quantity [#]	Frequency per implementation [#]	Total costs per implementation [amount] [pqr]
1 None	0	0	0€
2 None	0	0	0€
3 None	0	0	0€
4 None	0	0	0€
5 None	0	0	0€
6 None	0	0	0€
7 None	0	0	0€
8 None	0	0	0€
9 None	0	0	0€
10 Other	0	0	0€

Grand Total Non-Effort Elements 0.00 €

Criteria for cost efficient SMS

- National safety regulatory framework
- Organisational structure of ANSP
- Number of staff per competency category
- Human resources dedicated to safety
- Capital expenditure for safety-related equipment
- Training of safety skills

What you can do with the cost model?

- Identify implementation and operation costs per procedure or for whole SMS
- What will be the cost of a new procedure
- Different analyses of human effort distribution
- Costs of different elements of SMS
- Optimise costs

Demo

Cost model demonstrator (one procedure) Part II

How are we doing it?

- **Two cost cards per procedure:**
 - Implementation
 - Operation
- **Four cost components in each card**
- **Procedure broken down into steps**
- **Steps decomposed by activities**
- **Equipment cost calculated adhering to strict accounting principles**

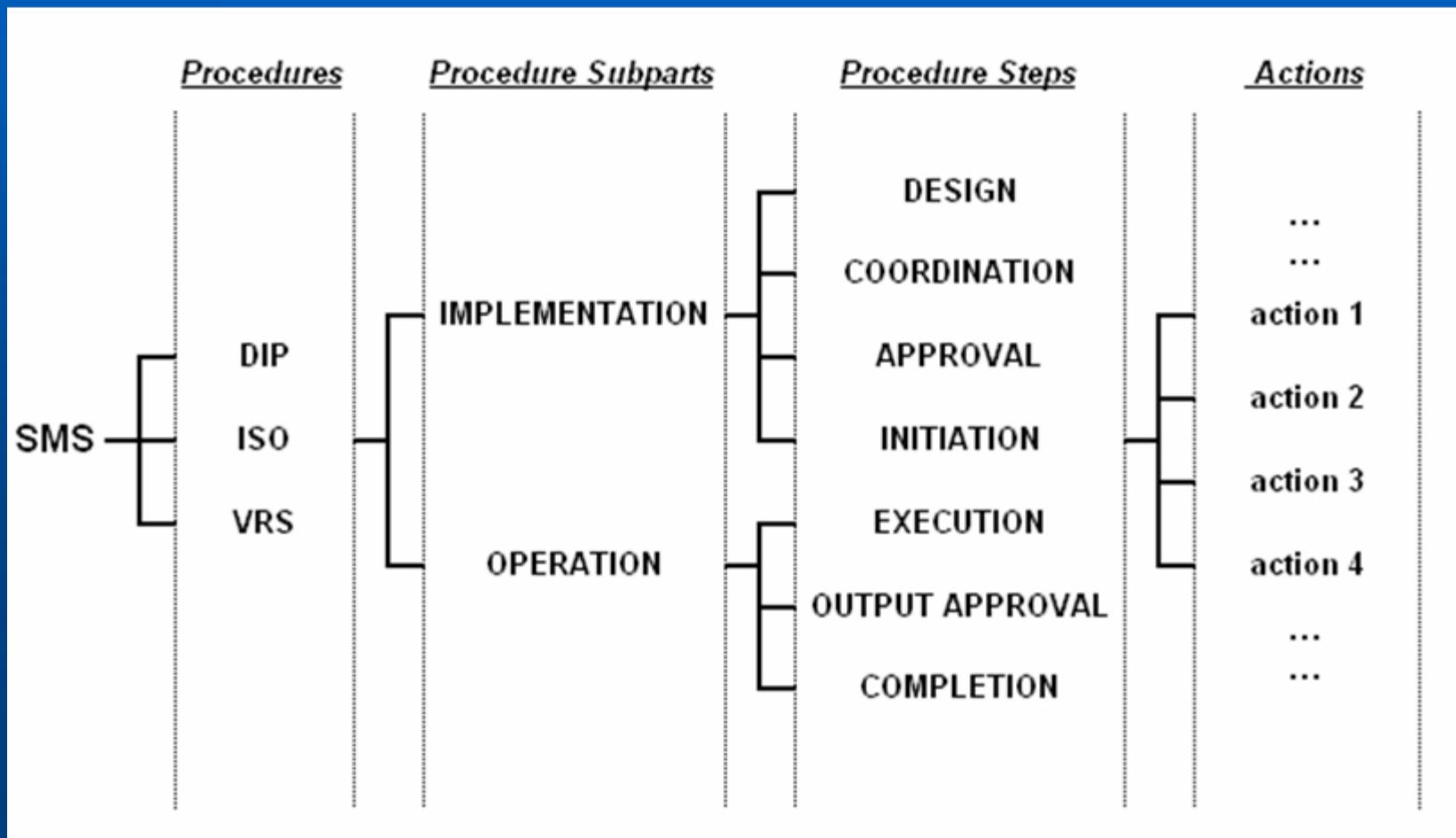
Human effort – Procedure Implementation

- Procedure Design
- Procedure Coordination
- Procedure Approval
- Procedure Initiation

Human effort – Procedure Operation

- Procedure Execution
- Procedure Output Approval
- Procedure Completion

Human effort structure



How are we doing it?

The model is actually a set of equations

BUT

It can be automated ...
Next demonstration of cost calculations of one SMS procedure

Demo – Model Input/Output

- **Model Input**
 - Global variables
 - Implementation cost card (ISO-I)
 - Operation cost card (ISO-O)
- **Model Output (results)**
 - Human effort
 - Training
 - Infrastructure & equipment
 - Non-effort elements
 - Summary
 - Charts
- **Help**

Demo – Global variables

- **Global variables**
 - Daily rates
 - SAF
 - OPS, ENG
 - MAN, ANC, ADM
 - INT & EXT Trainers or support
 - Inflation
 - Weighted average cost of capital
 - Annual effort cost increase

Demo – Human Matrix

Human effort assignment matrix					
SAF	OPS	ENG	MAN	ANC	ADM
[safety]	[operations]	[engineering]	[management]	[ancillary]	[administration]
Expert	Expert	Expert CNS	Top management (incl. directors)	MET	Procurement
Specialist	ATCO in OPS	COM	Line management	AIS	Accounting
	ATFM/ASM	NAV		SAR	HR
	Assistant	SUR		Instructor	
	OPS support (non-ATCOs)	IT			
	Trainee	Electro			
	Instructor	Instructor			

Demo – Global variables

Daily Rates		
Role	Rate	Overhead Rate
SAF - daily rate	220.00 €	20.00%
OPS- daily rate	200.00 €	20.00%
ENG - daily rate	150.00 €	20.00%
MAN - daily rate	260.00 €	20.00%
ANC - daily rate	110.00 €	20.00%
ADM - daily rate	90.00 €	20.00%
Internal Trainer - daily rate	220.00 €	20.00%
External Trainer- daily rate	500.00 €	N/A
External Human Effort - daily rate	300.00 €	N/A

SMS cost model - Human effort assignment matrix					
SAF	OPS	ENG	MAN	ANC	ADM
[safety]	[operations]	[engineering]	[management]	[ancillary]	[administration]
Expert	Expert	Expert CNS	Top management (incl. directors)	MET	Procurement
Specialist	ATCO in OPS	COM	Line management	AIS	Accounting
	ATFM/ASM	NAV		SAR	HR
	Assistant	SUR		Instructor	
	OPS support (non-ATCOs)	IT			
	Trainee	Electro			
	Instructor	Instructor			

Global Variables	
Variable	Value
Annual effort cost increase	3.50%
Inflation	3.00%
WACC - weighted average cost of capital	5.00%

Demo – Global variables

Daily Rates		
Role	Rate	Overhead Rate
SAF - daily rate	220.00 €	20.00%
OPS- daily rate	200.00 €	20.00%
ENG - daily rate	150.00 €	20.00%
MAN - daily rate	260.00 €	20.00%
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	Instructor	Instructor			

Global Variables	
Variable	Value
Annual effort cost increase	3.50%
Inflation	3.00%
WACC - weighted average cost of capital	5.00%

Demo – Human effort

Human Effort

Internal						External
SAF	OPS	ENG	MAN	ANC	ADM	
[mandays]						

Procedure Design

Review applicable regulatory

1 5 3

requirements

Review guidance material and

2 7 3

available best practices

Review existing in houses

Demo – Training

- **Input data**
 - Training courses
 - Training infrastructure and equipment
e.g. SOE, venue
 - Training missions
 - Training non-effort elements e.g.
training materials
- **Output**
 - Total training cost

Demo – Infrastructure & Equipment

- **Input data**
 - Gross balance value
 - Expecting operating life
 - % for SMS purposes
- **Output data**
 - Cost (depreciation and interest) for the whole operating life

Example 

Demo – Non effort elements

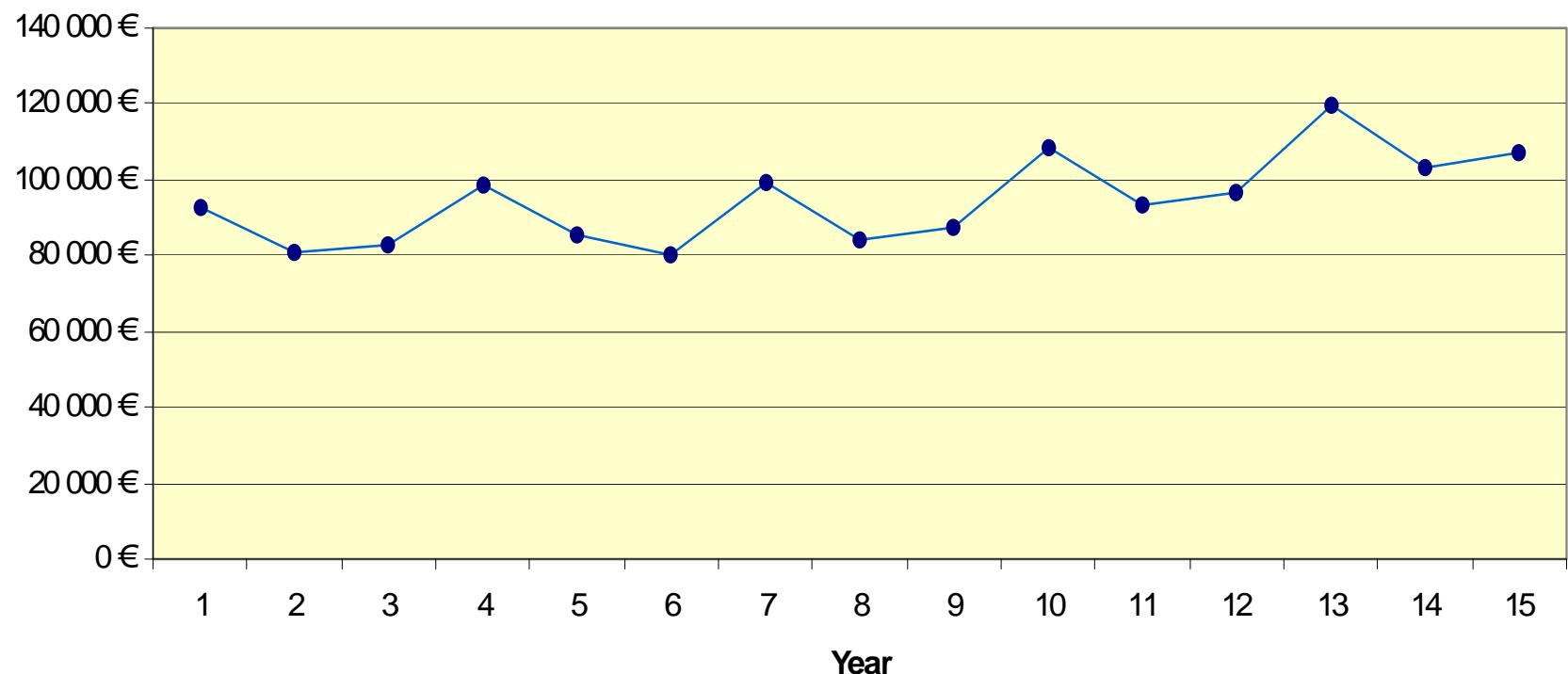
- **Input data**
 - Single prise
 - Quantity
 - Frequency per year
- **Output data**
 - Total cost

Questions & Answers

- What is the operation profile in some years?
- What is the total man effort per annum? How is this effort distributed?
- What are direct/hidden costs?

Operation profile - Example

Operation profile for 15 years



Man effort per implementation

Human Effort for Development and Implementation of SMS

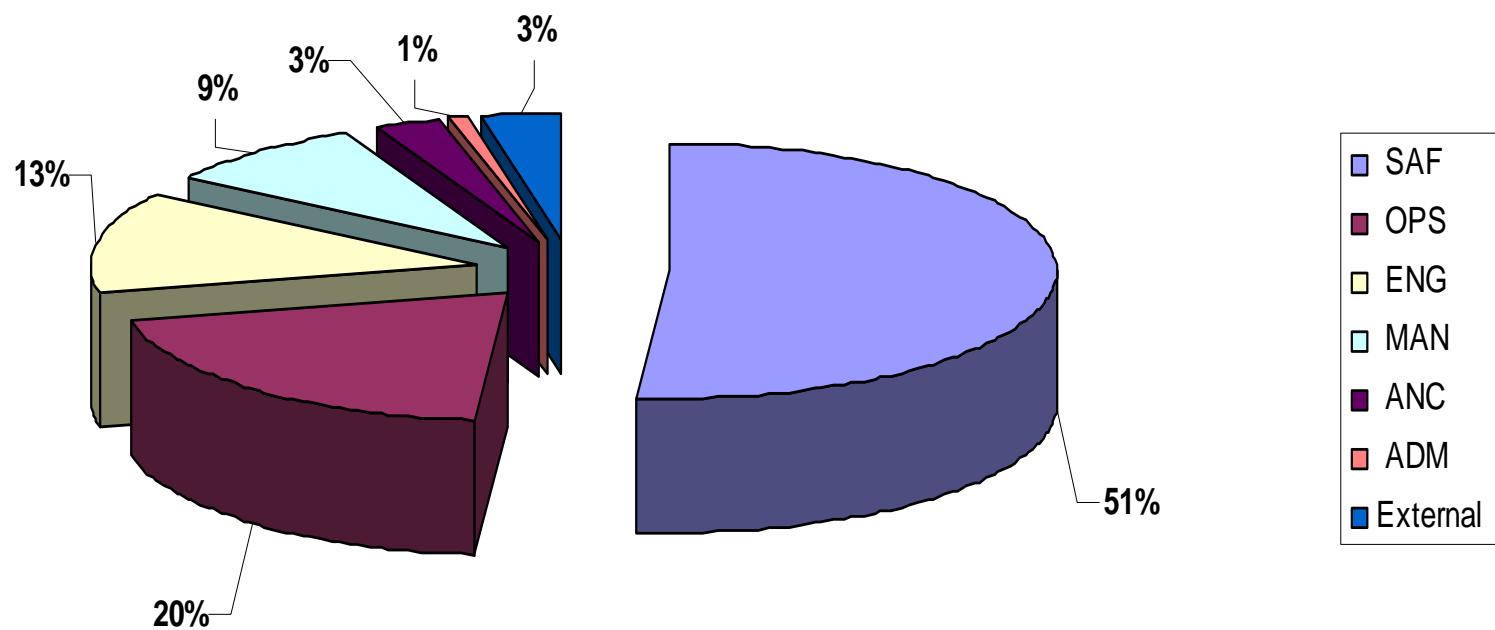
Procedure Action	Internal						External
	SAF	OPS	ENG	MAN	ANC	ADM	
	[total mandays]	[total mandays]	[totalmandays]	[total mandays]	[total mandays]	[total mandays]	
1-Design	41	0	0	0	0	0	
2-Coordination	12	20	20	0	0	0	
3-Approval	2	0	0	1.25	0	0	
4-Initiation	39	20	20	12	10	5	
Grand Total Human Effort	94	40	40	13.25	10	5	
R-Average Rate [per day]	220 €	200 €	150 €	260 €	110 €	90 €	
OH-Overhead [%]	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	
<i>Rate for estimations</i>	<i>264.00 €</i>	<i>240.00 €</i>	<i>180.00 €</i>	<i>312.00 €</i>	<i>132.00 €</i>	<i>108.00 €</i>	
Total Human Effort Costs	24 816 €	9 600 €	7 200 €	4 134 €	1 320 €	540 €	1 800 €

Man effort for day-to-day operation

Human Effort for Maintenance and day-to-day Operation of SMS

Procedure Action	Internal						External [total amount]
	SAF	OPS	ENG	MAN	ANC	ADM	
	[total mandays]						
5-Execution	10.625	0.5	0.25	3	0.25	0	
6-Output approval	0	0	0	2	0	0	
7-Completion	1.5	2	2	1	1	1	
Grand Total Human Effort	121.25	25.00	22.50	60.00	12.50	10.00	
R-Average Rate [per day]	220 €	200 €	150 €	260 €	110 €	90 €	
OH-Overhead [%]	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	
<i>Rate for estimations</i>	264.00 €	240.00 €	180.00 €	312.00 €	132.00 €	108.00 €	
Total Human Effort Costs	32 010 €	6 000 €	4 050 €	18 720 €	1 650 €	1 080 €	0 €

Human effort distribution - Example

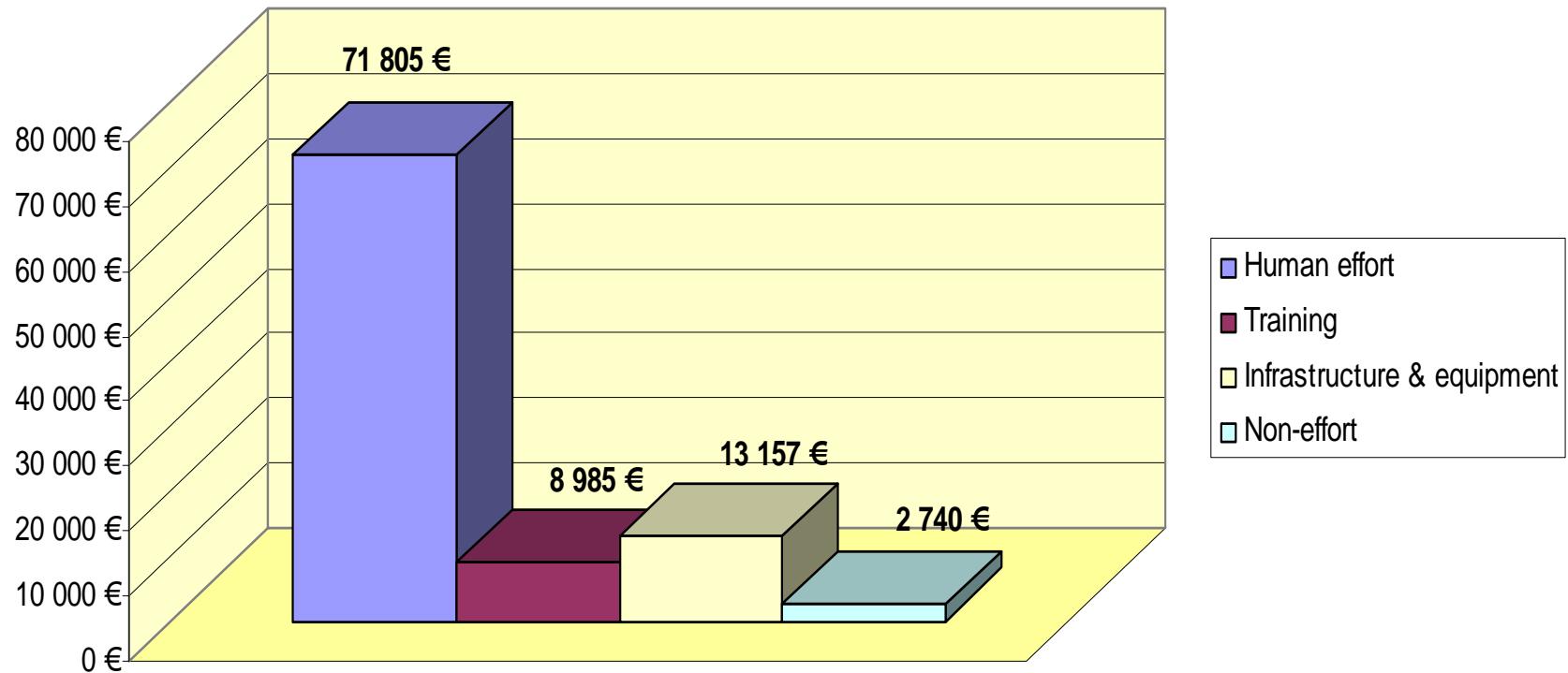


Direct/hidden/variable costs

- **Direct costs**
 - SAF effort
- **Hidden (indirect) costs**
 - Communication to and familiarisation of concerned staff
 - Involvement of OPS/ENG/ANC staff in SMS related activities
 - Venue costs
- **Variable costs**

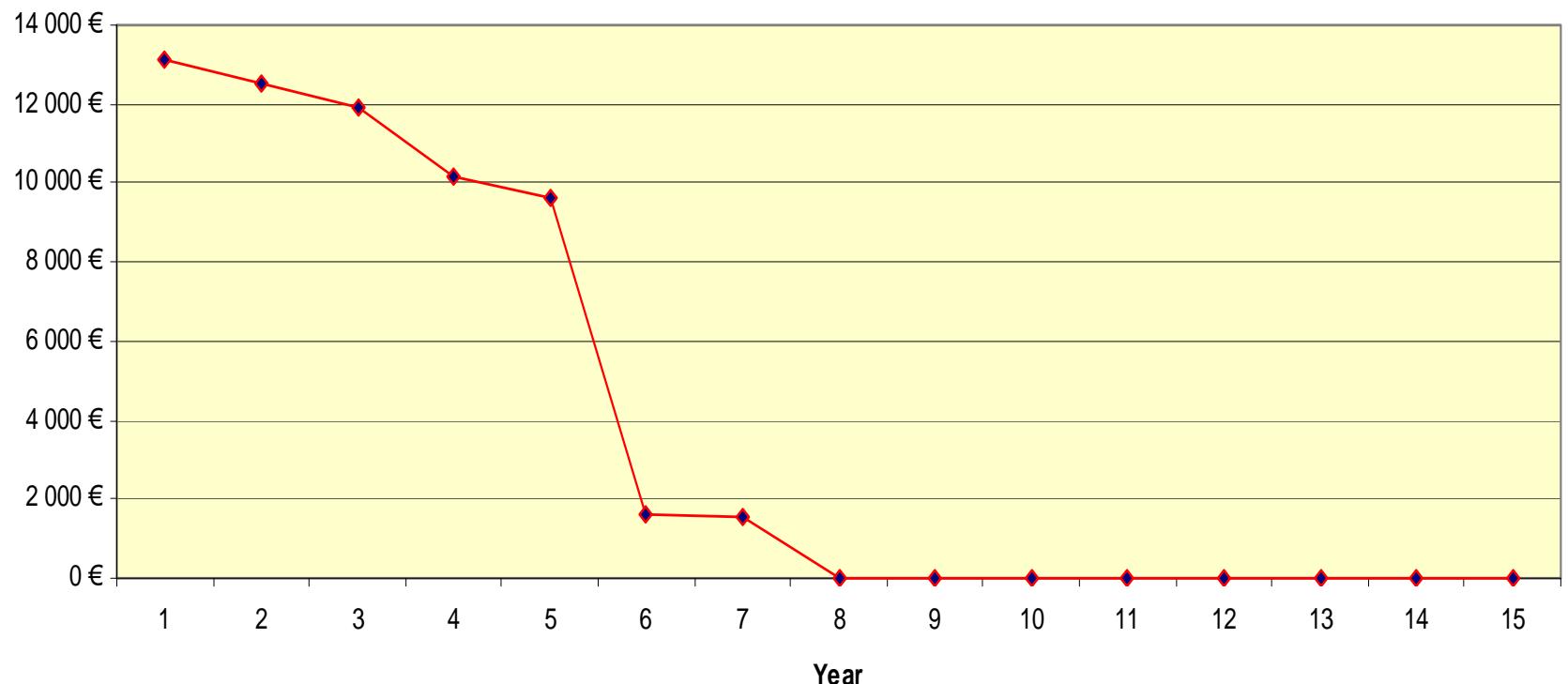
Distribution by elements - Example

Operation - Distribution by elements



Equipment profile - Example

Infrastructure and Equipment for 15 years



Financial crisis

- May I optimise SMS procedure in terms of effort/cost?
- Can I make a cost-benefit analysis so far years ahead?
- May I plan improvements for my SMS?
- How much costs me each particular activity?



YES

Thank you!

