NESMA SCES 2021- ESTIMATE
(DUTCH TAX ADMINISTRATION)

SEABED OBSERVATORY CONTROL SYSTEM
(3RD GENERATION RESEARCH CENTER)

NOVEMBER 9TH 2021, V1.0

Contents

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APPROACH - SUMMARY

- **General**
  - SCES challenge has been regarded as a serious game
  - Multidisciplinary estimation team formed
  - Historical references have been analyzed
  - *Extra: recommendations/next steps defined*
- **Sizing**
  - FPAi early stage method deemed applicable
  - Non-functionals included in historical records; part of referenced hours per FP
  - Uncertainty-level (bandwidth) assigned
  - An expected estimated size of 1.860* FP or 2.516* CFP -> size sanity check performed
- **Estimation**
  - Development language assumed as being Java
  - Expected organic size growth quantified
  - Sanity top-down checks performed; *Extra: scenarios based on expectations - duration, number of teams and team staffing*
  - Budgeted hours: 62k* hours, budgeted cost 9M* Euro (includes specification effort)

(note: bandwidth had been calculated around these numbers)*

SIZE RESULTS

- **Function Points (NESMA)**
  - Since the documentation does not provide an architectural decomposition, we had to assume that the system boundary encompasses *all* SOCS functionality described in the functional requirements
  - We use an adapted version of the Nesma FPAi early sizing method in the sense that we do not specify minimal and maximal numbers of estimated functions per (sub)requirement. At DTO, we choose to consider a bandwidth on the total size to express the uncertainty. The number of functions are multiplied by 5 (FP) to calculate the total number of function points. This applies only to the *transactions*; the *logical files* are not directly included, but *indirectly* via this factor of 5 FP
  - The specification of the SOCS functionality is too high-level to be able to perform an FSM (COSMIC, FPA, etc.) count. For many requirements we have chosen to express the size in assumed *CRUD functions*. The number of functions deduced in this manner must be understood as an estimation of the size, not as a literary amount of specific Create, Read, Update, Delete functions. The Nesma FPAi method describes a class of "average" requirements, like CRUD, which have a size of 4 functions

- **Cosmic FP (CFP)**
  - We have read the recommendation under bullet 3 on page 4 of the Cosmic conversion Guideline. Nonetheless we have to use the formulas from appendix A while we have no measurements in Cosmic within our organization. For the conversion of Nesma function points into Cosmic Function Points we used the mathematical equation for All Datasets (projects 400-2000 FP) on page 40 in the document "Conversion-Guideline-v1.0.pdf". The conversion formula used is CFP = 1.5017 x (Nesma FP) - 277.32
  - Acting as described, we have calculated an (expected) estimated size of 1.860 FP or 2.516 CFP. High uncertainty: +/- 30%

size minus 30% bandwidth in CFP ->	1.678 CFP	1.302 FP	<- size minus 30% bandwidth in FP
size plus 30% bandwidth in CFP ->	3.354 CFP	2.418 FP	<- size plus 30% bandwidth in FP
size in CFP ->	2.516 CFP	1.860 FP	<- size in FP
	Functions	5 FP	<- FPAi factor to calculate FP from # of functions
	372	1.860 FP	<- total number of FP within selection

SIZE PROCESS

- **Process**
  - Within each requirement, functionality (if any) has been identified and has been estimated in terms of number of functions
  - Each assumption is described and remarks are made, which are all have been examined by a reviewer
  - This setup is designed to feed a discussion with the subject matter expert(s) and the customer **- example (selection) below**

Requirement	Paragraph/Users	Description of functionality	FPA functions	# of functions	Function points estimation	Remarks	Review remark
REQ-UI-1: Provide Observer User Interfaces (UI)	Observers	• Online work area for reducing and analyzing data in real-time,	assumption: at least reducing (CRUD) and Analyzing (CRUD) Observer data	8	40	Review remark 1: Object added.	1
REQ-UI-1: Provide Observer User Interfaces (UI)	Observers	• Online observatory data reduction pipeline and tools,	assumption: CRUD pipeline and tools data	0	0	Review remark 1: Object added. Already estimated for Marine Scientist. From 0.2 to 0.3 - 20 FP	1
REQ-UI-2: Provide Instrument Specialists User Interfaces (UI)	Instrument Specialists	– Maintenance (predictive, preventive, condition-based, reactive)	CRUD per maintenance type	16	80	Review remark 3: this assumption needs te be checked at the client	3
REQ-UI-2: Provide Instrument Specialists User Interfaces (UI)	Instrument Specialists	– Configure, calibrate, and operate instrument on science level	assumption: configure (CRUD), calibrate (CRUD) and operate (CRUD)	12	60	Review remark 3: this assumption needs te be checked at the client	3
REQ-UI-Number unknown	Data Specialist	• Environment to perform data processing, reduction, and analysis	assumption: data processing (CRUD), reduction (CRUD), and analysis (CRUD) science data	12	60	Review remark 1: Object added.	1
REQ-RG-5: Support Maximum Scan Distance Travel Limit	3.2		cannot be included in an FSM count according to the respective counting guidelines	0	0	not elementary	
REQ-OOM-8: Implement Engineering Data System	4.3	The engineering data system includes hardware and software to collect, store, retrieve,analyze and display engineering data and telemetry. Engineering data will be generated by the seabed robot system, instruments, the facility (enclosure and infrastructure) and environmental monitoring systems	collect, store, retrieve,analyze and display engineering data and telemetry: for 4 types of systems	20	100	Review remark 3: this assumption needs te be checked at the client	3
REQ-OOM-10: Enable Subsystem Safety Monitoring from Control Room	4.3	The seabed robot operator and observers will mostly work in the control room, thus information about subsystem and personnel safety must be made available there.	assumption: show status of subsystems.	1	5	Assumption: onlu 1 subsystem	
REQ-OOM-11: Enable Safety Monitoring via Remote Sensors	4.3		assumption: monitor human safety (R.) and monitor equipment safety (R.)	2	10	Unclear whether this is reuse. Assumption made.	
REQ-OOM-13: Provide Visual Warning Regarding Unsafe Environmental Conditions	4.4		show visual warnings	5	25	Assumption: for every type of warning 1 function	

ESTIMATE RESULTS

- **Estimate results**
  - Development language assumed as being Java, historically 21 hours per FP. Java is assumed for frontend and backend functionality
  - Effort for non functional requirements is included in the historical DTO Java productivity numbers
  - Expected autonomous size growth quantified as 15%
  - Sanity top-down checks performed by analysis of PI-level recent historical results (Java) **–slides #7-9**
  - Specification effort included: transformation of epics/features into (Definition Of Ready) user stories is needed
  - For the cost estimate we choose the expected size (1.860 FP) and add 15% for uncertainty AND 15% for autonomous growth

Number of functionpoints		
Expected	*Budgeted*	*Incl. organ.growth*
1.860	**2.139**	**2.460**

Needed Hours Total		
Expected	*Budgeted*	*Incl. organ.growth*
53.940	**62.031**	**71.336**

Needed Hours Realization		
Expected	*Budgeted*	*Incl. organ.growth*
39.060	**44.919**	**51.657**

Needed Hours Specification		
Expected	*Budgeted*	*Incl. organ.growth*
14.880	**17.112**	**19.679**

Expected cost	€ 7.907.367 EUR
Budgeted cost	€ 9.093.472 EUR
Cost incl. Organic growth	€ 10.458.130 EUR

4. Estimate the cost related tot the estimated effort		
hourly rate USA	$152	60%
hourly Europe W+E	$57	20%
hourly S-America	$54	20%
Taxes and benefits	30%	
Overhead	20%	
Weighted hourly rate USD	$170	
Weighted hourly rate EUR	€ 147	

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ESTIMATE PROCESS (1 OF 2)

Estimate FPA-i Seabed Robot Observatory, calculated with Standard 2021 in hours/fp

Calculated with : Standard 2021 % organic Growth : 15			Number of functionpoints			Needed Hours Realization			Needed Hours Specification			Needed Hours Total		
			Expected	*Budgeted*	*% organ growth*	*Expected*	*Budgeted*	*% organ growth*	*Expected*	*Budgeted*	*% organ growth*	*Expected*	*Budgeted*	*% organ growth*
			1.860	2.139	2.460	39.060	44.919	51.657	14.880	17.112	19.679	53.940	62.031	71.336
			Number of fp requirements:			Number of hours requiement			Number of hours requiement			Number of hours requiement		
1 Work Marine scientist		Marine Scientist	100	115	132	2.100	2.415	2.777	800	920	1.058	2.900	3.335	3.835
2 Science Operations Staff		Science Operations	60	69	79	1.260	1.449	1.666	480	552	635	1.740	2.001	2.301
3 REQ-UI-1: Provide Observer User Interfaces (UI)	The SOCS shall provide user interfaces (UI) for observing setup and execution by Observers and observing support	Observers	140	161	185	2.940	3.381	3.888	1.120	1.288	1.481	4.060	4.669	5.369
4 REQ-UI-2: Provide Instrument Specialists User Interfaces (UI)	The SOCS shall provide user interfaces (UI) for facility instrument setup and operation by staff Instrument Specialists.	Instrument Specialists	490	564	648	10.290	11.834	13.609	3.920	4.508	5.184	14.210	16.342	18.793
5 REQ-UI-3: Provide Seabed Robot Operator User Interfaces	The SOCS shall provide user interfaces for setup and operation of the underground and enclosure by staff	Seabed Robot Operators	140	161	185	2.940	3.381	3.888	1.120	1.288	1.481	4.060	4.669	5.369
6 REQ-UI-4: Access Observatory Telemetry Data Source for Engineering and Technical Uis	The SOCS shall provide the capability for engineering and technical user interfaces to access observatory	Engineers & Technician	0	0	0	0	0	0	0	0	0	0	0	0
7 REQ-UI-5: Access User Data Source for Engineering and Technical Uis	The SOCS shall provide the capability for engineering and technical user interfaces to access user-provided data.	Engineers & Technician	0	0	0	0	0	0	0	0	0	0	0	0
8 REQ-UI-Number unknown		Data Specialist	80	92	106	1.680	1.932	2.222	640	736	846	2.320	2.668	3.068
9 REQ-UI-Number unknown		Observatory Manager	0	0	0	0	0	0	0	0	0	0	0	0
10 REQ-OM			175	201	231	3.675	4.226	4.860	1.400	1.610	1.852	5.075	5.836	6.712
11 REQ-RG			40	46	53	840	966	1.111	320	368	423	1.160	1.334	1.534
12 REQ-OOM			530	610	701	11.130	12.800	14.719	4.240	4.876	5.607	15.370	17.676	20.327
13 REQ-OPM			105	121	139	2.205	2.536	2.916	840	966	1.111	3.045	3.502	4.027
14 REQ-Others			0	0	0	0	0	0	0	0	0	0	0	0

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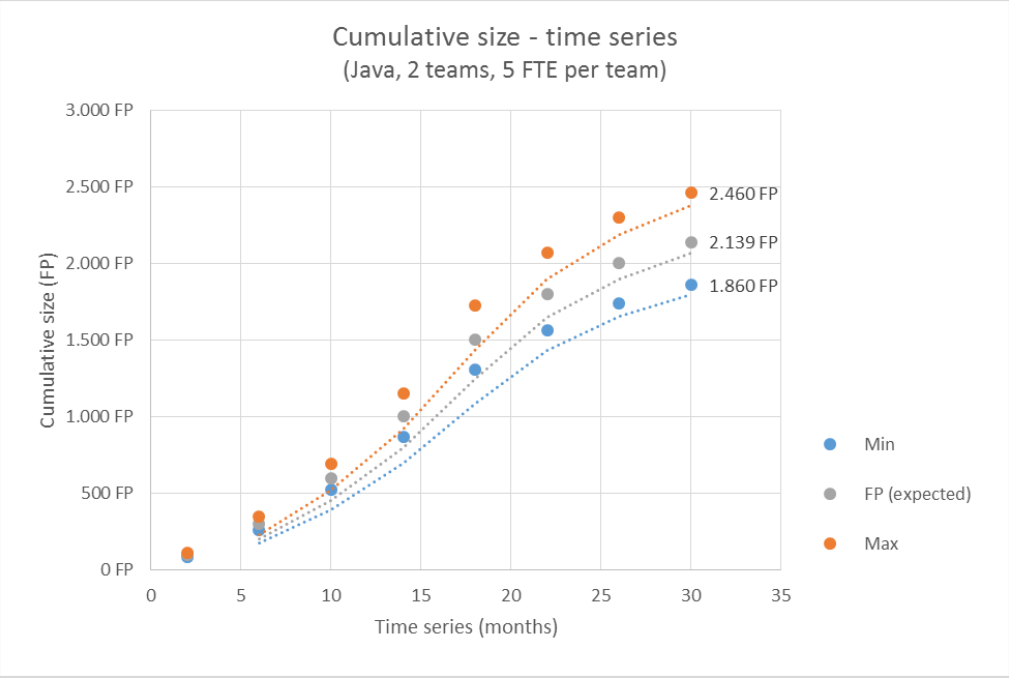
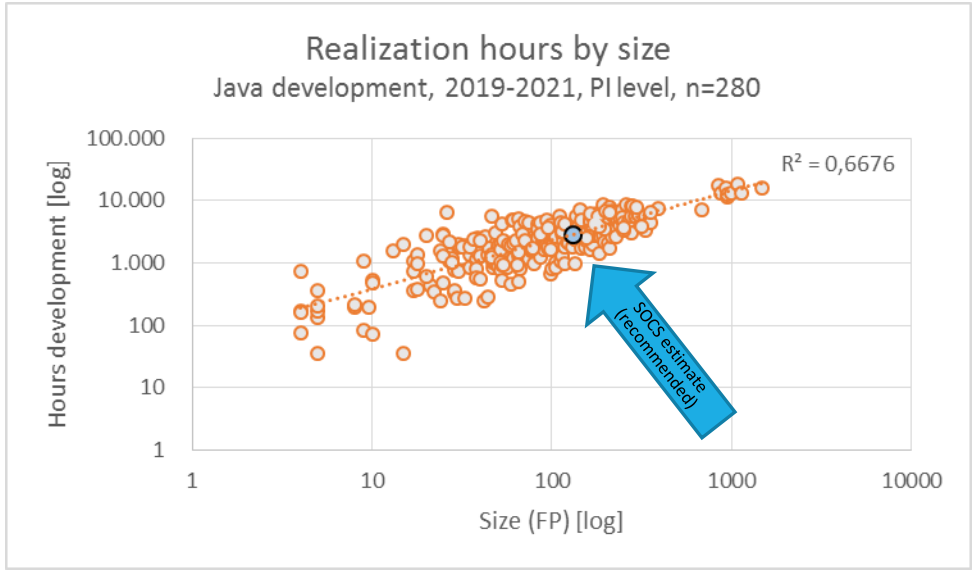
ESTIMATE PROCESS (2 OF 3)

- **Recommended scenario**
  - Examined evaluated PI periods 2019-2021 (Java)
  - 2 parallel teams is *recommended*; 30 month delivery
  - Keep teams small; max. 5/6 FTE per team

Total hours (estimated)	44919
Total hours per PI	3840
Number of PI's	12
FP per PI (average)	183 FP
Number of weeks	140
Number of months	32
FP per month (average)	66 FP
FP per team per month (average)	33 FP

Quartile	Size per PI	Effort per	FTE (staff)
Q1	44	1.195	3,0
Median	87	2.295	5,5
Q3	169	4.020	9,5



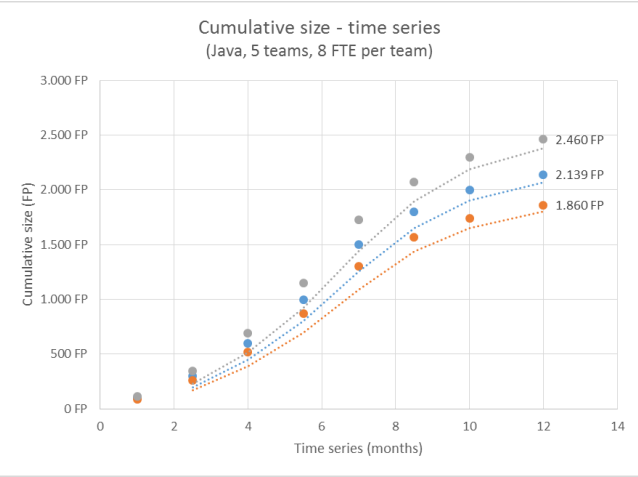


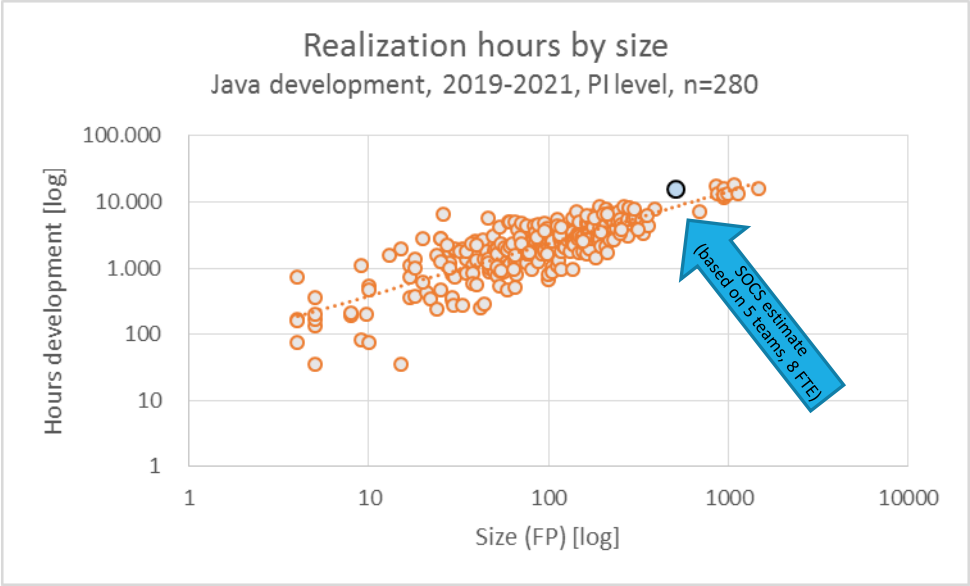
ESTIMATE PROCESS (3 OF 3)

- **Alternative scenario(s)**
  - Many alternative scenarios imaginable (multi-criteria);
  - E.g. 60% USA (3 teams), 20% South Am (1 team), 20% EU (1 team);
  - 5 parallel teams fully staffed (8 FTE); 12 month delivery

  Discussion points with the steering board:
  - Time to delivery, MVP – PI partitioning, WSJF-method, MoSCoW
  - Extra co-ordination within/between teams, delivery pressure
  - Higher uncertainty with team increase; adjust budgeted productivity

Total hours (estimated)	64170
Total hours per PI	15360
Number of PI's	4
FP per PI (average)	512
Number of weeks	50
Number of months	12
FP per month (average)	185
FP per team per month (average)	37





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RECOMMENDATIONS

- **Requirements/specifications**
  - Refine the requirements in sessions with subject matter experts; currently only sizing *estimates* can be done
  - A number of requirements have more then 10 functions. The FPAi methods recommends further specification by the client
  - Investigate which components can be developed independently
  - Consider several dimensions: front- and backoffice, main/sub/auxiliary, etcetera
  - Investigate how requirements can be partitioned
  - e.g. REQ-4 (490 FP) and REQ-12 (530 FP) are too big for a PI
- **Initial plan**
  - Start with a logical work breakdown structure (PI level), focusing on system integration test milestones (PI delivery)
  - Include a well-defined Minimal Viable Product (first release), using MoScoW-type tags
  - Investigate intermediate delivery (‘working software’) during PI’s
  - Anticipate on production issues (maintenance)
- **Project governance and quality assurance**
  - Manage expectations w/regard to scope, MVP, budget and time-to-market
  - Due to the considerable estimated size: consider scenario 2 teams, 5 FTE per team => 10 PI’s and 2,5 years (ref: DTO)
  - Evaluate progress per PI by measuring delivered functionality, check autonomous growth assumption and scope creep

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APPENDIX - PHASE ACTIVITIES

Which Activity in which Phase			
Activity	**Specification- and Acceptance Phase**	**Realization Phase**	**No subject for FPA**
Support Information Systems Management developing Business Case/Epics	x		
Developing features	x		
Developing user stories (baseline)	x		
Events planning/specification (PI-event, Refinement)	x		
Architecture	x		
Functional design / expand user stories		x	
Realization/configuration with unittest		x	
Regression- and functional-test		x	
Integrationtest		x	
Deployen		x	
Support Acceptancetest		x	
Preparing and Perform Acceptancetest (Information Systems Management)	x		
Preparing and Perform Acceptancetest (User Organisation)			x
Idle Time Demand Side	x		
Idle Time as a Result of Computer Malfunction			x
Chain/projectmanagement	x	x	
Coördination Activities	x	x	
Implementation			x
Implementation (new) software userorganisation			x
Events for Process/Productimprovement	x	x	

APPENDIX – FPA GLOSSARY

Target size in FP based early phase FPA (FPAi)

The total of estimated functions per (sub)requirement, multiplied by 5 (FP). This applies only to the *transactions*; the *logical files* are not directly included, but *indirectly* via this factor of 5 FP. The NESMA method prescribes to estimate the minimal, expected and maximal number of estimated functions per (sub)requirement.

Autonomous growth *(organic growth)*

The increase in application size (number of function points) that originates from the uncovering of functionality as the specifications are analyzed in more detail. This is *implicit* user requested functionality that was not counted originally but should have been. See also: 'Scope creep'.

Scope creep

Increase of the application size during development as a result of *additional* functionality requested by the user. These are extra user requirements that should be counted as additional work. See also 'Autonomous growth'.

Rework

When a function as part of one specific feature is changed after delivery, yet not due to ‘scope creep’, this effort is considered ‘rework’. Changing a function following an issue (finding/defect) is also considered rework. See also: 'Scope creep'.

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APPENDIX – SOURCES

Sources

- Sizing - Seabed Observatory Control System_v1.0.xlsx - **example (selection) shown in slide #4**
- Estimate FPAi Seabed Robot Observatory Ship V.01.xlsx - **example shown in slide #6**
- Seabed Robot Observatory Ship - Requirements v5.pdf
- 2021 Practitioners Challenge Instructions - final.pdf

For this challenge we have used several templates, data and references from the Dutch Tax Office.

- List of DTO project results 2019-2021 (for the sanity check on effort, team size, number of teams) - **graph shown in slide #7**
- List of DTO application sizes 2010-2021 (for the sanity check on size)
- Hours per FP references DTO (for the Java reference, audited by Gartner) **- mentioned throughout the slides**
- Template FPAi (DTO)
- Template Estimate To Complete (DTO)
- NESMA N20_FPA_in_Early_Phases_(v2.0)