



Improving sustainability of Fish Aquaculture by control of malformation

From data to performance:

What can we learn from production data ?

The FineFish development of a tool for data mining and benchmarking Francesca Margiotta FEAP & Philippe Mack PEPITe





Bergen March 2009









Some background information...

The FineFish project aims to generate new practical knowledge on how to reduce the incidence of malformations in the major species used in European Aquaculture and apply this to the professional sector.

LACK of HATCHERY PERFORMANCE DATA

- How to measure technical and economic performance improvements?
- How to understand the underlying causes?
- How to transform this knowledge in best available practices?





One of objective of FineFish is the systematic collection of hatchery data and the analysis of these data with regard to incidence of malformation in hatcheries and commercial fish farms.

Help aquaculture operators in:
 Benchmarking their activities
 Being able to share data and knowledge
 Implement good practices





A Professional Approach is necessary!

- The data collection for benchmarking started by using a relatively simple Excel worksheets for follow-up and reporting.
- Software exists on the market that can recover and analyse production parameters (Novafish/ Superior Systems/ Fishtalk...) but each SME has a different programme adapted to its reality.



> Need of a common platform for all fish producers







Benefits of a common platform

- Having all data available stored in a single, standardized database will enable the comparison and benchmarking of data on production methodologies applied in the different hatcheries involved in the project.
- The following analysis of the data will enable the extraction of useful information and the improvement of current practices.
- The main goal is to identify key factors affecting production performance and the underlying causes of malformations onset.





PEPITE is a company specialized in **DATA MINING**

Main objectives of PEPITe's work

- develop a common database with an accessible, user friendly web interface for the SME partners
- apply data mining techniques to analyse production data
- apply predictive analysis

(connects data to **effective action** by drawing reliable conclusions about current conditions and future events) to improve production performance.







Data mining

- Is "the science of extracting implicit, previously unknown, and useful information from large data sets or databases"
- Or "the **process of discovering meaningful new correlations, patterns and trends** by sifting through large amounts of data stored in repositories, using pattern recognition technologies as well as statistical and mathematical techniques."

Methodology that aims to extract information from large databases, that is:

- Previously unknown
- Valid
- Comprehensible
- Useful

Wide range of tools

 Visualization, statistics, automatic learning from prediction models (forecasting models)





Benefits of better data usage

Understand the past

- Explain key performance indicator (malformation rate, growth rate,...) behaviour
- Transform implicit knowledge into rules
- Identify past conditions that improved production performance (in order to be able to reproduce it)
- Identify process weaknesses and root causes of failure

Address the present

- Take a decision based on reliable KPI
- Track process drifts (early detection of abnormal fluctuation in malformation rate, production performance)

Foresee the future

- Predict process states or KPI values ideally "predictive model of malformation rate"
- Predict maintenance actions predict actions to improve performance





Benefits of better data usage

Understand the past 📥 Address the present 📥 Foresee the future







Key Performance Indicators



In a broad sense, a key performance indicator (KPI) is a tool for business improvement, focusing upon significant measurements within a company that indicate success or failure of that particular business.

Following a consultation with farm managers and technicians the main KPI identified in the scope of the FineFish project is **MALFORMATION RATE x BATCH**

A KPI is a composite of the following:

- a measure of the performance of specific goals that a business has defined to be of critical importance to their success → malformation rate x batch
- □ a target (or targets) → set of a threshold value > than 10 %
- an action resulting from that measurement → corrective actions following the overtaking of the set threshold value





The "making" of the database

> TECHNICAL EXPERTISE WAS REQUIRED TO BUILD UP THE SYSTEM

- After several days of observation and interviews in a test hatchery and detailed analysis of different hatchery structures and procedures, including interactions of the various areas (water area, tanks, lighting area...), LOGICAL RELATIONSHIPS between these components were used to **design a data model to be implemented in a RDBMS.**
- A relational database is a database management system that is based on a relational model data is stored in form of tables and the relationship among the data is also stored in form of tables.



The test hatchery: La Ferme Marine de Douhet – France







The making of the database

- Analyse and model the hatchery production process
 - Understand the farm structure and the production process
 - Audit the data collection on site
 - Discuss with sector experts the database business logic

Design a data model and implement it in a data warehouse

 A data warehouse is a repository of an organization's electronically stored data. Data warehouses are designed to facilitate reporting and analysis





Data model of a farm and the production process



The model is based on the test farm "FMD" but is adapted to all farms, 'cause it is a model of the real world and of relationships that are in the real world.





Configure

Access to the database is made through a **WEB BASED INTERFACE** where a "user" can design, define and update a hatchery's configuration.

You can import data on:

- Generic farm information
- □ Farm production (which sp.)
- □ Farm areas (water, lighting)
- Tanks
- Cycles

Food

000		Finefish Web-based Interface		\bigcirc
	http://local	host:8888/finefish/farm/	😭 💌 - 💽 🕻 Google	Q
S Finefish Web-based In	terface 🕲			Ę
HOMEPAGE FARM	MONITORING TR/	ACKING BENCHMARKING Welcome demo (log o	HELP ut) <u>Control contor</u>	
General informations	Productions - Building / Zo	nes · Water parameters · Lighting p	parameters Tanks Cycles Parameters	Food
GENERAL INFORMATIO	NS			
Company name				
Demo Farm				
Acronym				
DF				
Address				
4010				
Postal code				
City				
Country				
Email address				
b.stevens@pepit	e.be			
Submit				
<u>Go to top ^</u>				
Terminé				11





Monitoring

Once the configuration of your farm is complete...

You can import data on:

Monitoring of single tanks (pH, T, [O₂], salinity...)







Monitoring

You can import data on:

Malformations x batch

00)			Fin	efish Web-based	i Interface
HOMEPAGI	E FARM	MONITORING	TRACKING	BENCHMARKING	HELP	
						Welcome demo (log out) Control center
 Tanks () 	with Excel) Def	ormities				
DEFOR	AITIES					
BATCH	(GRAME SIZ	E)			ACTIONS (CREATE NEW)
Sup (0 g	ram size)				Modify	Delete
Batch						
- Control	Sup 🛟					
Fish gram	size					
Operculur	0 n Shortened					
	1					
Operculur	n Twisted					
Operador	2 Mission left					
opercolo	3					
Operculur	n Missing right					
Jane Lawrence	4					
Jaw Lowe	s jaw					
Jaw Uppe	er jaw					
	6					
Jaw Cros	7					
Fins Dors	al fin					
	8					
Fins Caud	al fin					
Vertebral	Lordosis					
	10					
Vertebral	Haemal lordosis					
Juveniles	with two or more	deformities				
	12					
Total nun	ther of fish evaluation	ated				
	13					
	Submit					
						4
Go to top ^						





Tracking

You can enter data about broodstocks and batches and set their position (in tanks) and their cycle parameters (nursery, larval rearing...)

You can import data on:

- Broodstocks
- Batches
- Broodstocks' movements
- Batches' movements
- Broodstocks' food
- Batches' food

Fin	efish Web-based Ir	terface
C X A (http://localhost:8)	888/finefish/batche	s 😭 🗸 Google Q
🛞 Finefish Web-based Interface 🔹		
HOMEPAGE FARM MONITORING TRACKIN	IG BENCHMA	RKING HELP
· · · · · · · · · · · · · · · · · · ·	Welcome dem	o(log_out) Control center
Development Development Development		
Broodstocks, Batches, Broodstocks movements, Bat	<u>ches movements</u>	Batches Tood - Broodstocks Tood
BATCHES NOT DELIVERED		
NAME	ACTIONS • <u>CREATE N</u> • <u>CREATE N</u>	EW FROM A BROODSTOCK EW FROM (A) BATCH(ES)
C1	Modify	Marked as delivered or deleted
C7	Modify	Marked as delivered or deleted
B107	Modify	Marked as delivered or deleted
B110	Modify	Marked as delivered or deleted
B206	Modify	Marked as delivered or deleted
B206	Modify	Marked as delivered or deleted
Sup	Modify	Marked as delivered or deleted
Moyen	Modify	Marked as delivered or deleted
Inf	Modify	Marked as delivered or deleted
BATCHES DELIVERED OR DELETED		
NAME	ACTIONS	
erminé	A. d 197	**





View and download data

Farm structure

26

Benchmarking

	Safari	Fichier	Édition	Présentation	Historique	Signets	Fenêtre	Aide	6
00	0						F	inefish Web	-based Interface
a)	10	王岡	😫 http://	doc.pepite.be/fir	refish/benchma	arking/farm			
ш	Bunjuar -	Geogle Ap	pps Apple	(65) - cBay tra	nce Yahoot I	Informations	(1634)+	Svenska v	
tindic	sh Web i be	oved Interfac							
HOMES	PAGE	FARM M	онтолия	TRACKING	DENDIMARKING	HELP			



You can benchmark data on:

Given Structure

F 4 8 4											
TANKHANG	TANKCREATIONDATE	TANKCAPACITY	TARKSHAFE	TANKCOLOR	LIGHTINGNAME	LIGHTINGTYPE	LIGHTINGPHOTOPCRIOD	LIGHTINGSOURCE	ARCANANC	WATERSOURCE	WATERSY
DH07	2007-01-01 00:00:00	10806	Grouian	Gmy	LarvalRearing	Atiliai	Dark	Tabe	Larvel/Rearing	Ges veter	Devireugh
KITE	2807 01 01 00 00 00	10808	Grade	Coup	LosoPostig	Addition	nes	Tabe	Level Housing	See well in	Producip
0000	2007-01-01 00:00:00	10000	Grouier	GNY	LawalRearing	Adital	Dark	Tabe	LarvalRearing	Sea vatar	Flow trough
1208	2807 01 01 00 00 00	10808	Grade	Coup	LosoPlastig	Addition	nes	tabe	Loss (Hearing)	See well in	Producip
DOI	2007-01-01 00:00:00	10000	Grouier	Diack	Dropolationik	Adital	Other	Tabe	Dropdatock	Sea vatar	Reviseuph
628	202 01 01 00 00 00	10808	Grade	March .	Rendshok	Addition	10 M P	tabe	Rechtlich	See well in	Producip
0107	2007-01-01 00:00:00	125	Conical	White	Harchingtonk	Addical	Dark	None	Incubation	Sea vatar	Devireigh
c	202 01 01 00 00 00		Control	Walo	Hat of any family	Addicat	nes	Novo	Incluios	See volum	Rectorph
Greekreen	2008-09-01 00:00:00	10toms	Cylinchoconical	Dark Green	Dropdatock	Adital	Other	Tabe	Dropdatock	Sea vatar	Devireigh
02scobroam	2807 01 01 00 00 00	18kow	Ophotosoical	Dark Claure	Rendshok	Addition	0.65	Tabe	Readshot	See well in	Proclample
6 Section 1	2006-01-02-000-00	States.	O. Secondesi	Dark Gran	Encoderace 2	an Ind	(char	Tex	Facedaria 2	Can and an	Courses.





Benchmarking

You can benchmark data on:

Monitoring

00			resentation	the state of the s	iets.	- Fen	etre Aude		0 10 6	<u>9 9 </u>	<u>ଅ</u>	0.	10.	a rectan	roose 🚺 me	r. 11:45 - S	~
							Finefish We	b-based Interfax	oc.								
<u>►</u> C	E 🖾 🧯	ð http://do	c.pepite.be/fin	efish/benchmarking/	mon	ritoring							• • Q	 Google 			_
Engines Groupe Apps Apple 051s cBay transe Tabout Informations (1634) scenakas																	
wind Web lased Interface																	
MEPAGE	FARM MON	TORING	TRACKING	BONGHMARNING H	oup.										a		
												bloene den	a (jag ost)	Gastral o			
Any and covoland cats																	
as 🖞																	
	ritorios data																
	and gass																
	COMPANY A COMP																
		ALC: LEVE															
	_																
ADBITGRING IATA																	
ADEITGRING 14TA							CHEATCAL					DCLTA	DELTA	DELTA	EVENING	NORMING	
ADDITORING 14TA ARMID	TANENAUX	TANKID	TINKSTAAP	MONITONINGDATE		4.5.4	CREATCAL TERATORIT (PECHUCT)	COANDLATIVE	CYCLE	DATE	DAY	DELTA G2 (MAX- AIN)	DELTA DC IAAK- MINI	DELTA PET (MAX- AIN)	FVERING TEAPERATURE (GC)	NORMING TEAPPEATURE (CC)	
	TANE NAME 101	таякі р 24	THERE	NCHI TORI NODA TR		40 4	ERRAIGAL TERATAKAT (PRODUCT)	CUANULATIVE D	6¥61.0	0470 1	DAN 1	DCLTA 02 (WAX: AIN) 0	DELTA DC (AAK- MIN) T	DCLTA PET (WAX- AIN) 0	FVXNING TFAFXEATURF (GC)	NORBING TRAFFATURE (CC) 212	•
666117481944 1474 48910 5	Takekaux Kat Dat	танкі в 201 201	THERETARY THERETARY THERETARY	MCHITOHINDRATH 2017/12/2016/00/06 2017-12-07/06/2010	-	400 1	CHPAICAL TERATARAT (PEGDUCT) C	CHANNEATIVE 0 0	6¥6L# 0	0479 1	54.V 1	0CLTA 02 (WAX- AIH) 0 0	DELTA DC IAAK- WINI I	DCLTA PFT (WAX- AIN) D	PVENING TRAFESTURF (GC)	можним трариватикр (ос) 21.2 19,7	•
ARUID 5	7 2 10 2 10 2 10 2 10 2 10 2 10 2 10 2 1	танків 24 24		MGN112001000419	-	45P 1 1	CREATCAL TERATURAT (PECHLOT)	CHANDLATIVE 0 0 0	CYCL) 0 0	DATH 1 1	DAY 1 2 3	0CLTA 02 (WAX- AIN) 0 0	DELTA OC IMAX- MINI I I I	DCLTA PFT (MAX- AIN) 0 0	PVFEING TEAPFEATURE (GC) 5 1 5	MORNING TRAFFICATURE (GC) 21.7 20.7 20.7	•
алын талина 14т4 алмы р 5 5 5	TANENAUR 101 101 101 101	танків 24 24 24 24	TI MASTANA TI MASTANA TI MASTANA TI MASTANA TI MASTANA TI MASTANA TI MASTANA TI MASTANA	MCHITOHINDEATH 2017 12 2010 Divid 2017-12-07 00:0000 2017-12-07 00:0000 2017-12-09 00:0000	-	409 1 1 1	CHPAICAL TBRATURAT (PEGRUCT)	CHANDLATIVE 0 0 0 0	6¥61.0 0 0 0	DATE 1 1 1	04N 1 2 3	0CLTA 02 (WAX: AIN) 0 0 0 0	DELTA DC IMAR- MIN I I I I I I I I	DCLTA PFT (MAX: AIR) 0 0 0 0	FYREING TRAFFEATURE (dc) 5 1 5 1	9036180 19492811089 (00) 212 19,7 202 224	•
ARMID ARMID 5 5	14 FE NA 44 1671 501 601 601 601 601	TANKID 24 24 24 24 24 24 24	THERE ARE THERE ARE THE AND ARE THE AREA THE AREA T	MCHIT2HINDOUTP 2007-02-07 00 0000 2007-02-07 00 0000 2007-02-09 00 0000 2007-02-09 00 0000 2007-12-09 00 0000 2007-12-09 00 0000	-	4109 1 1 1 1 1 1	TREATONET (PECHACE) 5 1 5 1 5 1 1 5 1 1 5	CHANDLATIVE 0 0 0 0 0 0	CYCL# 0 0 0 0 0	D479 1 1 1 1 1 1	Dav 1 2 3 4 8	0CLTA 02 (MAX- AIN) 0 0 0 0	DELTA OC IMAN- UNI I I I I I I I I I I I	DCLTA PFT (MAX- AIN) 0 0 0 0 0	PVXEING TPAPPEATURE (dc) 5 1 5 1 5 1 5	9036180 19439851089 (00) 212 19,7 202 22,4 211	•
ARMID ARMID 5 6 5 5	R21 D24 R21 D24 R21 D24 R21 D24 R21	танків 24 24 24 24 24 24 24 24	T19675000 119675000 119675000 119675000 119605200 119605200 119605500	MCHITSHINGGATP 2007-1347 00 0000 2007-1347 00 0000 2007-1342 00 0000 2007-1342 00 0000 2007-1342 00 0000 2007-1342 00 0000	-	*** * 1 * 1 *	THRAICAL TRACTURET (PRODUCT) 2 3 5 1 5 5 1 5 5 1 5 5 1 5 1	COANDLATIVE 0 0 0 0 0 0 0	CYCL 0 0 0 0 0 0 0	DATP 1 1 1 1 1 1 1 1 1 1	DAN 1 2 3 4 8 5	DCLTA G2 (WAX: AIN) 0 0 0 0 0 0	DELTA OC IMAR- MINI I I I I I I I I I	DELTA PFT (MAX- AIR) 0 0 0 0 0 0 0 0 0	PVANDAG TPARPATURP 0 0 0 0 0 0 0 0 0	мольние традяеватике (ос.) 21.7 19.7 20.7 22.4 21.1 21.3	•
Contracting A Nut D 0 5 5 6 5 5 6	Take kauk R01 D01 R01 D01 R01 D01 R01 D01 R01 D01 R01	TANKIB 24 24 24 24 24 24 24 24	ТІ ВИКТАЛЯ Пільськи 119270000 119270000 1192002000 1192002000 1192002000 1192002000 1192002000	MCHI TOHI MGA TO NICH ZOHI GUNG DOT-1547 00 0000 NICH ZOHI GUNG DOT-1547 00 0000 NICH ZOHI GUNG DOT-1549 00 0000 NICH ZOHI GUNG DOT-1549 00 0000 NICH ZOHI GUNG DOT-1549 00 0000 NICH ZOHI GUNG DOT-1541 00 0000 NICH ZOHI GUNG	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	40P	EMMAICAL TRATUKAT INATUKAT I I I I I I I I I I I I I I I I I I I	CHANDLATTYY 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0	DATP 1 1 1 1 1 1 1 1 1	045 1 2 3 4 8 5 2 5 2	0 0 0 0 0 0 0 0 0 0 0 0 0 0	DELTA DC IAAK- WI NI S S S S S S S S	DCLTA PFT (MAX- AIR) 0 0 0 0 0 0 0 0	PYXEING TRAFFILTURF 1 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2	наяния трарятьтике (ас) 2017 907 2017 2017 2017 2015 2018	•
Del I I G RING ATA ARUI D 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	Table halls R01 D01 R01 D01 R01 D01 R01 D01 R01 D01 R01 D01 R01	TARKIP 201 201 201 201 201 201 201 201 201 201	Т I ИКСТААР Поветовой 1000000 10000000 10000000 10000000 10000000 10000000 10000000 10000000 10000000 10000000 10000000 10000000 1000000 1000000 1000000 1000000 10000 100000 10000 10000 10000 10000 10000 10000 100000 1	Michi Tahi Maka Tahi Niki 12 Michi Biling Niki 12 Michi Biling Ditti 12 Michi Biling	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	4114 1 1 1 1 1 1 1 1 1 1 1	EMPAICAL TRATUKT INATUKT I I I I I I I I I I I I I I I I I I I	CIANULATIVA 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	CYCL.) 0 0 0 0 0 0 0 0 0 0 0	DATP 1 1 1 1 1 1 1 1 1 1 1 1 1	Dax 1 2 3 4 8 5 2 2 2 2	02LTA (WAX- (WAX- 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	DELTA OC IMAR- MINI I I I I I I I I I I I I I I I I I	DCLTA PFT (WAX- WIR) 0 0 0 0 0 0 0 0 0 0 0 0	P790140 TAAPPEATURE (CC) 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	UCANING THEFT AT THE (CC) 21.7 20.7 22.4 21.1 21.5 20.6 20.1	•
Contraction A RMI D 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0 1 1 1 1 1 1 1 1 1 1 1 1 1	Takekawi P21 D21 P31 D21 P31 D21 P31 D21 P31 D21 P31	TLAKID 201 201 201 201 201 201 201 201 201 201	TI MASTAAP 1108/2008/ 1108/2008 1108/2008 1108/2008 1108/2008 1108/2008 1108/2008 1108/2008 1108/2008	MIGHT TOOL NOD-ATP PREF 12 PALES BUILD 2007-12-07 00 2000 PREF 12 PALES BUILD 2007-12-09 00 2000 PREF 12 PALES BUILD 2002-09-22 00 2000 PREF 12 PALES BUILD		4 11 P	E MARICAL TRACTUCT, TRACTUCT, T 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	CIANULATIVA 0 0 0 0 0 0 0 0 0 0 0 0	CYCL.) 0 0 0 0 0 0 0 0 0 0 0 0 0	DATP 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Dan 1 2 3 4 8 5 2 2 2 5 8 5 8 8	DCLTA GE (MAX: AIH) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	DELTA OCAR- URAR-	DCLTA PFT PFT 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Pyyeles TAAPPEATURE (CC) 7 7 8 8 9 8 9 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	40.48.140 11.49.84.11484 12.5 14.7 14.	•
ANUID ANUID 0 5 6 5 6 5 6 5 6 5 6 5 6 5 6 5 6 5 6 5 6 5 6 5 6 5 6 5 6 6 6 6 6 6 6 6 7 7 8 8 8 7 8 7 8 7 8 7 8 8 8 7 8 8 8 8 8 8 8 8 8 8 8 8 8	74888484 P31 D21 P31 D21 P31 D21 P31 D21 P31 D21 P31 D21 P31 D21 P31 D21 P31 D21 P31 P31 P31 P31 P31 P31 P31 P3	TLAKID 24 24 24 24 24 24 24 24 24 24	TIMATAAA 110620000 110620000 11060000 11060000 11060000 11060000 11060000 11060000 11060000 11060000 11060000	MICHI TODI NODATP NICHI TODI NODATP 2007-0247 02 2000 NICHI 2000 0000 NICHI 10000 NICHI 2000 0000 NICHI 10000 NICHI 10000 NICHI 10000 NICHI 10000 NICHI 10000 NICHI 10000 NICHI 100000 NICHI 100000 NICHI 100000 NICHI 100000 NICHI 1000000 NICHI 1000000 NICHI 1000000000000000000000000000000000000			EMPAILON TYPESTUCTY PRESSUCTY 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	CIANULATIVA 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	CYCL.	PATP 1 1 1 1 1 1 1 1 1 1 1 1 1	D43 1 2 3 4 8 5 7 8 8 8 8 8 10	DCLTA OS (WAX: AIH) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	DELTA DC DC DC DC DC DC DC DC DC DC DC DC DC	DCLTA PFT PFT AIR) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Pyysiad 144994311049 14499431049 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	MORE 140 TAPPES THREE 196.7 20.7 20.7 20.8 20.1 20.1 20.1 20.1 20.1 20.1 20.1 20.1	•
5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	Takekawi P31 D21 P31 D31 P31	TLINK P 20 20 20 20 20 20 20 20 20 20 20 20 20	TIMATAAA 11000000 11000000 11000000 11000000 11000000	MICHI TOHI NODATE NICHI TOHI NODATE 2007-12-20100 2007-12-20100 2007-12-20100 2007-12-20100 2007-12-20100 2007-12-20100 2007-12-20100 2000-01-20100 2000-01-20100 2000-01-201000 2000-01-201000 2000-01-2010000 2000-01-2010000 2000-01-20100000 2000-01-20100000 2000-01-20100000 2000-01-20100000 2000-01-201000000 2000-01-2010000000000000000000000000000		4.00P	EMMAICAL TIRASTUCT INTEGRACE C C C C C C C C C C C C C C C C C C	CIANULATIVA 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	CYCLP 0 0 0 0 0 0 0 0 0 0 0 0 0	DATP 1 1 1 1 1 1 1 1 1 1 1 1 1	D43 1 2 3 4 8 5 2 5 5 8 6 7 10 10 11	9CLTA G2 (WAX- Alit) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	BELTA OC NIAN- UIAI I I I I I I I I I I I I I I I I I	DCLTA PFT (MAX- AIR) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	P778140 17889821189 1060 / 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	MORINING 1940 21.7 98.7 28.4 21.1 28.5 20.6 20.1 20.1 20.1 20.1 20.3 20.4	•
ARUTA()44 ARUT 5 6 5 6 5 6 5 6 5 6 5 6 5 6 5 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	Falle Faller F01 D01 F01	TARKID 20 20 20 20 20 20 20 20 20 20 20 20 20	TI MASTAAA 1118-008-0 11967-0000 1197-0000 1198-02200 1198-022000 1198-022000 1198-022000 1198-022000 1198-02000 1198-02000 1198-02000 1198-02000	MCHI TOHI NODATE NICY 12 XI IG DING 2007-13-27 00 2000 2007-13-29 00 2000 2007-13-29 00 2000 2007-13-29 00 2000 2007-13-21 00 2000 2007-13-21 00 2000 2007-13-21 00 2000 2000-04-20 0000 2000-04-20 0000 2000-04-00 0000 2000-04-00 0000 2000-04-00 0000 2000-04-00 0000 2000-04-00 0000		4.11P	EMMAICAL Tradition President 2 2 3 3 4 3 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	CIANULATIVA 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	CYCL.) 0 0 0 0 0 0 0 0 0 0 0 0 0	DATP 1 1 1 1 1 1 1 1 1	D45 1 2 3 4 8 5 2 7 8 8 8 10 11 12	0 CLTA C2 (WAX- Alit) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	DELTA 1448- 1448- 15 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	DCLTA PFT (MAX- AIR) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	PVVEIHO TAMPARTIKA IGC) S C C C C C C C C C C C C C C C C C C	MCREING 1960 21.7 1967 26.7 26.7 26.7 26.4 27.1 26.4 27.5 26.4 27.1 26.4 27.1 26.4 27.1 26.4 27.1 26.4 27.1 26.4 27.1 26.4 27.1 26.4 27.1 26.4 27.1 26.4 27.1 26.4 27.1 26.4 27.1 26.4 27.1 27.1 27.1 27.1 27.1 27.1 27.1 27.1 27.1 27.1 27.1 27.1 27.1 27.1	
ANU D ANU D ANU D 5 5 5 5 5 5 5 5 5 5 5 5 5	Take halls R01 D01 R01	TANKIP 24	TINKSTARF 11000000 1100000 11000000 11000000 11000000 11000000 11000000 11000000 11000000 11000000 11000000 110000000 110000000 110000000 110000000 110000000 110000000 110000000 110000000 110000000 1100000000	MCHI TEH HERATI NICY 12 Xi LG BUIG 2007-12-27 October 2002-07-22 October 2002-07-22 October 2002-07-22 October 2002-07-24 October 2002-07-24 October 2002-07-24 October 2002-07-26 October			EMPAICAL Traditional President S S S S S S S S S S S S S S S S S S S	COANDLATIVY 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	CYCL) 0 0 0 0 0 0 0 0 0 0 0 0 0	DATP	D41 2 3 4 8 5 7 8 8 9 10 11 11 12 12	0 2 4 4 4 4 4 4 5 6 6 6 6 6 6 6 7 6 7 6 7 7 7 7 7 7 7 7	DELTA 144.8- 144.8- 15 15 15 15 15 15 15 15 15 15 15 15 15	0 5 5 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	PVVkIHd TAAPPAATUKP Iddo; 2 2 3 3 3 4 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	NORMETRIC 1917 1937 1937 2017 1937 2017 2017 2017 2017 2017 2018 2014 2015 2016 2017 2018 2019 2010 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2010 2011 2012 2014 2015 2016 2017 2018 2019 2010 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2010	

...and actually all available data!





Output are tables containing data in an organized structure

- B	OpenOffice.or	g File Edit View	Insert Format	Tools Data	Window Help	0 🕐 🛞	0040	📕 🛜 🚯 🖃 (100%)	📕 mer. 11:56	* Q.			
0	90				farm.csv – OpenO	ffice.org Calc							
2) • 🙋 🖬 🖙 📝	🗈 🖾 🖄 💥 💥 🎽	(🖫 🛍 - 🎸 🤫	• 🖓 – 🌚 💱 🖥	ւ 🖞 🕖 👬 🖉	🚔 🗟 🔍 👩 🔒							
	Arial	💌 7 💌 B	1 U	🗎 🕹 %	8 2 X 🗧	E L · <u>M</u> · <u>A</u> · .							
89	89 ▼ <i>3 x</i> = [01/01/2007 00:00:00]												
	A	В	c	D	E	F	c	н	1	6			
1	tankName	tankCreationDate	tankCapacity	tankShape	tankColor	lightingName	lightingType	lightingPhotoPeriod	lightingSource	area			
2	B107	01/01/07 00:00	10000	Circular	Grey	LarvalRearing	Artifical	Dark	Tube	Lan			
- 3	B110	01/01/07 00:00	10000	Circular	Grey	LarvalRearing	Artifical	Dark	Tube	Larv			
4	B206	01/01/07 00:00	10000	Circular	Grey	LarvalRearing	Artifical	Dark	Tube	Lan			
5	B208	01/01/07 00:00	10000	Circular	Grey	LarvalRearing	Artifical	Dark	Tube	Larv			
G	B21	01/01/07 00:00	10000	Circular	Black	Broodstock	Artifical	Other	Tube	Bro:			
7	823	01/01/07 00:00	10000	Circular	Black	Broodstock	Artifical	Other	Tube	Broc			
в	C107	01/01/07 00:00	125	Conical	White	Hatchingtank	Artifical	Dark	None	Incu			
9	C110	01/01/07 00:00	125	Conical	White	Hatchingtank	Artifical	Dark	None	Incu			
10	G1seabream	01/09/08 00:00	18tons	Cylindroconics	L Dark Green	Broodstock	Artifical	Other	Tube	Bro:			
11	G2seabream	01/01/07 00:00	18tone	Cylindroconica	Dark Green	Broodstock	Artifical	Other	Tube	Bro:			
12	G3seabass	05/11/08 00:00	18tone	Cylindroconics	L Dark Green	Broodstock	Artifical	Other	Tube	Bro:			
13	G4seabream	05/11/08 00:00	18tone	Cylindroconica	Dark Green	Broodstock	Artifical	Other	Tube	Brox			
14	G5seabream	05/11/08 00:00	18tone	Cylindroconics	L Dark Green	Broodstock	Artifical	Other	Tube	Bro:			
15	G6seabass	05/11/08 00:00	18tone	Cylindroconica	Dark Green	Broodstock	Artifical	Other	Tube	Bro:			
16	G7seabream	05/11/08 00:00	18tone	Cylindroconics	L Dark Green	Broodstock	Artifical	Other	Tube	Bro:			
17	G8seabream	05/11/08 00:00	18tone	Cylindroconica	Dark Green	Broodstock	Artifical	Other	Tube	Bro:			
18	G9seabass	05/11/08 00:00	18tone	Cylindroconics	L Dark Green	Broodstock	Artifical	Other	Tube	Bro:			
19	110	18/01/08 00:00	1950	Cylindroconica	Dark Green	Hatchingtank	Artifical	Dark	None	Hate			
20	l1bis	29/02/08 00:00	1950	Cylindroconics	I Dark Green	Hatchingtank	Artifical	Dark	None	Hat			
21	12	14/05/08 00:00	1950	Cylindroconica	Black	Hatchingtank	Artifical	Dark	None	Hate			
22	12	05/11/08 00:00	1950	Cylindroconics	g Black	Hatchingtank	Artifical	Dark	None	Hat			
23	13	11/11/07 00:00	1950	Cylindroconica	l Black	Hatchingtank	Artifical	Dark	None	Hate			
24	13	05/11/08 00:00	1950	Cylindroconics	g Black	Hatchingtank	Artifical	Dark	None	Hat			
25	InfTank	01/01/07 00:00	20000	Circular	Grey	Weaningtank	Artifical	Other	Tube	Nun 🗸			
.26	Marais Sheet1	01/01/07 00:00	10000000	Conical	White	Broodstock	Artifical	Other	Tube	Cut T			
Shee	e1/1		2efault		1575	5 810 *		Sum=01/01/07 (00:00	. 1997			





Depending on what information farmers want to extract from the database queries can be applied.

Queries are precise requests for **information retrieval** within a database and information system.

Ex. I want to see all fish species produced in the farms in the database!

name	specie
Ferme marine du douhet	Sea bream
Viviers de france	Trout
A very big farm	Salmon
A very big farm	Sea bream
A very big farm	Trout

Purely as a technical indication, PEPITe used this query to create the result: SELECT farms.name, productions.specie

FROM farms

LEFT JOIN farms_productions ON farms.id = farms_productions.id_farm

LEFT JOIN productions ON farms_productions.id_production = productions.id;





QUERYS

In the same way, through a query we can retrieve batch paths in the farm and obtain a table like this one:

identifier	tank_departure	tank_destination	cycle_from	cycle_to
batch one	C1	B110	Incubation	Larval rearing
batch two	C7	B107	Incubation	Larval rearing





Data analysis - PEPITo A DATA MINING TOOL



The result of a query is a table, a CSV file that can be easily converted in an Excel sheet and uploaded in the analitical software PEPITo for further analysis.





Data analysis

to be performed with the SOFTWARE PEPITo

Data validation and filtering

Data transformation: FFT, sampling,...

Data visualisation: distribution plots, scatter plots, temporal curves,...

Statistical analysis: analysis of variance, correlations analysis,...

Predictive analysis: neural networks, decision trees, association rules,...









Data analysis - PEPITo PREDICTIVE AND ROOT CAUSE ANALYSIS

Once enough data will be stored in the system, we will be able to apply predictive analysis tools (like decisions trees models) to detect root causes of malformation rate.

Possible analysis:

detect in a farm the parameters explaining the malformation rate drift between two production cycles (in this case conclusion would probably be specific to the farm)

detect in the whole set of farm recorded in the database why malformation rate is higher in some farms' production (in this case we can expect that the conclusion would be broader, and that the improvements actions could be applied to every farm)







PEPITe & FEAP working with Fish Farms

VALIDATING DATA MODEL & COLLECTION PROCESS

5 hatcheries have configured their structural inputs and are registering production cycle data (in France, Italy, Spain, Norway and Israel).

PEPITe and FEAP are working in synergy with these farms:

 \geq Giving individual support and training to upload data and perform analysis.

 \succ Using the experience and knowledge of their technical and scientific staff so as to improve the system

Through farms' feedback it will be possible to:

Improve the web interface and make it more user-friendly and responsive to farmer's necessities

Identify possible bugs in the database and correct these in order to enable and facilitate a correct and easy input of data

Modify the database and the data organization in a way to enable the creation of specific queries to be analysed through the data mining tool.





FEEDBACK from HATCHERIES

Some feedback on queries:

- Panittica pugliese SpA Italy (Sea bass and Sea bream):
- "we want to be able to keep track of parameters such as T, pH, salinity, food quality and quantity (fed to fish larvae) per tank in time."
- Bolaks AS Norway (salmon):
- "we want to be able to keep track of different light regimes in tanks in time"
- "we want to keep track in time of the different treatments reserved to fish in tanks."
- These are requests that can easily be achieved through the database and the data mining software!





APPLICATIONS

An example:

- THE DATABASE RECORDS ALL MOVEMENTS OF FISH FROM ONE TANK TO ANOTHER and THE DIFFERENT CONDITIONS IN EACH TANK VARYING IN TIME.
 - FOR EVERY SINGLE BATCH OF FISH PRODUCED BY THE HATCHERY IT IS POSSIBLE TO EXTRACT INFORMATION FROM HISTORICAL DATA REGARDING CHANGE in TIME of:
- POSITION (tank id)
- **TREATMENTS (chemical treatment, antibiotics...)**
- MONITORING PARAMETERS (T, pH, light...)
- FOOD (rotifers, algae, different feeds..)

This is very important since these are the variables potentially influencing malformation incidence!





POTENTIAL of THE SYSTEM

- discover unexpected correlations between parameters
- benchmark different farms and point out good practices (BMP)
- verify ad hoc knowledge with historical data in order to early detect abnormal situations
- expand the system to other KPIs (identify new KPI)
- include genetic information in the system
- automate the creation of reports
- automate the import of data in the system collected through other software available on the market