A (new) unified model of custom software costs determination in contracts.

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The discipline and practice for software contracts is not as mature as in other industrial sectors.

No “measurement culture” for software procurement
Houston, we have many problems!

Current software development trends show an increasing relevance of the outsourcing option.

Pure time & material contracts are not preferred anymore by customers.

Software procurement practices and organizations are not mature enough.

Software measurement discipline is overlooked by customers & suppliers.

High # of inadequate SW Contracts:
- Too many Litigations
- Too many Wasted Resources
- Too many Low Quality Systems
Scope identification

- ex novo Development Activities
- extra-ordinary Functional Enhancement Maintenance (FEM)
- Custom Software
- Production cost
- Selling price
- Ordinary Maintenance
- Non Functional Maintenance
- COTS
In 2014 AD, custom software is still valued in the market in the same way as oranges by the greengrocer:

<table>
<thead>
<tr>
<th>Type of orange</th>
<th>Net weight in kg</th>
<th>Price per kg</th>
<th>Any transportation to home or collateral services...</th>
</tr>
</thead>
</table>

Actually, in many custom software acquisitions the ‘collateral services’ component is even not considered ...🙁
Decoding the metaphor...

The most popular “type of orange” corresponds to the technological environment of the custom software followed by the software application type.

The most popular “weight unit” corresponds to IFPUG FP followed by COSMIC FP.

The most articulate and courageous “price engine” is a two-dimensional matrix in which the unitary price depends on two variables.
Is custom software like oranges?

- “Built on demand based on requirements” versus “Standard product with default characteristics”.
- “Many not evident and interdependent quality attributes” versus “Few evident quality attributes”.
- “Each supply is different from other supplies even in the same class” versus “within a specific class (type of oranges) all the supplies are very similar”.

Custom software as a market good.

- Custom software is produced “on demand” based on customer’s requirements.
- Custom software is still a "labor intensive“ product and therefore its development cost is usually strongly correlated to the work to be done to release the required quantities.
- In a “perfect market”, selling prices should be strongly correlated with development costs.
- Two important modifiers are emerging...
  - The reuse of already done components
  - Automatic production technologies
Relations among variables

- Process
- Requirements
- DURATION
- EFFORT
- SIZE (FP)
- STAFF
- COSTS
- Non Functional Requirements

Direct effect
Indirect effect

- Size (FP) affects Process Requirements and Effort.
- Effort affects Staff and Duration.
- Duration affects Size (FP) and Staff.
- Staff affects Costs.
- Costs affect Size (FP) and Non Functional Requirements.
- Effort affects Non Functional Requirements.

- Size (FP) has both direct and indirect effects on Effort.
- Effort has both direct and indirect effects on Staff.
- Staff has both direct and indirect effects on Costs.
- Costs have both direct and indirect effects on Effort.
What kind of measures are available?

Technical vs. Logical
Technical metrics

LOC, number of programs, modules, reports, screens, classes, objects, components, boxes, widgets etc.

technology dependent
FSM (ISO 14143): a real revolution!
Effort = f(\text{Size})

- Extremely variable productivity
- There is a correlation between size and effort
Not all costs are proportional to the FP

It makes no business and technical sense to “spread” the fixed costs of the project or related project components not proportional to FP on the price of the proportional component.

For example: the cost of installing an application does not depend on how big it is in FP but how many times it must be done and in what logistic situations.
Effort derivation

Effort = \( f(FP) \) * \( \Pi PAF_i \) + \( \Sigma NFDE_j \)

- FUR = Functional User Requirements
- NFR = Non-Functional Requirements
- PR = Process Requirements
- PAF = Productivity Adjustment Factors
- NFDE = Non Functional Dependent Effort

\( FUR \approx 55\% \)
\( PR \approx 100\% \)
### From effort to cost

#### Work costs and calendar duration summary

<table>
<thead>
<tr>
<th>Phase / Skill</th>
<th>Project Manager</th>
<th>Analyst</th>
<th>Software Designer</th>
<th>Programmer</th>
<th>Other</th>
<th>Work total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Management</td>
<td>€ 4,744,29</td>
<td>€ 922,50</td>
<td>€ -</td>
<td>€ -</td>
<td>€ -</td>
<td>€ 5,666,79</td>
</tr>
<tr>
<td>Quality control and</td>
<td>€ 1,186,07</td>
<td>€ 2,767,50</td>
<td>€ 658,93</td>
<td>€ -</td>
<td>€ -</td>
<td>€ 4,612,50</td>
</tr>
<tr>
<td>Test</td>
<td>€ 1,186,07</td>
<td>€ 2,767,50</td>
<td>€ 658,93</td>
<td>€ -</td>
<td>€ -</td>
<td>€ 4,612,50</td>
</tr>
<tr>
<td>Functional Design</td>
<td>€ 889,55</td>
<td>€ 9,686,25</td>
<td>€ 2,470,98</td>
<td>€ -</td>
<td>€ -</td>
<td>€ 13,046,79</td>
</tr>
<tr>
<td>Technical Design</td>
<td>€ 296,52</td>
<td>€ 691,88</td>
<td>€ 1,976,79</td>
<td>€ 527,14</td>
<td>€ -</td>
<td>€ 3,492,32</td>
</tr>
<tr>
<td>Software Construction</td>
<td>€ 889,55</td>
<td>€ 1,383,75</td>
<td>€ 1,976,79</td>
<td>€ 5,139,64</td>
<td>€ -</td>
<td>€ 9,389,73</td>
</tr>
<tr>
<td>Final Test</td>
<td>€ 296,52</td>
<td>€ 691,88</td>
<td>€ 988,39</td>
<td>€ 1,317,86</td>
<td>€ -</td>
<td>€ 3,294,64</td>
</tr>
<tr>
<td>Roll out</td>
<td>€ -</td>
<td>€ -</td>
<td>€ -</td>
<td>€ -</td>
<td>€ -</td>
<td>€ -</td>
</tr>
<tr>
<td>Total</td>
<td>€ 8,302,50</td>
<td>€ 16,143,75</td>
<td>€ 8,071,88</td>
<td>€ 6,984,64</td>
<td>€ -</td>
<td>€ 39,502,77</td>
</tr>
</tbody>
</table>
From cost to price

- Margin
- Contingency
- General costs
- Production costs

Price

Years ‘90

Today

- History of previous competitions
- Expectations / information on competitors
- Client ‘s available budget
A model for market valuation of custom software must:

- Help to increase the predictability of the transactional costs
- Help to achieve the fairness of the transactions

... for the delight of customers and suppliers
General agreement between customer and supplier which defines the context in which individual supplies may take place with simplified procedures inheriting the general conditions and tailoring them to specific cases.

- Rules to apply to specific supplies
- Unitary Prices
- Measuring Guidelines
- Etc.
Each project should achieve a local fairness because there is no guarantee to have a “compensating project” in a broad contract. No project loss is accepted in the hope of a future major gain. Do not expect an average behavior at the global level.
The first very common error!

- To have only one (or few) “fixed” or “constant” unitary price for all the initiatives in a broad contract.

- No warranty that, during the specific contract, the projects will be equally distributed around the “average”.

- Compensations tend to happen at the “project level” in any case but... they may be “biased” depending on the power of the contractual parts.
A typical workaround

So... let me see how much this project should cost...

I need a FP count within tomorrow

Hey Boss, the size of the application is 400 FP

Well, using the ISBSG equations, some COCOMO adjustment factors, a little bit of analogy... The cost is €120'000, let’s call the procurement department...

Sorry, Joe but that supplier has signed an agreement with us for a unitary price of €200/FP this year

OK, in order to respect the budget then the required FP size should be: 120'000/200 ....
Oh yes this application must be 600 FP big!
Lack of control

If no control is done on the delivered FP quantities on which the supplier’s invoices are based then there is the eventuality that the contractual price is not the “actual” price used to manage the contract.
What elements are to be considered?

- Scope of the supply
- Software size
- Reuse - Replication
- Software quality
- Technical constraints
- Production factors
- On going Change Request
- Early termination
Scope of the supply

- It does not influence size
- It does influence unitary prices
YES, Function Points!
The Generic Reuse is a mean of interception of reuse of specifications, code documentation and test cases based on the recognition of "functional similarities" between transactions and logical archives.
Component Reuse

ASM01
- Processo elementare
- Processo elementare
- pe0103
- Servizio0101
- Servizio0102

ASM02
- Processo elementare
- Processo elementare
- Servizio0201
- Servizio0202
- Servizio0203

ASM03
- Processo elementare
- Processo elementare
- Servizio0301
- Servizio0302

ASM04
- Processo elementare
- Processo elementare
- Servizio0401

elementary process
service component
Replication

Same functionalities (EI, EO, EQ, ILF, EIF)
Different platforms
Product Quality

ISO 25010
Systems and software quality requirements and evaluation (SQuaRE) product model

- Installability
- Replaceability
- Adaptability
- Functional completeness
- Functional correctness
- Functional appropriateness
- Modularity
- Reusability
- Analyzability
- Modifiability
- Testability
- Time behavior
- Resource utilization
- Capacity
- Confidentiality
- Integrity
- Non-repudiation
- Accountability
- Authenticity
- Co-existence
- Interoperability
- Maturity
- Availability
- Recoverability
- Fault tolerance
- Operability
- User error protection

Maintainability
Portability
Performance efficiency
Usability
Reliability
Technical constraints

Imposed by Customer’s requirements!

Programming Languages

Architecture etc. etc.
Production factors

Knowledge

Experience

32
Only visible factors please!
Unifyed Cost Model

Price = CFM * AUP + \( \sum_{j} NFDP_{j} \)

- Reuse by similarity
- Reuse by component
- Replication
- On going CR

- NUP - Nominal Unitary Price
- PAF from NFR
- PAF from process requirements

CFM = Contractual Functional Measure
AUP = Adjusted Unitary Price
NFDP = Non Functional Dependent Price
PAF = Productivity Adjustment Factor
Simple tender rules

Only one tender discount

Tabella 1 - PERCENTUALE OFFERTA DI SCONTO UNICO APPLICATA ALLE TARIFFE UNITARIE

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Required Volume</th>
<th>Unitary Price</th>
<th>Maximum Value</th>
<th>Offered Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1-A</td>
<td>Functional Dependent Price (FDP)</td>
<td>50'000 FP</td>
<td>250,00 €/FP</td>
<td>12'500'000,00 €</td>
<td>8'750'000,00 €</td>
</tr>
<tr>
<td>C1-B</td>
<td>Non Functional Dependent Price (NFDP)</td>
<td>1'000 PD</td>
<td>350,00 €/PD</td>
<td>350'000,00 €</td>
<td>245'000,00 €</td>
</tr>
</tbody>
</table>

...   ...                                                ...               ...                   ...               ...
general fairness vs. local fairness

\[ y = 0.7407x + 3.9295 \]

\[ R^2 = 0.4244 \]

Price = CFM * AUP + \( \sum_j NFDP_j \)
### Project Price

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>€</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contractual Functional Measurement (CFM)</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Nominal Unitary Price (NUP)</td>
<td></td>
<td>€ -</td>
</tr>
<tr>
<td>Production Model Correction (PMC)</td>
<td></td>
<td>1.00</td>
</tr>
<tr>
<td>NUP General Adjustment Factor (GAF)</td>
<td></td>
<td>1.00</td>
</tr>
<tr>
<td>Adjusted Unitary Price (AUP)</td>
<td></td>
<td>€ -</td>
</tr>
<tr>
<td>Functional Dependent Price (FDP)</td>
<td></td>
<td>€ -</td>
</tr>
<tr>
<td>Non Functional Dependent Price (NFDP)</td>
<td></td>
<td>€ -</td>
</tr>
<tr>
<td>Total Price</td>
<td></td>
<td>€ -</td>
</tr>
</tbody>
</table>

### Professional Mix Unitary Price (PMUP)

<table>
<thead>
<tr>
<th>Non Functional Dependent Factors</th>
<th>Person days</th>
<th>€</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFDF 1</td>
<td>0</td>
<td>€ -</td>
</tr>
<tr>
<td>NFDF ...</td>
<td>0</td>
<td>€ -</td>
</tr>
<tr>
<td>NFDF N</td>
<td>0</td>
<td>€ -</td>
</tr>
</tbody>
</table>

| Non Functional Dependent Price (NFDP)            | 0.00        | € - |

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Simple as a form....
Conclusions

- Software is a complex asset and cannot be acquired by the same rules of a vegetable food.
- The functional measure is a primary driver of cost because it is linked to the needs and the value for the user but needs correctives.
- The corrective actions may impact the size in itself (reuse / replication), the unitary price of the size or may be not proportional to the size.
- A new contractual cost model must take into account all these aspects but merely those visible in the customer-supplier relationship.
- The model requires a local calibration to be adapted to different companies.
Any question?