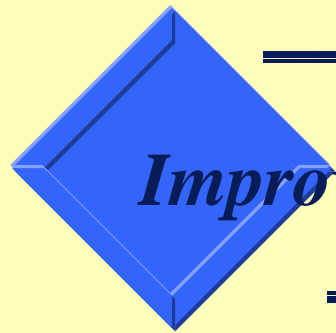


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**IMPROVED EFFORT/DURATION  
PRODUCTIVITY MODEL**  
*some preliminary results*

**Presented by:**  
**Serge Oligny, M.Sc., ass. researcher**  
**Software Engineering Management Lab.**  
**UQAM**



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*Improved effort/duration productivity model*

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# Agenda

**Context**

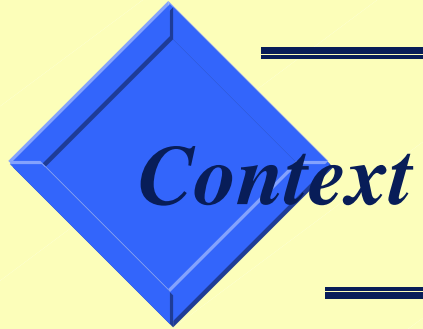
**Analysis conducted on ISBSG data**

**Constructing a model**

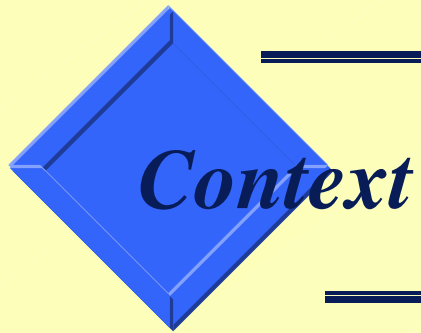
**Comparing results to other models**

**Conclusions**

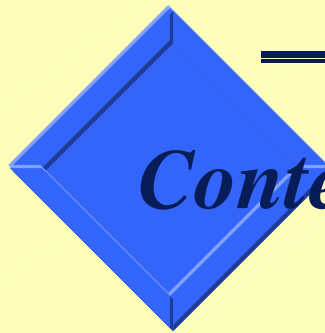
**Further research**



❖ **Perspective: software projects portfolio management**



- ❖ **Perspective: software projects portfolio management**
- ❖ **4 key factors:**
  - **Product size**
  - **Project effort**
  - **Project cost**
  - **Project schedule**

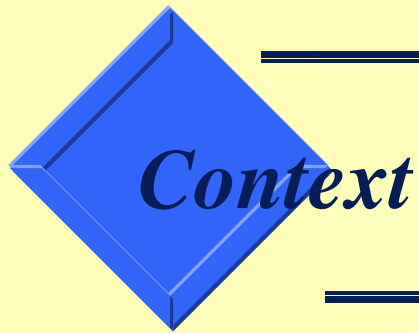


# *Context*

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- ❖ **Perspective: software projects portfolio management**
- ❖ **4 key factors:**
  - **Product size**
  - **Project effort**
  - **Project cost**
  - **Project schedule**
- ❖ **Given adequate and equivalent control over these 4 factors, schedule is usually the most critical one to control**



- ❖ **Perspective: software projects portfolio management**
- ❖ **4 key factors:**
  - **Product size**
  - **Project effort**
  - **Project cost**
  - **Project schedule**
- ❖ **Given adequate and equivalent control over these 4 factors, schedule is usually the most critical one to control**
- ❖ **What's the "ideal" duration for a given level of effort ?**



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## *Analysis conducted on ISBSG data*

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- ❖ **ISBSG release 2 "ladder data" used**
- ❖ **Pick projects showing both effort and duration**
- ❖ **Remove outliers**
- ❖ **Study distribution of both effort and duration**
- ❖ **Build duration model, driven by effort**
- ❖ **Study model's characteristics**
- ❖ **Compare results with known models**
- ❖ **Set basis for further analysis**



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## *Analysis - sample selection*

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- ❖ **Pick projects showing both effort and duration**
  - 136 projects in the database
  - 111 projects show both effort and duration (82%)
- ❖ **Remove outliers**
  - **Effort (expressed in pm, 1 pm = 140 ph)**
    - ◆ avg.: 31,6 pm, std. dev.: 45,0 pm
    - ◆ +/- 3 std. dev. range: 0 to 166,6 pm
  - **Duration**
    - ◆ avg.: 11,0 months, std. dev.: 11,0 months
    - ◆ +/- 3 std. dev. range: 0 to 44,0 months
  - 107 projects fit within both ranges
- ❖ **Retained sample size: 107 projects**

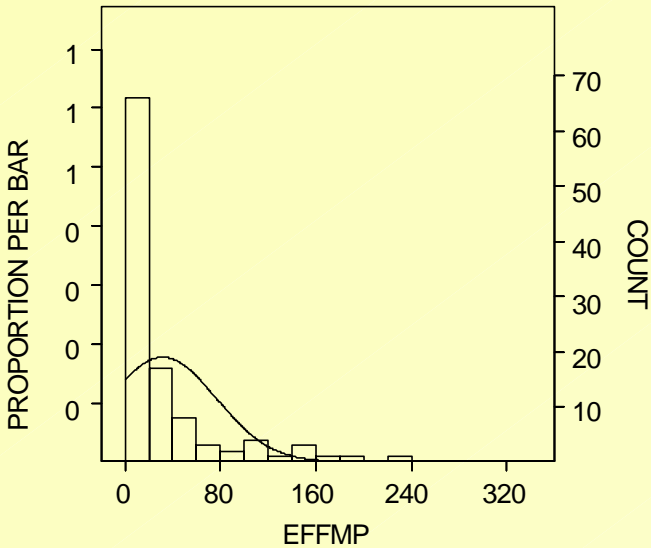




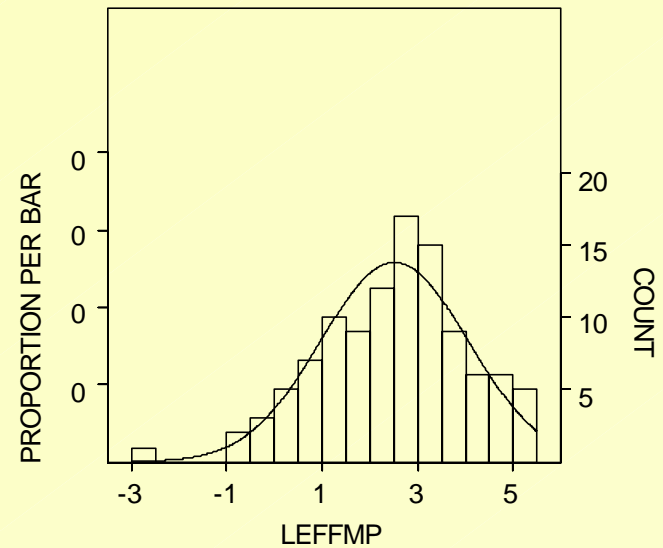
# Analysis - distribution of observations

## ❖ Distribution of effort:

**Effort**



**Log(Effort)**



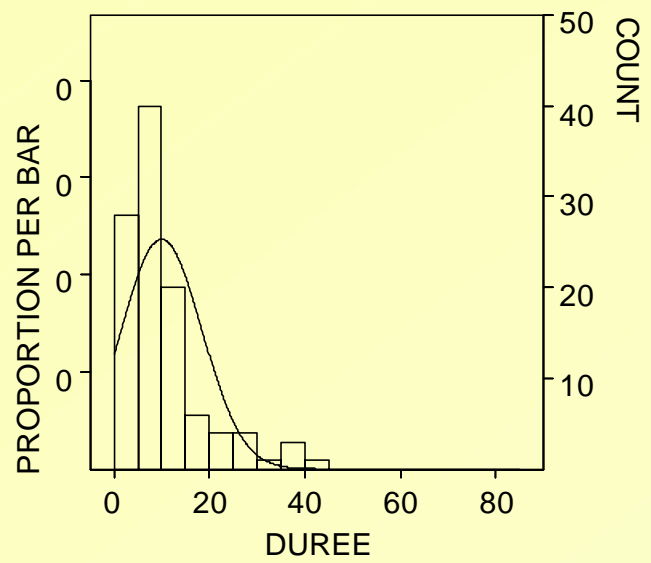
**Log(Effort) is normally distributed (d.c.= 0,001)**



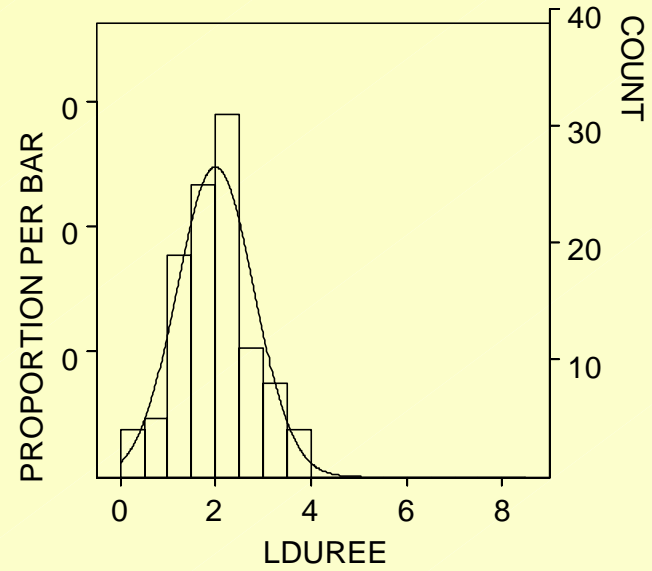
# Analysis - distribution of observations

## ❖ Distribution of duration:

**Duration**



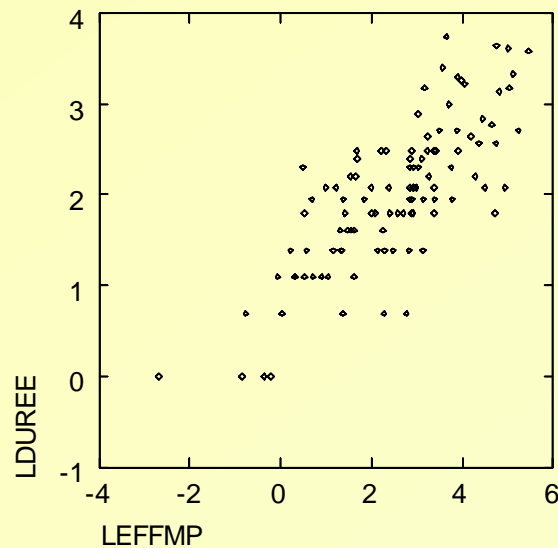
**Log(Duaction)**



**Log(Duration) is normally distributed (d.c.=0,001)**

## *Analysis - modeling duration*

- ❖ **Model based on log transform of variables**
- ❖ **Pearson correlation coefficient: 0,78**





# *Analysis - modeling duration*

- ❖ **Independant variable: effort (pm)**
- ❖ **Dependant variable: duration (months)**
- ❖ **Linear regression results:**

DEP VAR: LDUREE N: 107 MULTIPLE R: 0.776 SQUARED MULTIPLE R: 0.601  
ADJUSTED SQUARED MULTIPLE R: .598 STANDARD ERROR OF ESTIMATE: 0.511

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2 TAIL)
CONSTANT	0.979	0.095	0.000	.	10.340	0.000
LEFFMP	0.405	0.032	0.776	1.000	12.587	0.000

#### ANALYSIS OF VARIANCE

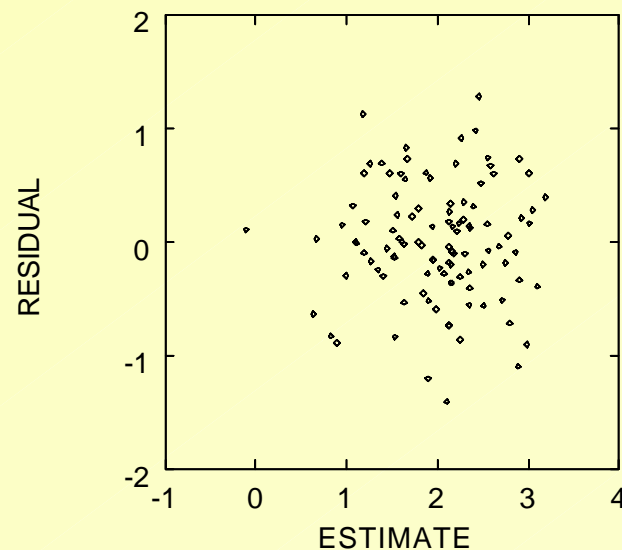
SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	41.446	1	41.446	158.429	0.000
RESIDUAL	27.468	105	0.262		

WARNING: CASE 57 IS AN OUTLIER (STUDENTIZED RESIDUAL = -2.857)  
WARNING: CASE 63 HAS LARGE LEVERAGE (LEVERAGE = .116)

DURBIN-WATSON D STATISTIC 1.700  
FIRST ORDER AUTOCORRELATION .143

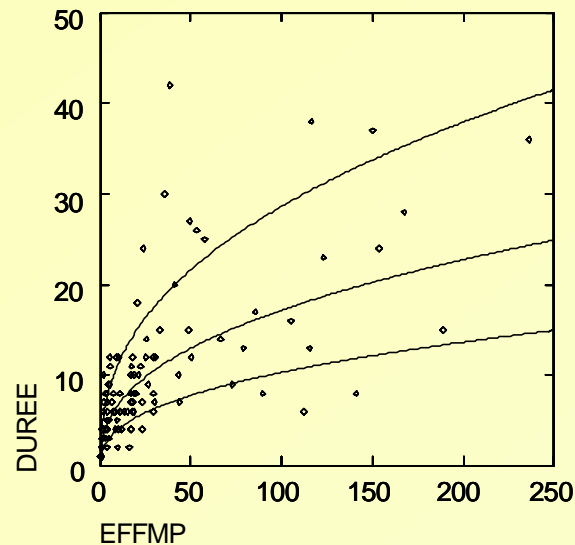
## *Analysis - model characteristics*

- ❖ **Linear model is deemed adequate**
- ❖ **A fair proportion of variance (60%) is explained by the model**
- ❖ **Adjacent residual correlation is low (D.W.: 1,7)**
- ❖ **Residuals distribution is random**

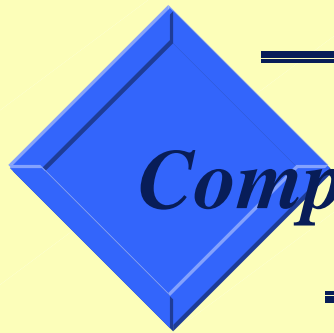


## *Analysis - results*

- ❖  **$\text{Log}(\text{Duration}) = (0,405 * \text{Log}(\text{Effort})) + 0,979$**
- ❖  **$\text{Duration} = 2,662 * \text{Effort}^{0,405}$**



- ❖ **Shown with +/- 2 std. error band**

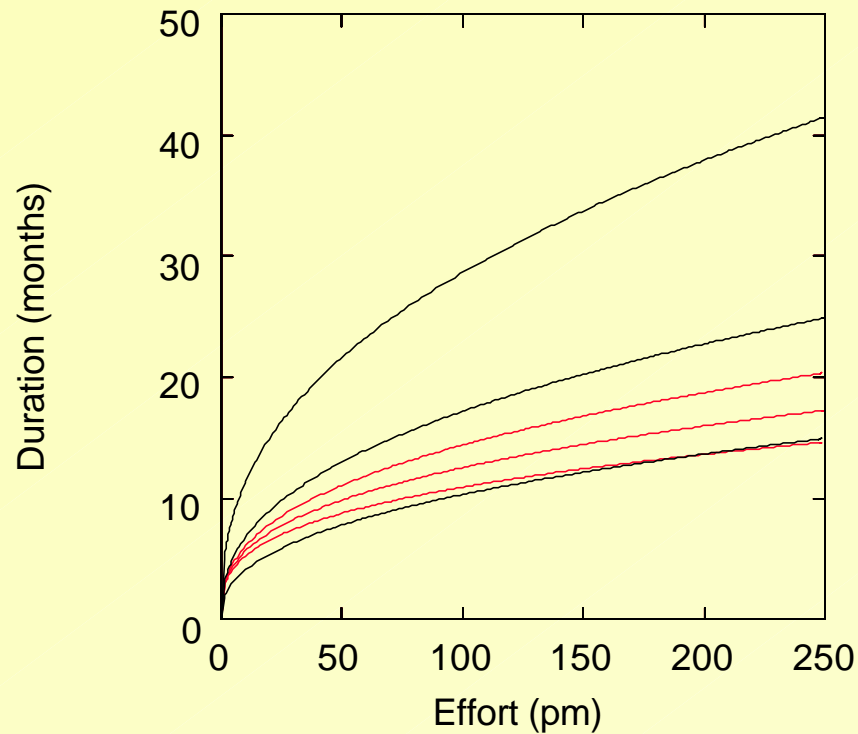


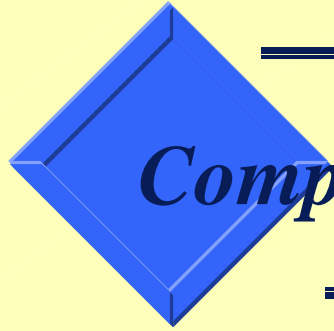
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# *Comparing with other models*

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## ❖ **Comparing with COCOMO & Watson-Felix:**



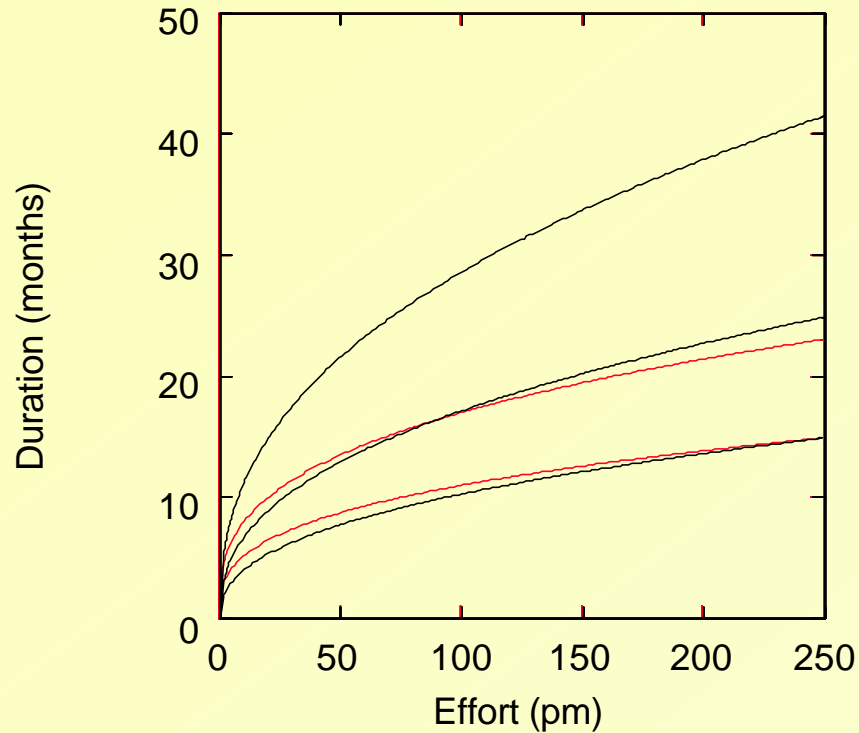


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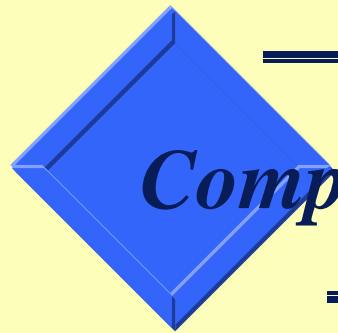
# *Comparing with other models*

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## ❖ **Comparing with Putnam (min. duration):**





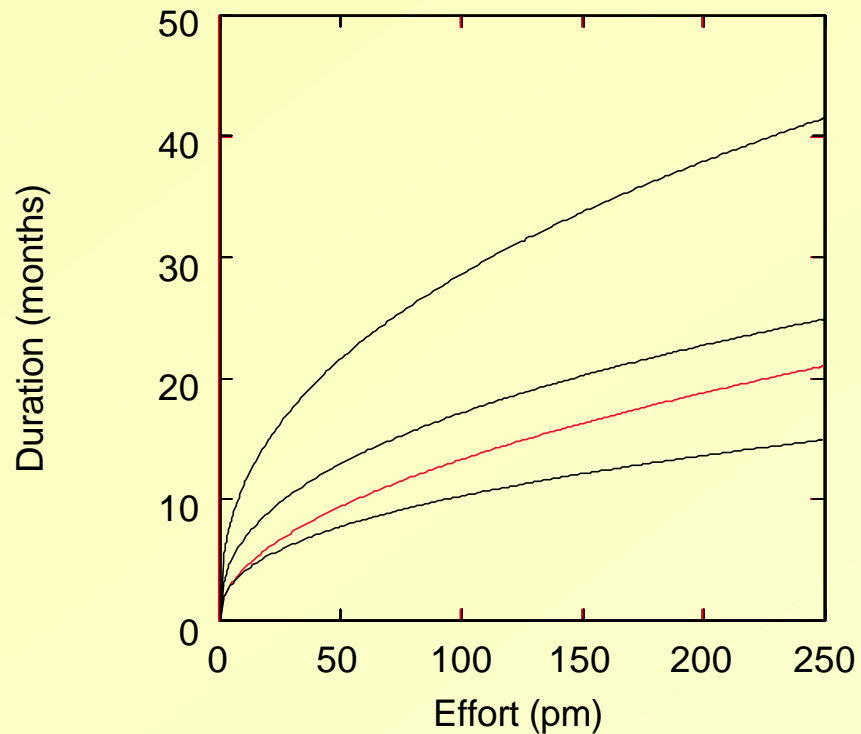


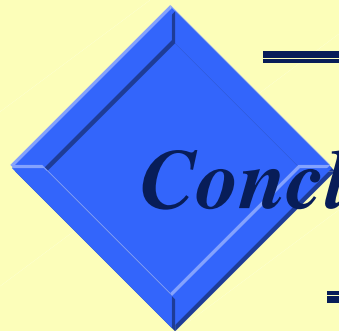
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## *Comparing with other models*

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### ❖ **Comparing with IBM generic model:**





# *Conclusions*

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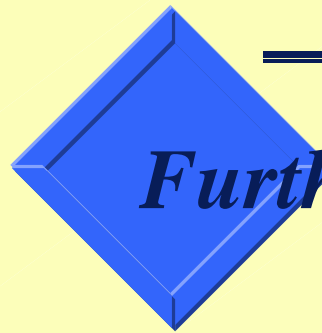
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## ❖ **About the model derived from ISBSG data:**

- **Variance of predicted duration is high for practical application**
- **Work required for:**
  - ◆ **Fine tuning statistical modeling**
  - ◆ **Identify a small number of qualitative factors to help reduce this variance (sample partitioning)**

## ❖ **About the relation with other models:**

- **Most comparison models fit in the "optimistic" area of the ISBSG derived model (exception being Putnam's)**
- **All comparison models show smaller variance of predicted duration, is it an effect of "local" calibration ?**



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## *Further research*

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- ❖ **What factors are limiting the contraction of duration for a given level of effort ?**
  - focus on factors specific to software engineering projects
  - how is S.E. to evolve from sequential techniques to parallel ones ?
  
- ❖ **How does effort/duration relation in S.E. compares with other disciplines ?**
  - Civil engineering,
  - Scientific research,
  - ...
  
- ❖ **Can characteristics of the effort/duration relation be used to derive a measure of the "degree of maturity" of our field ?**