

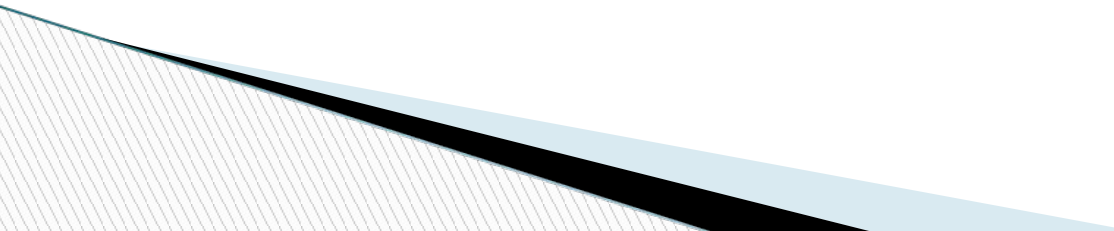
SOFTWARE METRICS USING CONSTRUCTIVE COST MODEL

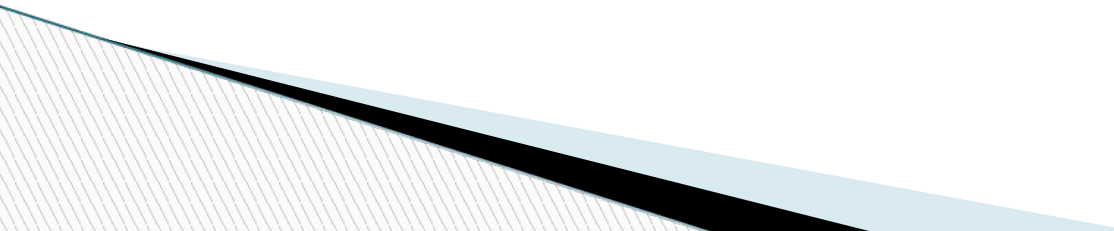
By

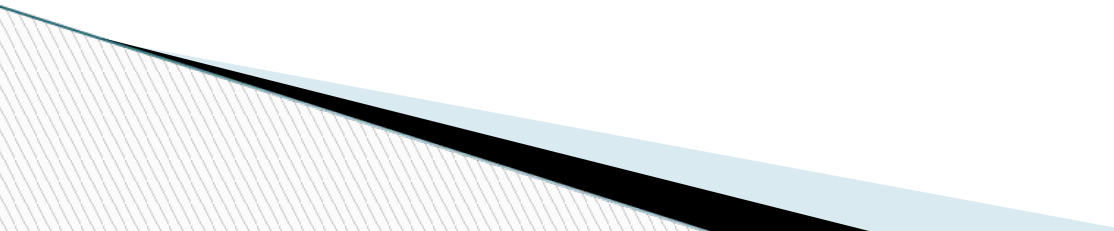
K Gopal Reddy



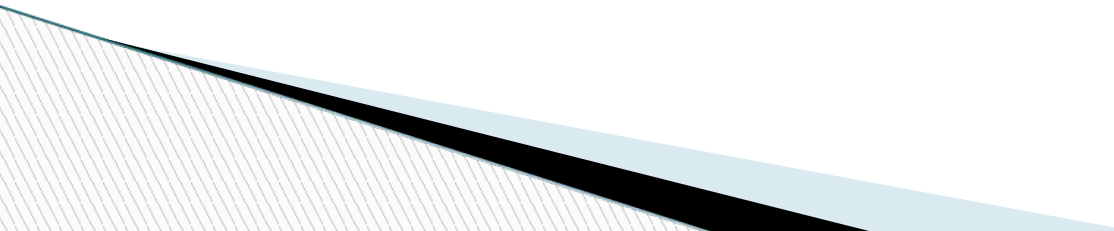
Introduction

- Metrics in software are of two types .direct and indirect .
 - Function points as indirect metrics .
 - Function points are used to measure the effort of the project
 - Cost estimation model
- 

- What is cost estimation model ?
 - Why use cost estimation ?
 - How are they calculated ?
- 

- Cost estimation model is used to calculate the effort and schedule of a project .
 - Cost estimation models give easy ways for risk mitigation and prepare plan for building the project .
 - They are calculated using cost drivers .
 - What are cost drivers ?
 - Cost drivers are critical features that have a direct impact on the project.
- 

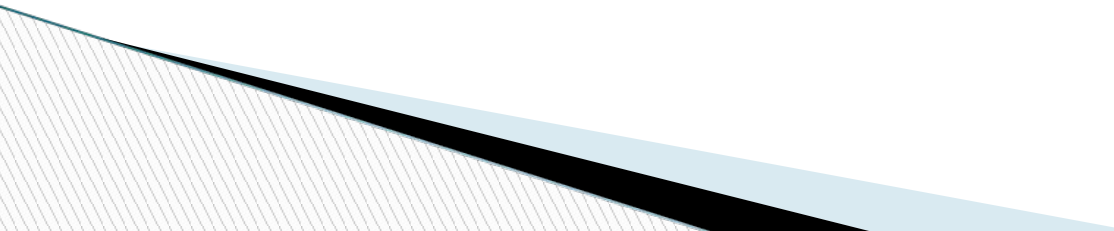
CONSTRUCTIVE COST MODEL

- It was developed by Barry W Boehm in the year 1981.
 - It is an algorithmic cost model.
 - It is based on size of the project.
 - The size of the project may vary depending upon the function points .
- 

COCOMO MODELS

- Basic cocomo
 - ✓ used for relatively smaller projects .
 - ✓ team size is considered to be small.
 - ✓ Cost drivers depend upon size of the projects .
- Effort $E = a * (KDSI)^b * EAF$ Where KDSI is number of thousands of delivered source instructions a and b are constants, may vary depending on size of the project .
- schedule $S = c * (E)^d$ where E is the Effort and c, d are constants.
- EAF is called Effort Adjustment Factor which is 1 for basic cocomo , this value may vary from 1 to 15.

Classes of software projects

- ▣ Organic mode projects
 - ✓ Used for relatively smaller teams.
 - ✓ Project is developed in familiar environment.
 - ✓ There is a proper interaction among the team members and they coordinate their work.
 - ✓ Bohem observed $E=2.4(KDSI)^{1.05}$ E in person-months.
 - ✓ And $S=2.5(E)^{0.38}$.
- 

- Semidetached mode projects
- ✓ It lies between organic mode and embedded mode in terms of team size.
- ✓ It consists of experienced and inexperienced staff.
- ✓ Team members are unfamiliar with the system under development.
- ✓ Bohem observed $E=3(KDSI)^{1.12}$ E in person-months.
- ✓ $S^{.35}=2.5(E)^0$ And

- Embedded mode projects
- ✓ The project environment is complex.
- ✓ Team members are highly skilled.
- ✓ Team members are familiar with the system under development.
- ✓ Bohem observed $E=3.6(KDSI)^{1.20}$ E in person-months.
- ✓ And $S=2.5(E)^{0.32}$.

Table for the constant values

	constants			
Modes	a	b	c	d
Organic	2.4	1.05	2.5	0.38
Semidetached	3.0	1.12	2.5	0.35
embedded	3.6	1.20	2.5	0.32

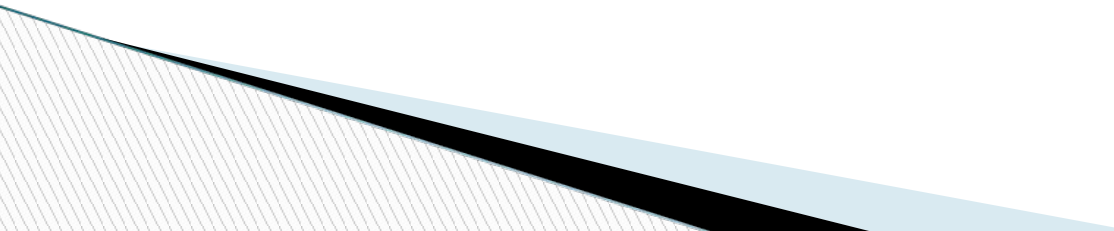
▣ **Intermediate COCOMO**

- ✓ It is used for medium sized projects.
- ✓ The cost drivers are intermediate to basic and advanced cocomo.
- ✓ Cost drivers depend upon product reliability, database size, execution and storage.
- ✓ Team size is medium.

▣ **Advanced COCOMO**

- ✓ It is used for large sized projects.
 - ✓ The cost drivers depend upon requirements, analysis, design, testing and maintenance.
 - ✓ Team size is large.
- 


LIMITATIONS OF COCOMO

- ❑ COCOMO is used to estimate the cost and schedule of the project, starting from the design phase and till the end of integration phase. For the remaining phases a separate estimation model should be used.
 - ❑ COCOMO is not a perfect realistic model. Assumptions made at the beginning may vary as time progresses in developing the project.
 - ❑ When need arises to revise the cost of the project. A new estimate may show over budget or under budget for the project. This may lead to a partial development of the system, excluding certain requirements.
 - ❑ COCOMO assumes that the requirements are constant throughout the development of the project; any changes in the requirements are not accommodated for calculation of cost of the project.
 - ❑ There is not much difference between basic and intermediate COCOMO, except during the maintenance and development of the software project.
 - ❑ COCOMO is not suitable for non-sequential ,rapid development, reengineering ,reuse cases models.
- 

COST ESTIMATION ACCURACY

- The cost estimation may vary due to changes in the requirements, staff size, and environment in which the software is being developed.
- The calculation for cost estimation accuracy is given as follows
 - Absolute error = $(E_{\text{pred}} - E_{\text{actual}})$
 - Percentage error = $(E_{\text{pred}} - E_{\text{actual}}) / E_{\text{actual}}$
 - Relative error = $1/n \sum (E_{\text{pred}} - E_{\text{actual}}) / E_{\text{actual}}$
- The above results give a more accurate estimation of costs for future projects. The cost estimation model now becomes more realistic .


COCOMO II

- ❑ COCOMOII was developed in 1995
 - ❑ It could overcome the limitations of calculating the costs for non-sequential, rapid development, reengineering and reuse models of software.
 - ❑ It has 3 modules
 - ❑ Application composition: - good for projects with GUI interface for rapid development of project.
 - ❑ Early design: - Prepare a rough picture of what is to be designed. Done before the architecture is designed.
 - ❑ Post architecture: - Prepared after the architecture has been designed.
- 

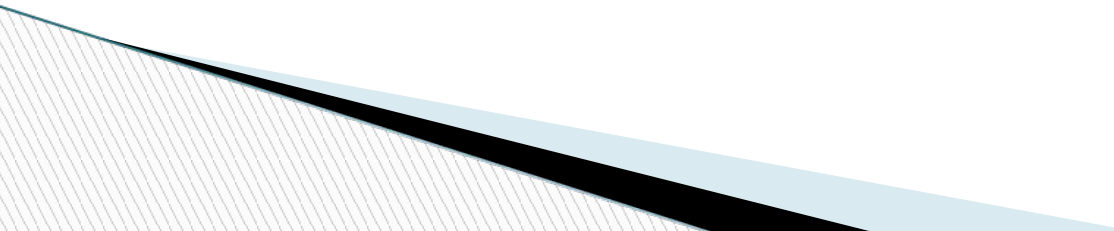
COCOMO II calculation

- In COCOMO II the constant value b is replaced by 5 scale factors.
- Effort (E) is calculated as follows
$$E = a * (KDSI)^{sf} * \pi (EM)$$
- Where a is constant, sf is scaling factor, EM is Effort Multiplier (7 for Early design, 17 for Post architecture).

COCOMO II USES

- ❑ Helps in making decisions based on business and financial calculations of the project.
 - ❑ Establishes the cost and schedule of the project under development, this provides a plan for the project.
 - ❑ Provides a more reliable cost and schedule, hence the risk mitigation is easy to accomplish.
 - ❑ It overcomes the problem of reengineering and reuse of software modules.
 - ❑ Develops a process at each level . Hence takes care of the capability maturity model.
- 

CONCLUSION

- ❑ Constructive Cost Model was developed by Barry W Boehm, is the most common and widely used cost estimation models for most software projects.
 - ❑ The effort and schedule calculated by the model is based on two things, historical information and experience. Thus the reliability on cocomo has been increased.
 - ❑ The website provided by NASA on cocomo, provides a cocomo calculator with cost drivers for a complex project. Cost drivers directly have an impact on the development of the project.
- 

References

- **[1] Farshad Faghiih, " Software Effort and Schedule Estimation",**
<http://www2.enel.ucalgary.ca/People/Smith/619.94/prev689/1997.94/reports/farshad.htm>
- **[2] IAN SOMMERVILLE, " Software Engineering",** published by Addison Wesley, pg 514-521.
- **[3] Seth Bowen, Samuel Lee, Lance Titchkosky, "Software cost estimation",**
<http://www.computing.dcu.ie/~renaat/ca421/BLTCostEst.ppt>
- **[4] Barry Boehm, "Cost Estimation With COCOMO II",**
http://sunset.usc.edu/classes/cs577a_2002/lectures/19/ec19.pdf
- **[5] Center for Systems and Software engineering, "COCOMO II",**
http://sunset.usc.edu/csse/research/COCOMOII/cocomo_main.html

Queries

