Parametric Cost Estimating: A Practical Independent Method of Estimating the Manufacturing Cost of Chips to Modules in the Peoples Republic of China

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Why use the parametric cost estimating method?

- We know the Shenzhou 5 program cost 2 billon U.S dollars to build. (Tu Yun, CRI news)
- We know that we need a better estimating method for future systems and components. The accounting systems can report only past incurred costs and the historical costs often do not lend themselves to future estimates.

So what are the alternatives that we can use for cost estimating?

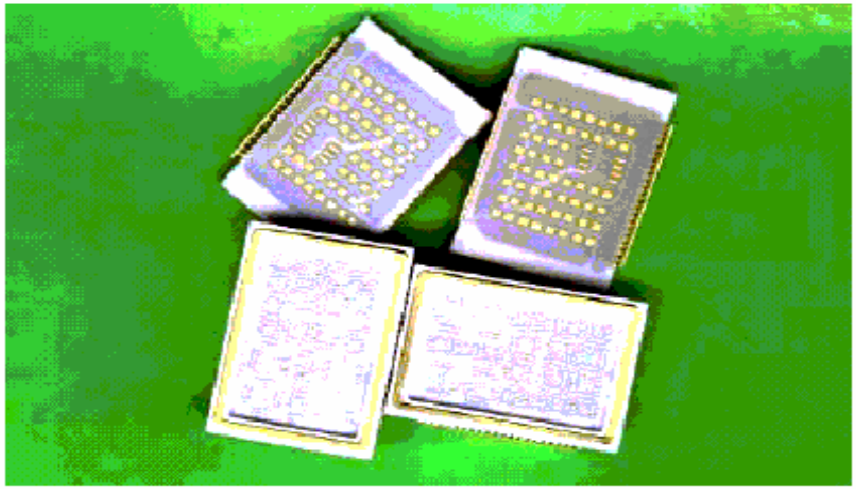
1. Use prior system costs and extrapolate (analogy method). This is the least accurate approach.
2. Attempt to determine the detailed cost elements of a system or component that may not be designed (bottoms-up cost estimate). This method is time consuming and costly.
3. Use a parametric cost estimating system to incorporate the best of alternatives 1 and 2.

Parametric Estimating:

- The PRICE System Suite of parametric estimating systems is based upon your available engineering knowledge and your known rates and factors and proven detailed actual industry estimating relationships. PRICE M is the model used for microcircuits and modules.

The PRICE (M) Electronic Module Estimating Parametric Model can help us estimate circuits from chips to modules

- The PRICE M model is used to estimate costs, resources (labor and material) and schedules for development and production of custom microcircuit chips and /or electronic modules.
- For example, it could estimate PRC chips (Shanghai) or PRC microcircuits (Shijiazhuang):



We will demonstrate the use of PRICE M to do an independent cost estimate of a recently developed commercial microcircuit (as if estimated in PR China).

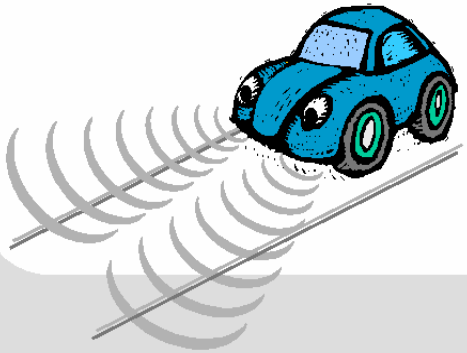
Estimating a LTCC Microcircuit module:

The microcircuit we will use in this demonstration is a RADAR Sensor for Automotive Applications in LTCC using technical data obtained from the IMAPS publication *Advancing Microelectronics* (March/April 2005 issue) and specific IMST information used with permission by IMST GmbH (Germany).

IMST: RADAR Sensor for Automotive Applications in LTCC

24 GHz RADAR Module

RADAR Sensor for Automotive Applications in LTCC



A Joint Project of

IMST GmbH and

DuPont Microcircuit Materials

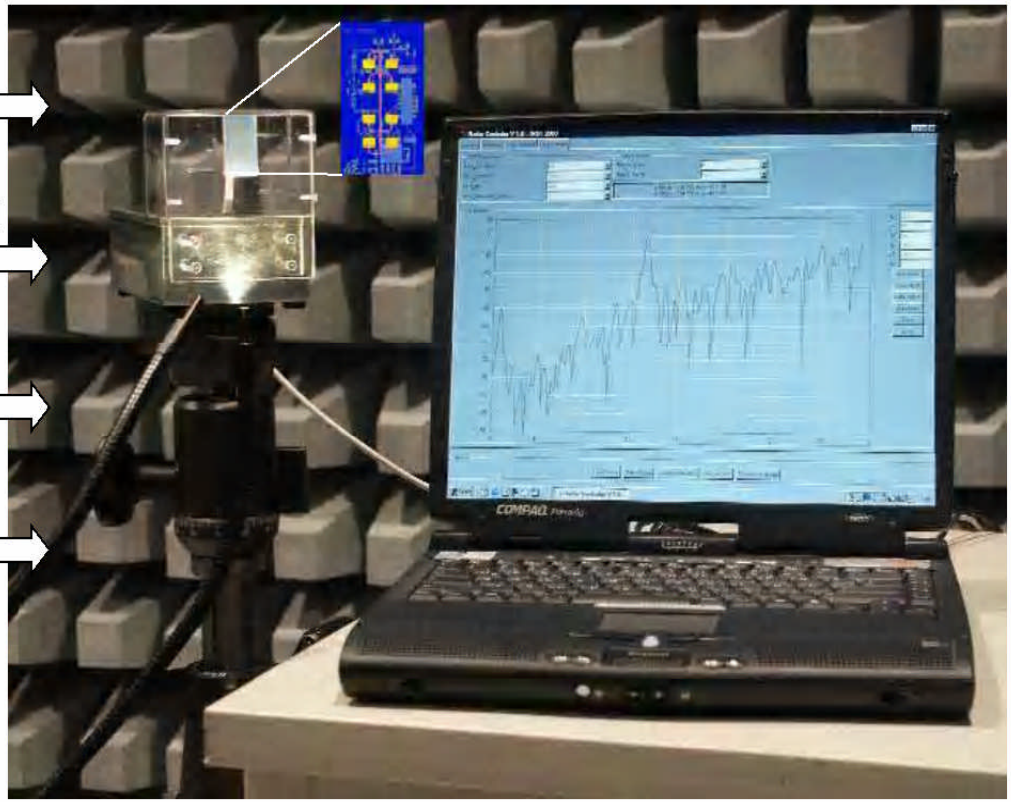
Demonstration Module with Software

FMCW
RADAR Sensor

Signal Processing
Unit

USB Interface

GUI and
Evaluation
Software



FMCW	Frequency Modulated Continues Wave
USB	Universal Serial Bus
GUI	Graphical User Interface

IMST

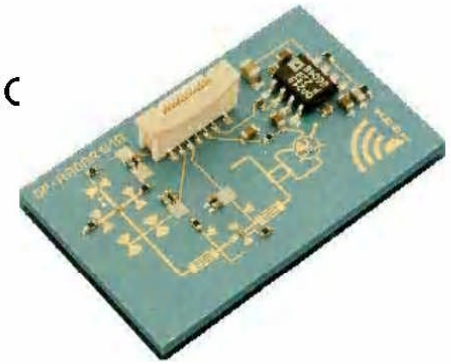
2

Goal Specifications

RADAR-Method	FMCW (Frequency Modulated Continues Wave)
Distance to Obstacles	10 cm ... 30 m
Obstacle Separation	± 10 cm
Resolution	± 1 cm
Centre Frequency	24 GHz (f_{ISM} = 24.125 GHz)
Band Width	2 GHz (b_{ISM} = 250 MHz)
Radiated Power	10 dBm (EIRP)
Antenna Characteristic	±30° Azimuth, ±15° Elevation
Dimensions	e.g. 60 x 45 x 20 mm
Interface	USB or CAN Bus

Main Advantages

- **Low Cost Technology**
  due to use of
  - LTCC standard thickfilm multilayer ceramic and screen-printing process
  - Single chip diodes and transistors instead of MMIC
- **Compact Size**
  thanks to
  - Integration of antenna and frontend on one multilayer substrate
  - Compact 3D RF components and interconnects
- **Robust**
  against
  - Shock, Vibration, Temperature Extremes



DuPont 951

IMST

PRICE M Work Breakdown Structure (WBS)

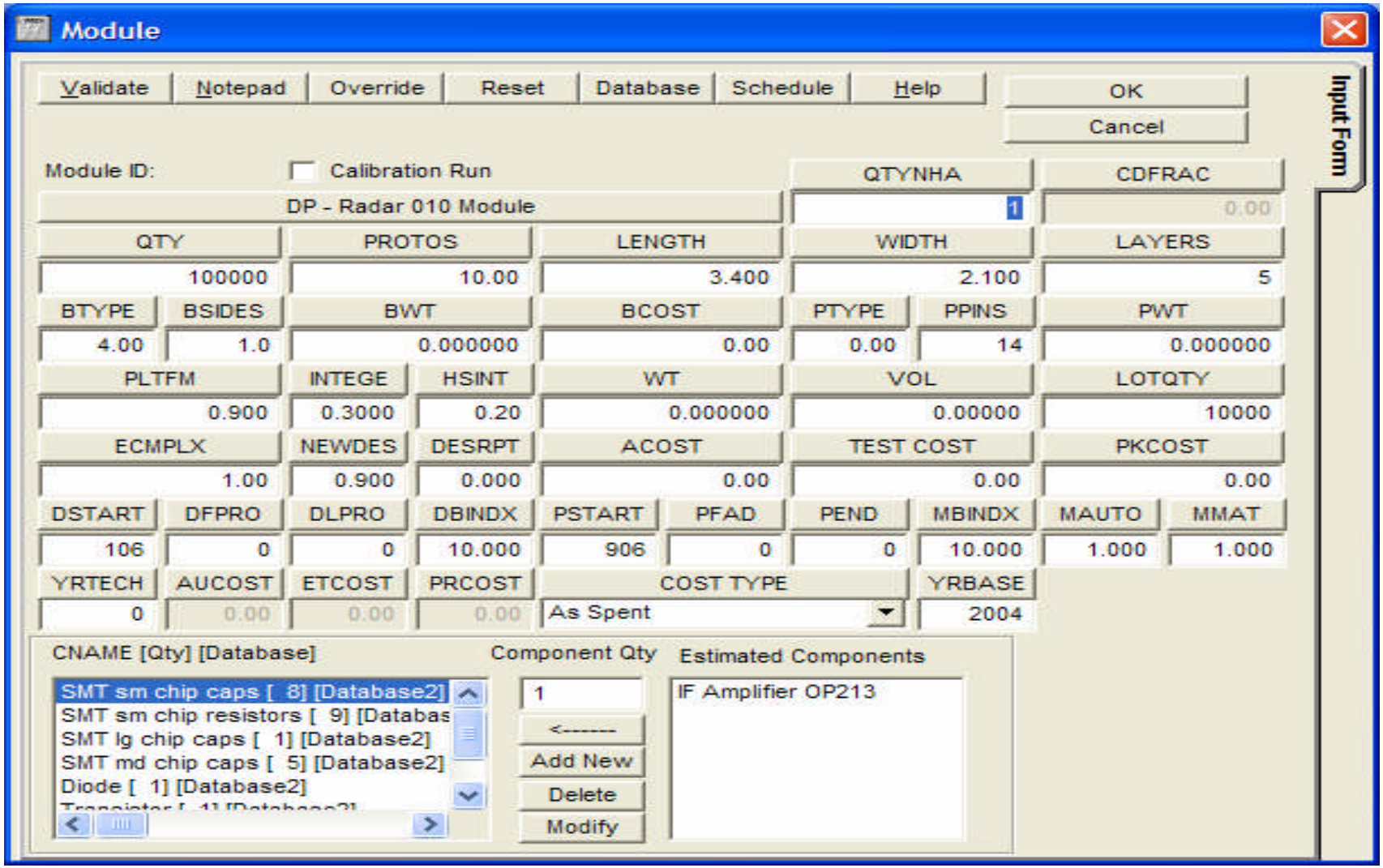
PRICE Estimating Suite 2004(2004147) Page 1 of 1

PRICE Estimating Suite 2004 - [c:\price\24 ghz fmcw radar sensor module.hpr]

0	Sys	Independent Cost Analysis LTCC Short Range Radar Sensor (IMST,Kamp-Lintfort -D)	HL		Glb	Esc	Fin	Dep
1		DP - Radar 010 Module	HL					

Note: Module contains PRICE M estimated IF – Amplifier OP213

DP – Radar 010 Module Input Parameters

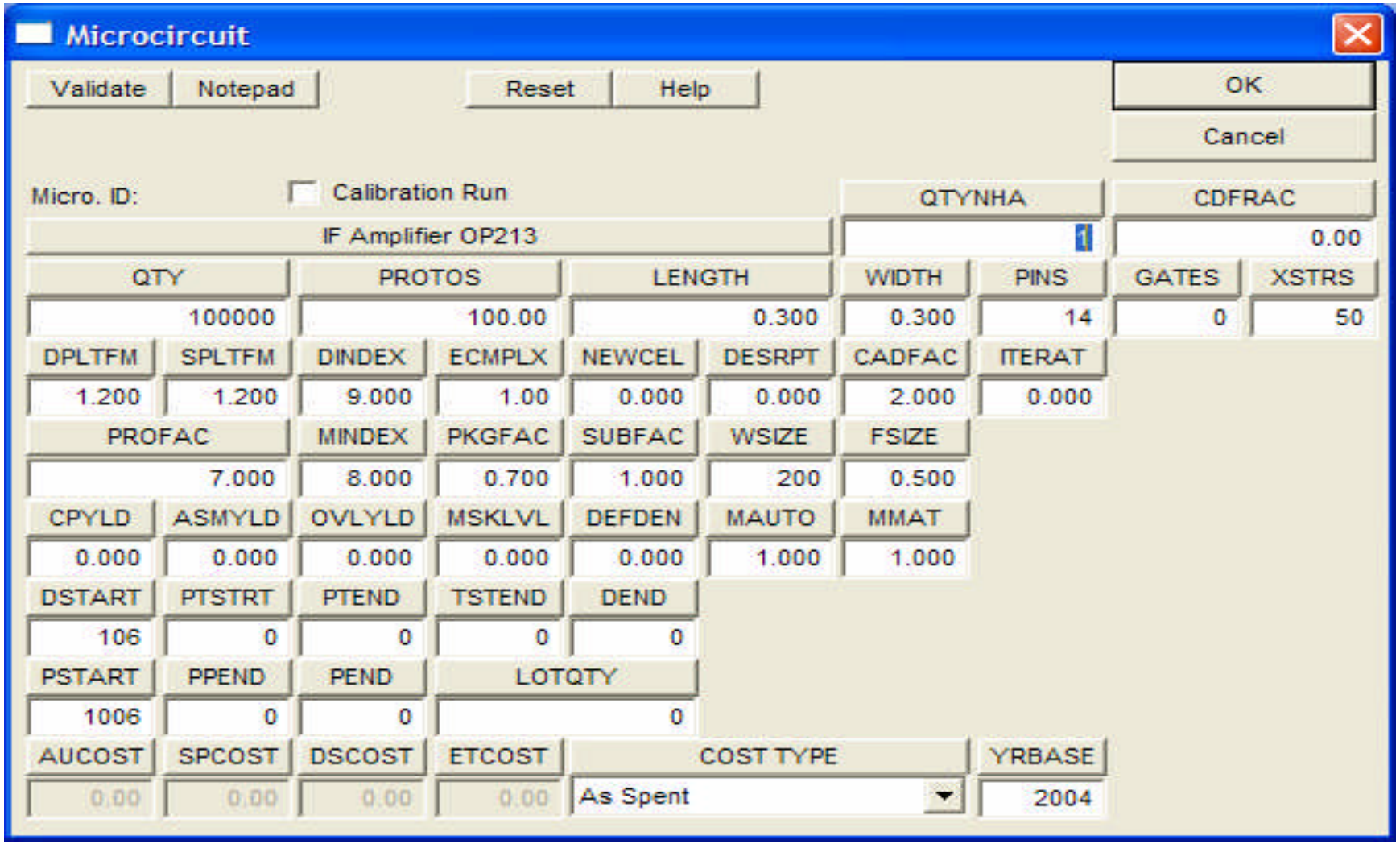


DP 10 Radar Module Estimating Database

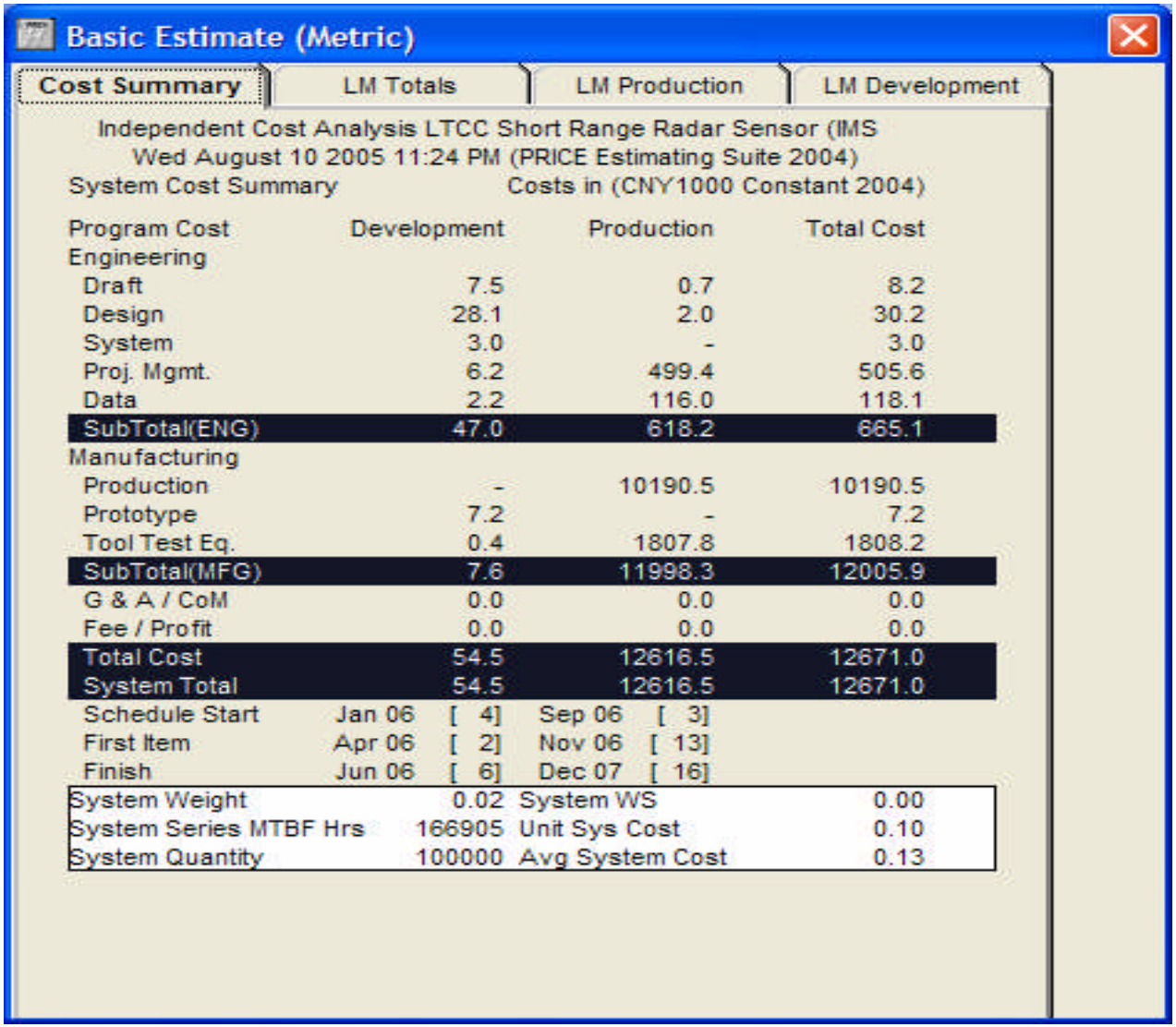
Name	Elements	Type	Package	Pins	Weight	Cost - PRICE M	Cost	Platform	Year
CELM		CTYPE	CPKG	CPINS	CWT	CCOST	CPERQ	Plat	YRBA
IF Amplifier	10	9	8	8	0.00055*	82.09*	0	0.6	2004
SMT sm chip caps	0.75	0.5	0.6	2	0.00055*	2.66*	0	1.2	2004
SMT sm chip resistors	0.75	0.4	0.35	2	0.00055*	1.8*	0	1.2	2004
SMT lg chip caps	0.75	0.5	0.6	2	0.00055*	2.66*	0	1.2	2004
SMT md chip caps	0.75	0.5	0.6	2	0.00055*	2.66*	0	1.2	2004
Diode	1	5	0	2	0.00055*	7.15*	0	0.9	2004
Transistor	1	5	0	3	0.00055*	7.15*	0	0.9	2004
Connector	1	,4	0	14	0.00055*	0.5	0	0.9	2004

* = Estimate from PRICE M

IF Amplifier OP213 Microcircuit Inputs



Total Cost of Development and Production – all costs in K RMB



Basic Estimate (Metric)

Cost Summary | LM Totals | LM Production | LM Development

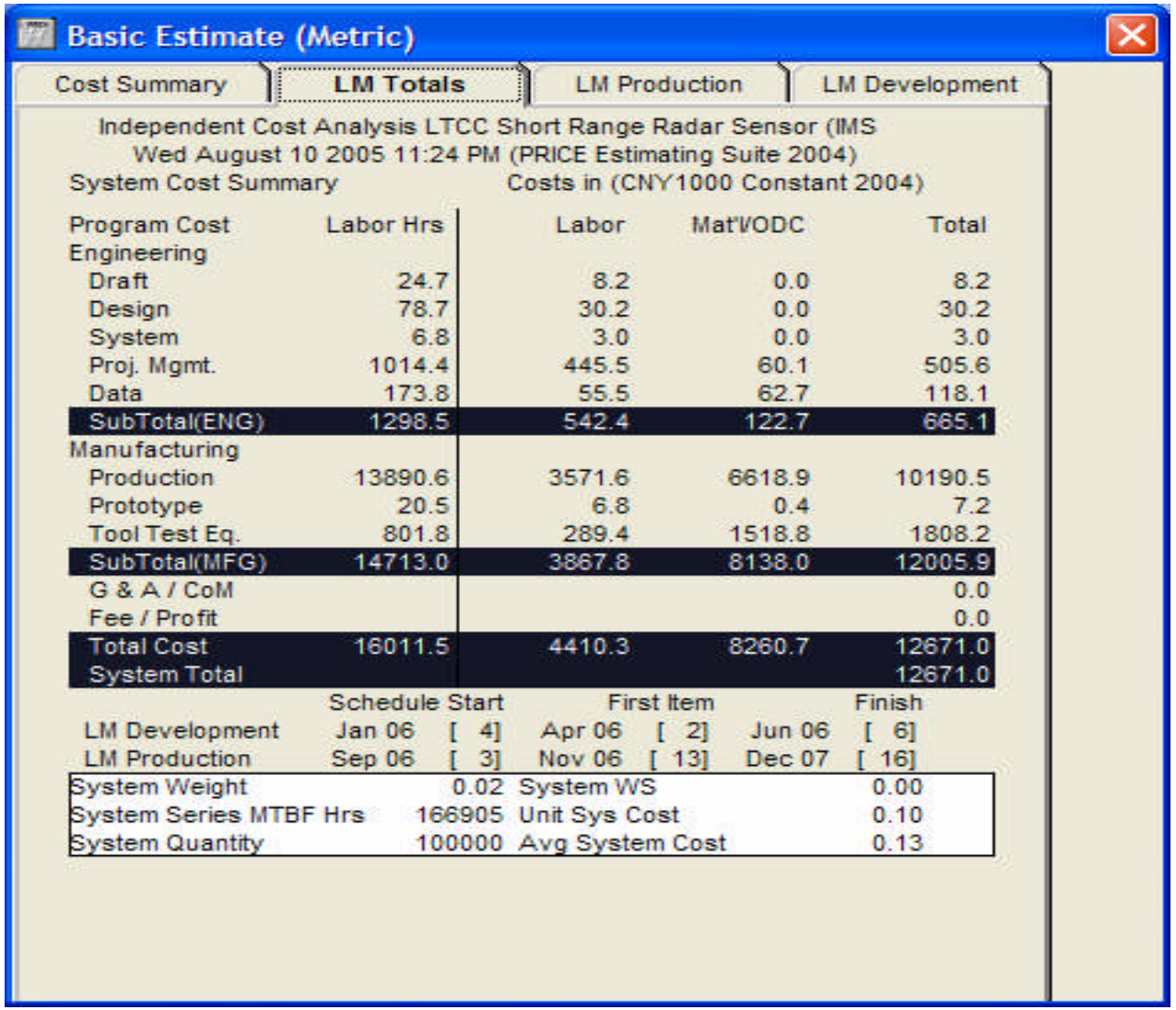
Independent Cost Analysis LTCC Short Range Radar Sensor (IMS
Wed August 10 2005 11:24 PM (PRICE Estimating Suite 2004)
System Cost Summary — Costs in (CNY1000 Constant 2004)

Program Cost	Development	Production	Total Cost
Engineering			
Draft	7.5	0.7	8.2
Design	28.1	2.0	30.2
System	3.0	-	3.0
Proj. Mgmt.	6.2	499.4	505.6
Data	2.2	116.0	118.1
SubTotal(ENG)	47.0	618.2	665.1
Manufacturing			
Production	-	10190.5	10190.5
Prototype	7.2	-	7.2
Tool Test Eq.	0.4	1807.8	1808.2
SubTotal(MFG)	7.6	11998.3	12005.9
G & A / CoM	0.0	0.0	0.0
Fee / Profit	0.0	0.0	0.0
Total Cost	54.5	12616.5	12671.0
System Total	54.5	12616.5	12671.0

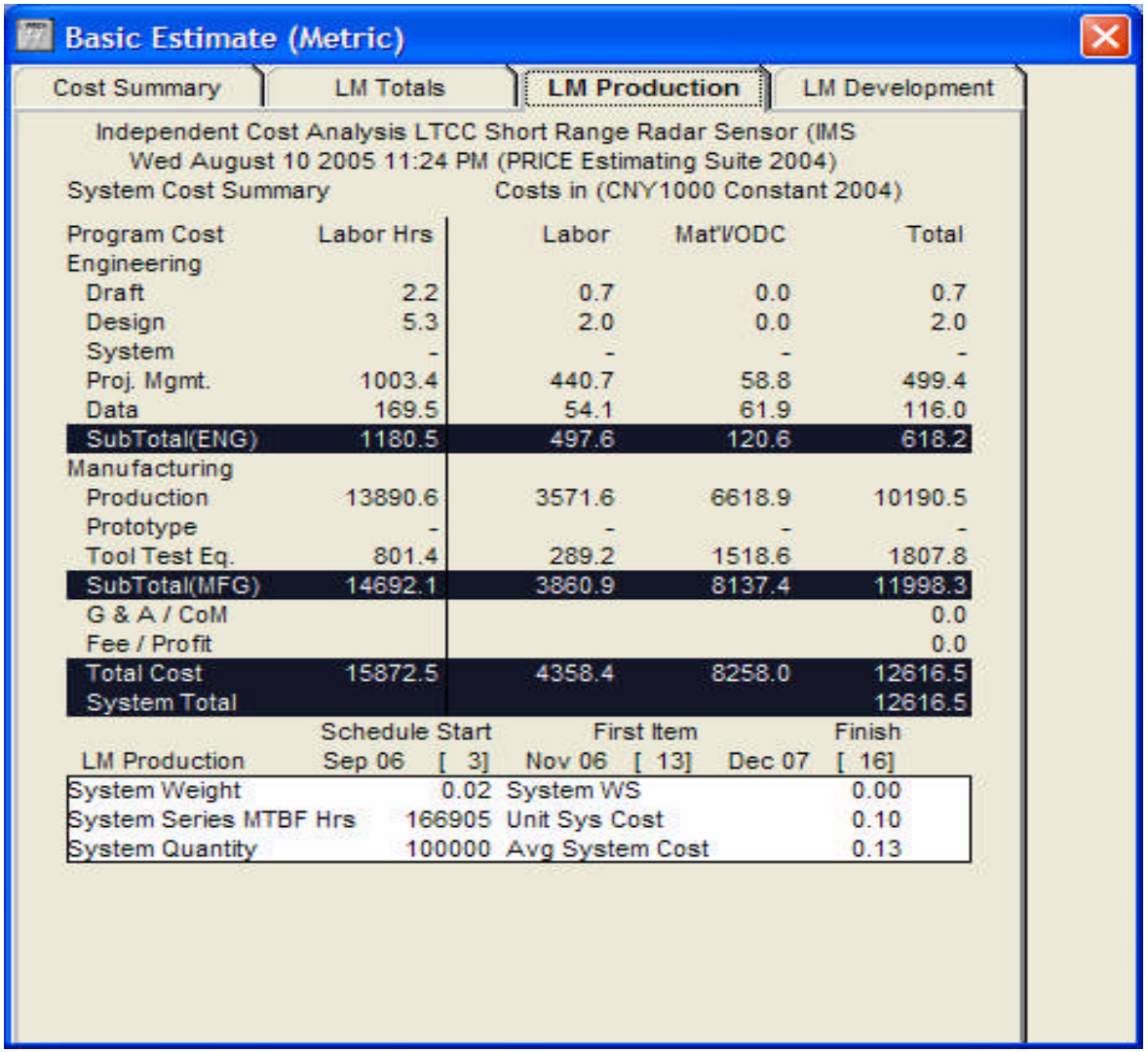
Schedule Start	Jan 06	[4]	Sep 06	[3]
First Item	Apr 06	[2]	Nov 06	[13]
Finish	Jun 06	[6]	Dec 07	[16]

System Weight	0.02	System WS	0.00
System Series MTBF Hrs	166905	Unit Sys Cost	0.10
System Quantity	100000	Avg System Cost	0.13

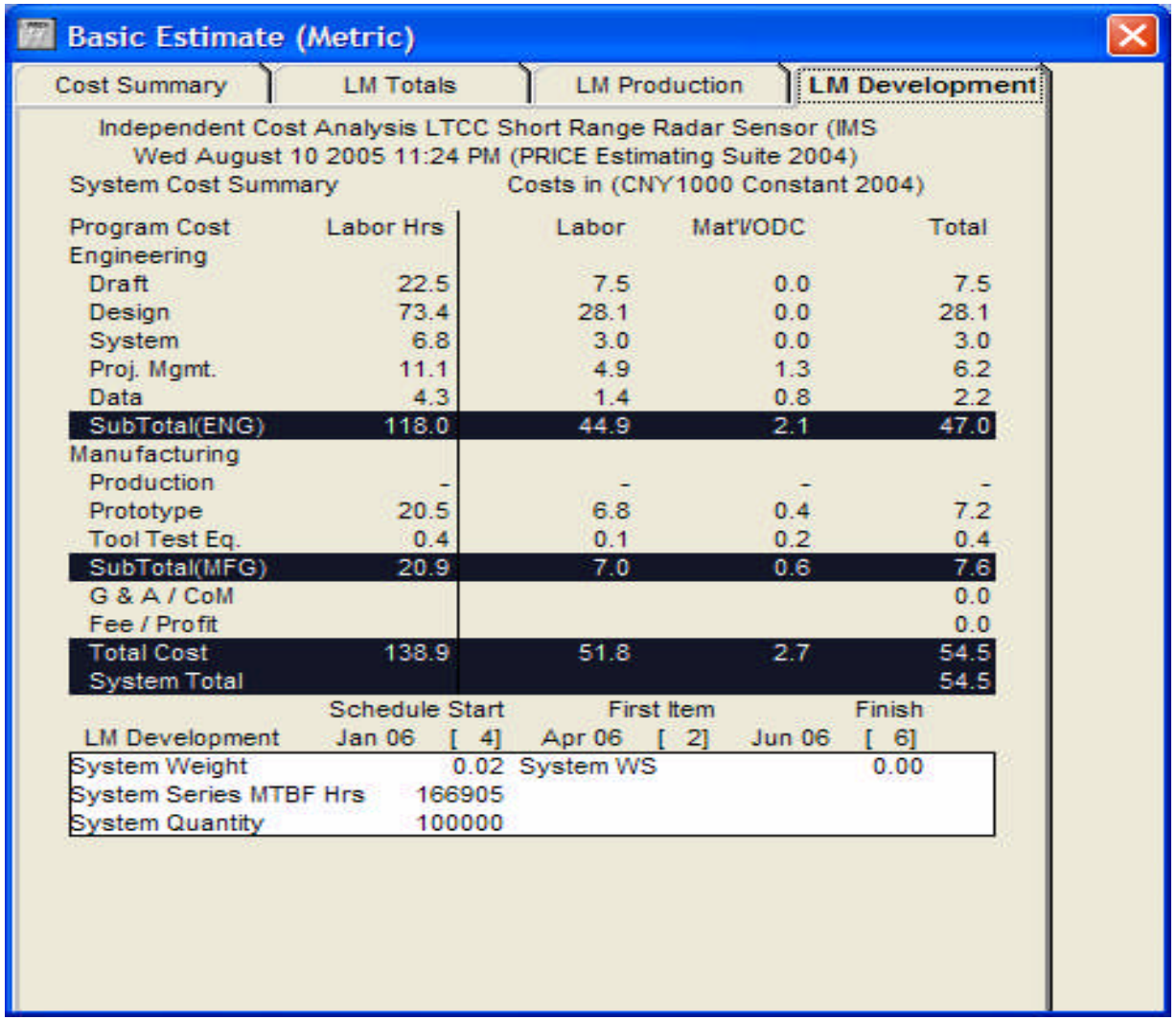
Labor and Material Totals – all costs in K RMB



Labor and Material Production – all costs in K RMB



Labor And Material Development – all costs in K RMB



Basic Estimate (Metric)

Cost Summary | LM Totals | LM Production | LM Development

Independent Cost Analysis LTCC Short Range Radar Sensor (IMS
Wed August 10 2005 11:24 PM (PRICE Estimating Suite 2004)
System Cost Summary — Costs in (CNY1000 Constant 2004)

Program Cost	Labor Hrs	Labor	Mat'l/ODC	Total
Engineering				
Draft	22.5	7.5	0.0	7.5
Design	73.4	28.1	0.0	28.1
System	6.8	3.0	0.0	3.0
Proj. Mgmt.	11.1	4.9	1.3	6.2
Data	4.3	1.4	0.8	2.2
SubTotal(ENG)	118.0	44.9	2.1	47.0
Manufacturing				
Production	-	-	-	-
Prototype	20.5	6.8	0.4	7.2
Tool Test Eq.	0.4	0.1	0.2	0.4
SubTotal(MFG)	20.9	7.0	0.6	7.6
G & A / CoM				0.0
Fee / Profit				0.0
Total Cost	138.9	51.8	2.7	54.5
System Total				54.5

LM Development	Schedule Start		First Item		Finish	
	Jan 06	[4]	Apr 06	[2]	Jun 06	[6]
System Weight	0.02		System WS		0.00	
System Series MTBF Hrs	166905					
System Quantity	100000					

In summary:

- Using parametrics and the PRICE model can provide you with quick, accurate, unbiased, and repeatable tool to estimate your semiconductor chips and microelectronics modules with PRICE M.
- In our demonstration example we have seen that with limited technical information it is possible to estimate state of the art modules to be manufactured in the Peoples Republic of China .

谢谢