

Measuring Function Point from
Requirements/Design Specification
- A Case Study of Joint Work between
Osaka University and Hitachi Co.

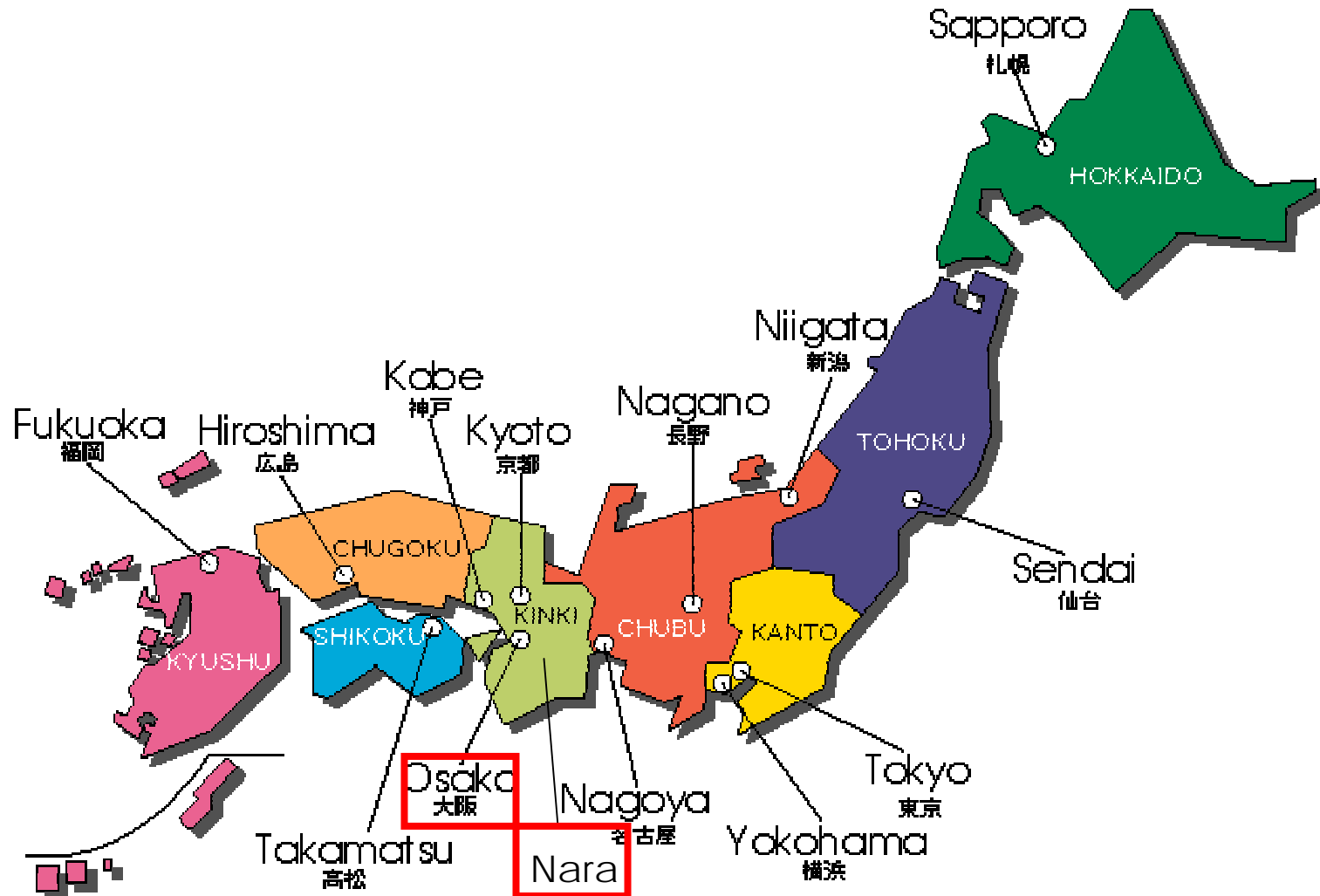
Katsuro Inoue

Graduate School of Engineering Science, Osaka University

Graduate School of Information Science, Nara Institute of
Science and Technology

Japan

Map of Japan



Osaka Univ./ NAIST



Osaka University

70 years history

10 schools

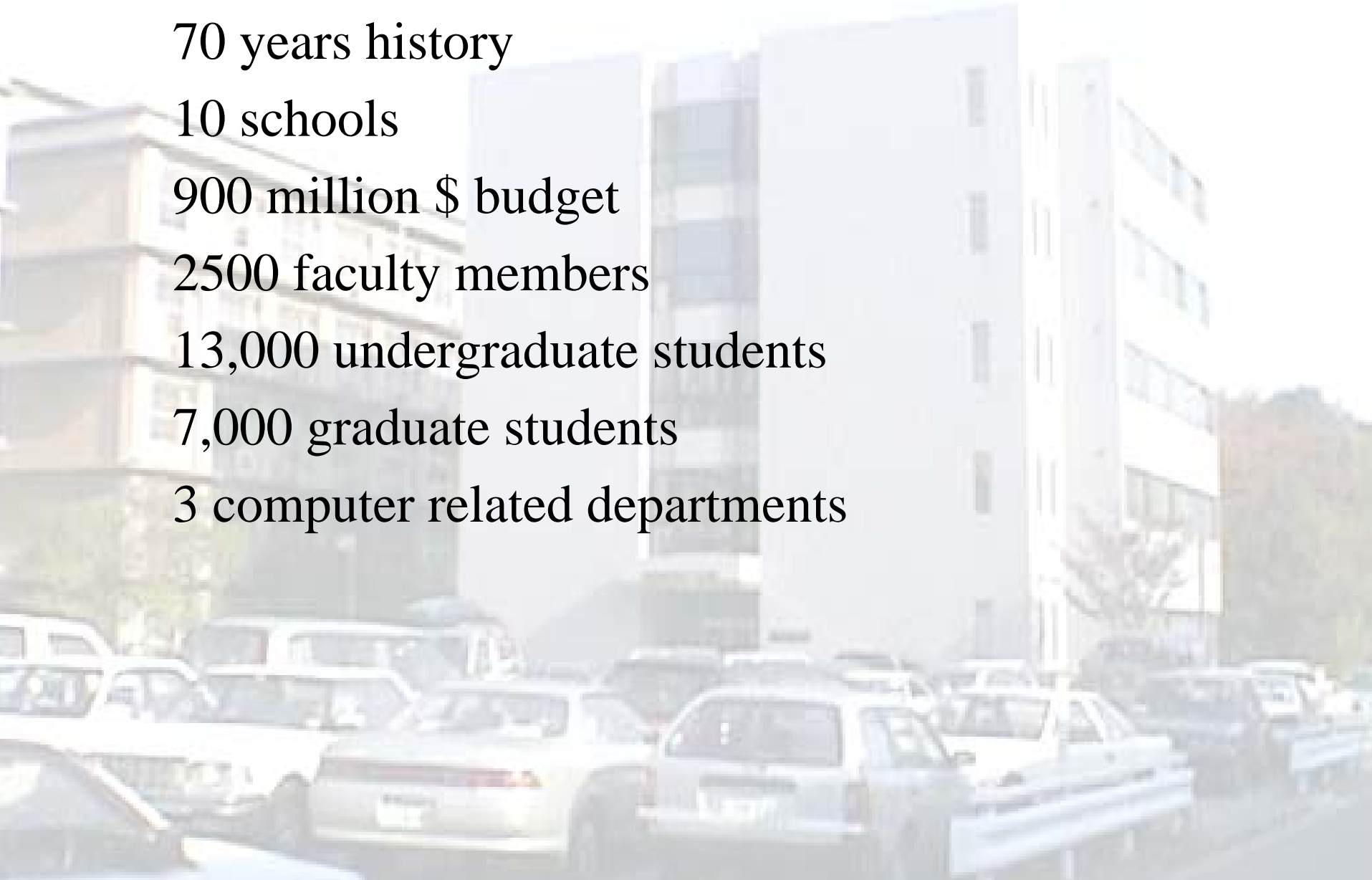
900 million \$ budget

2500 faculty members

13,000 undergraduate students

7,000 graduate students

3 computer related departments



Osaka Univ. SE Lab

3 faculty members

- Inoue, K. Slicing, Analysis
- Kusumoto, S. Metrics, Measurement
- Matsushita, M. Process, Environment

3 Ph.D. candidates, 13 master students,
5 undergraduate students

50,000\$ budget annual

Research Focus of Osaka SE Lab.

Program Analysis and Slicing

- Pascal base slicing system, Java alias analysis system, Combining dynamic and static analysis

Software Metrics and Measurement

- Function point analysis, Object oriented program measurement, Clone detection

Software process and development environment

- Process modeling, Quality assurance framework, Versioning file system

NAIST

The background of the slide is a photograph of the National Institute of Advanced Industrial Science and Technology (NAIST) campus. It features several modern, multi-story white buildings with large windows. In the foreground, there is a paved walkway or road. To the right, a prominent traditional Japanese pagoda tower with multiple tiers is visible against a clear blue sky.

9 years history

3 schools

90million \$ budget

200 faculty members

1000 graduate students

2 computer science departments

NAIST SE Lab.

4 faculty members

- Inoue, K. (adjunct)
- Matsumoto, K. Usability, Software quality
- Shima, K. Reliability model
- Monden, A Bug analysis, Software watermarking

6 Ph.D. students, 8 master students

60,000 \$ budget annual

Research Focus of NAIST SE Lab.

Usability of Computer Systems

- Analysis of human activities (eye, brain wave ...),
Tracking system on Unix and Windows

Bug Analysis for Large Legacy System

- Bug prediction based on complexity measures

Reliability Modeling

- Multi version software, Reliability growth model

Research Focus of Osaka SE Lab.

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Software process and development environments

- Process modeling, Quality assurance framework, Versioning file system

Background(1/2)

Function point analysis(FPA) :

Measures functionality of application software

Issues:

- FPA involves analyzer's judgment ->
instability of analysis results
- High deployment cost to overall organization

Background (2/2)

Hitachi: Business System Development Division

- Introducing FPA to various software development projects
- An object-oriented requirement analysis system REQUARIO has been used during the requirements analysis phase.

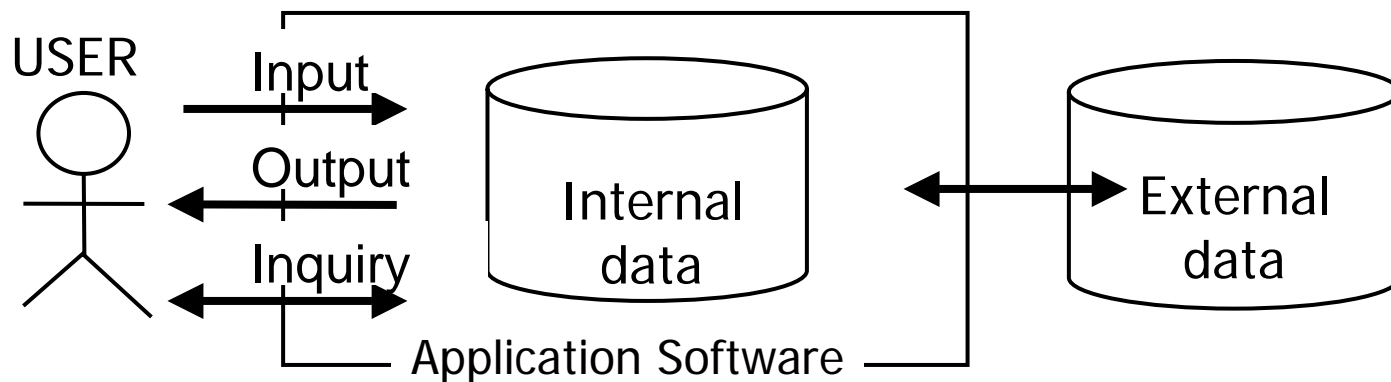


- Use REQUARIO document for FPA
- Automated analysis

Function Point Analysis

FPA: Specification or design documents

- Data functions
 - Internal and external data requirements
- Transactional Functions
 - Represent the functionality provided to the user for the processing of data by an application



Data Functions

- Internal Logical File(ILF) is...
 - user identifiable group of data.
 - maintained within the application boundary.
- External Interface File(EIF) is...
 - user identifiable group of data.
 - not maintained by the application being counted.
- Each ILF or EIF has a functional complexity based on the number of data element types (DETs) and record element types (RETs).
 - DET is a unique user recognizable, nonrecursive field on the ILF or EIF.
 - RET is a user recognizable subgroup of data elements within an ILF or EIF.

Transactional Functions


- External input(EI):
 - Processes data or control information that comes from outside the application's boundary.
- External output(EO):
 - An elementary process that generates data or control information sent outside the application's boundary.
- External inquiry(EQ):
 - An external inquiry is an elementary process made up of an input-output combination that results in data retrieval.
- Each EI, EO or EQ also has a functional complexity based on the number of file types referenced (FTRs) and data element types (DETs).
 - FTR is
 - An internal logical file read or maintained by a function type
 - An external interface file read by a function type.

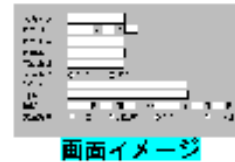
REQUARIO

- REQUARIO is a CASE tool for visually analyzing requirements developed in Hitachi.
- Features :
 - Use-cases(objects + events) are visually represented.
 - Users can easily develop and review the use-cases.
 - Use-cases are automatically translated into the object, UML use-case and sequence diagrams.

Example of REQUARIO Use-Case


旅費精算システム:「現場」
支払管理機能の流れ(旅費精算機能)


 現場	
氏名	日立花子



出張後、1週間以内に入力する

 端末	
1	旅費明細入力
3	旅費精算承認

 現場上長	
2	旅費精算承認依頼

 旅費管理DB	
入力NO	← 00000004
入力担当	← 日立花子
依頼日	← 1996/02/05
依頼部署	← 営業1課
依頼者	← 6000000001
支払金額	← 18,930
支払方法	← 振込
出張先	← 大阪営業所
用件	← 販売促進会議出席
期間	← 02/01
交通機関	← 鉄道
承認欄	

Collaboration Goals

- Hitachi:
 - Obtain a function point measurement tool for REQUARIO
 - Industrial strength tool
- Osaka University:
 - Understand industrial problems
 - Publish papers with background of industrial needs

Overview of collaboration

- Duration:
 - 2 years (June, 1997 ~ May, 1999)
- Fund from Hitachi to University
 - 20,000 \$ / annual
- Staff:
 - Hitachi: 2 engineers (part time).
 - Osaka University: 4 persons(2 students, Inoue, Kusumoto)
- Meeting:
 - Meeting (every two months)
 - Day-by-day communication (via e-mail/phone/fax)

Progress(1997.6-1997.12)

Osaka University

- Learning
- Proposal of detailed FP measurement rules
- Revision of the rules
- Design of measurement tool

Hitachi Ltd.

- Explanation
 - Software development
 - REQUARIO
 - Function Point
- Application of the rules to small example

Progress(1998.1-1999.5)

Osaka University

Development of prototype system.

- Extension of prototype system.

- Exhibition at ICSE99 poster&research demo in Los Angeles

Hitachi Ltd.

- Exhibition at ICSE'98 expo in Kyoto.

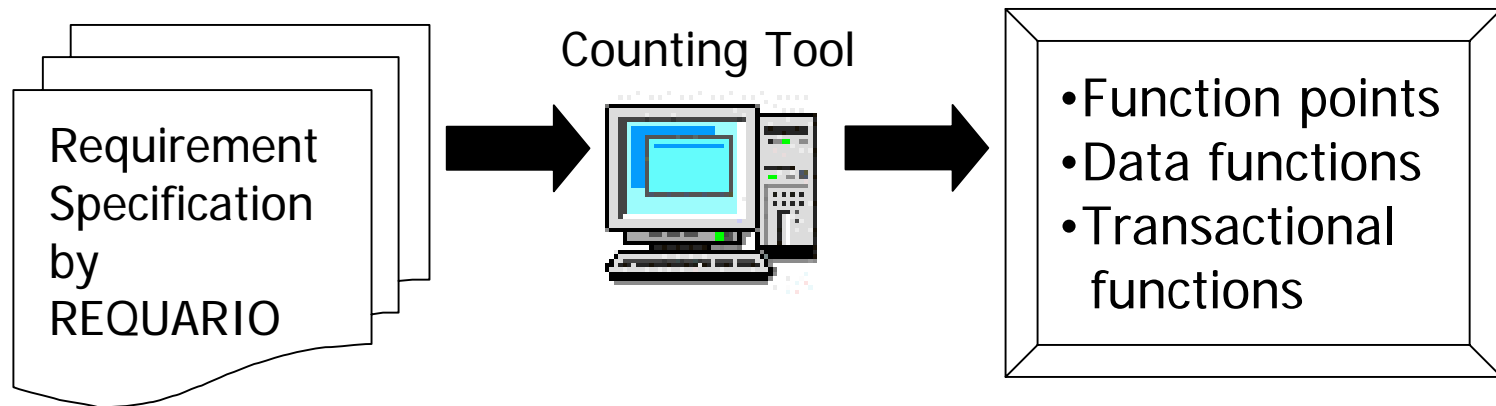
- Case study

Measurement Tool

Developed with Visual C++ on Windows95/98


Program size : about 14000 lines

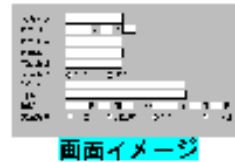
Function point counting: IFPUG counting
manual version 4.0.



Counting Rules

旅費精算システム:「現場」
支払管理機能の流れ(旅費精算機能)

 現場	
氏名	日立花子




Internal Logical File

出張後、1週間以内に入力する

External Input

 端末	
1	旅費明細入力
3	旅費精算承認

 現場上長	
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承認欄	

Example of screen

C:\Program Files\HITACHI\REQUARIO\SAMPLE\stock management.sty - FPTool
 ファイル(F) 編集(E) 表示(V) FP計測(S) ヘルプ(H)

Input file : C:\Program Files\HITACHI\REQUARIO\SAMPLE\stock management.sty

Function type	Complexity			Sum
	Low	Average	High	
ILF	1 × 7 = 7	0 × 10 = 0	0 × 15 = 0	7
EIF	1 × 5 = 5	0 × 7 = 0	0 × 10 = 0	5
EI	3 × 3 = 9	0 × 4 = 0	0 × 6 = 0	9
EO	2 × 4 = 8	0 × 5 = 0	0 × 7 = 0	8
EQ	5 × 3 = 15	0 × 4 = 0	0 × 6 = 0	15
Unadjusted function point				44
Sum of system characteristics				0
Final adjusted function point				28.60

Example of screen

C:\Program Files\HITACHI\REQUARIO\SAMPLE\stock management.sty - FPTool

ファイル(F) 編集(E) 表示(V) FP計測(S) ヘルプ(H)

Sender character	Receiver character	Relation character	Message	FTR	DET	Function type	Complexity
receptionist	DB of stock shortage	---	registration	1	4	EI	Low
receptionist	DB of load	---	retrieval	1	1	EI	Low
receptionist	DB of stock shortage	---	retrieval	1	1	EI	Low
DB of load	receptionist	---	flag of stock sit...	1	1	EO	Low
DB of stock shortage	receptionist	---	flag of delivery	1	1	EO	Low
receptionist	DB of stock shortage	indication for deliv...	elimination	1	0	EQ	Low
receptionist	DB of load	indication for deliv...	renewal	1	0	EQ	Low
receptionist	indication for delivery	DB of load,DB of s...	making	2	0	EQ	Low
receptionist	indication for delivery	DB of load,DB of s...	making	2	5	EQ	Low
receptionist	DB of load	---	registration	1	0	EQ	Low
receptionist	deliveryman	document of stock ...	stock shortage	0	4	---	---
receptionist	receptionist	---	renewal of SS	0	0	---	---
receptionist	receptionist	---	renewal of load	0	0	---	---
receptionist	receptionist	---	making	0	0	---	---
receptionist	receptionist	---	flag of stock sit...	0	1	---	---
receptionist	receptionist	---	flag of delivery	0	5	---	---
receptionist	receptionist	---	registration of L...	0	0	---	---
warehouseman	receptionist	document of load	load	0	0	---	---
receptionist	warehouseman	indication for deliv...	indication for d...	0	0	---	---
receptionist	receptionist	---	renewal of load	0	0	---	---
receptionist	receptionist	---	making	0	0	---	---
receptionist	receptionist	---	flag of stock sit...	0	1	---	---
receptionist	receptionist	---	flag of delivery	0	1	---	---
deliveryman	receptionist	request of delivery	request of deliv...	0	4	---	---

Case study

Applied the tool:

- (1) Purchase processing system
- (2) Order processing system
- (3) Stock control system

We have compared the FP values:

- Function point analysis specialist of Hitachi
- Our tool

Comparison

P : Purchase processing system

O : Order processing system

S : Stock control system

	Function point analysis specialist			Our tool		
	P	O	S	P	O	S
Data function	14	29	24	14	29	24
Transactional function	18	63	36	15	44	27
Total	32	92	60	29	73	51

No significant difference between two analysis results (specialist counts not described transaction functions)

Results of collaboration

- Research papers
 - International conference 2
 - Domestic conference 3
 - Journal paper 1
 - Master thesis 1
 - Bachelor thesis 2
- Exhibited tool at ICSE'98 & ICSE'99
- Hitachi applied for several patents and might integrate the FP tool into **REQUARIO**.

Lessons learned

- Students were very motivated.
 - find research theme easily.
 - get the information of the actual software development at the company.
- It was useful to train students.
 - required some results based on tight schedule
 - learning several manners
- Papers based on actual data and experience interest industry people

Derived Research Project

Function point measurement for UML
design specification

Collaboration with
Hitachi System Engineering, Ltd.
(subsidiary company of Hitachi)

Applied a government research fund
120,000 \$ budget

Collaboration Issues

- Start with small problems
 - Do not set ambitious goals at beginning
- Not consulting, equal research partner
 - Share ideas and labors
- Do not expect short term success
 - Long term relation, Good human relation
- Find publishable theme from university side
 - Money is a secondary issue
