APPENDIX

(A)   DR W. EDWARDS Deming's 14 Points on Quality

1. Create constancy of purpose for improvement of product and service.

2. Adopt the new philosophy of refusing to allow defects.

3. Cease dependence on mass inspection and rely only on statistical control.

4. Require suppliers to provide statistical evidence of quality.

5. Constantly and forever improve production and service.

6. Train all employees.

7. Give all employees the proper tools to do the job right.

8. Encourage communication and productivity.

9. Encourage different functionss to work together on problem solving.

10. Eliminate posters and slogans that do not teach specific improvement methods.

11. Use statistical methods to continuously improve quality and productivity.

12. Eliminate all barriers to pride in world-man-ship.

13. Provide ongoing retraining to keep apace with changing products, method, etc.

14. Clearly define top management's permanent commitment to quality.

(B)   SEI Certified Companies

Source: http://www.sei.cmu.edu/publications/documents/94.reports/94.tr.012.html
The Software Engineering Institute's
Compiled List of Published Maturity Levels
Updated as of October 29, 1998

Level 2 Companies

Company	Article Title	Source of Publication	Publisher	Date of Article
AT&T Network Systems Advanced Software Construction Center	The Honor Roll	Cross Talk - The Journal of Defense Software Engineering	Functions of Defense	Nov/Dec 1995
Boeing Information Services, RCAS Data and Applications Functions, Vienna, VA	Boeing Team Earns SEI Accreditation for RCAS	PRNewswire	PRNewswire via NewsNet	Jun. 25, 1997
Dynamics Research Corporation	DRC has been certified at SEI Level 2!	Systems Division (http://www.drc.com)	DRC	Sep. 17, 1997
Fuji Xerox	Fuji Xerox Introduced TQC for Software	Business & Technology		May 14, 1998
Hewlett Packard	Implementing the CMM for Software Development	Hewlett Packard Journal	Hewlett Packard	Aug. 1996
Lockheed Martin Aircraft Services Division	The Honor Roll	Cross Talk - The Journal of Defense Software Engineering	Functions of Defense	Nov/Dec 1995
Motorola CIG (Cellular Infrastructure Group)	Achieving Higher SEI Level	Cross Talk - The Journal of Defense Software Engineering	Functions of Defense	Sep. 1994
Motorola Transmission Products Group - Canton, Mass.	How We Climbed to Maturity Level Two	Application Development Trends	Practitioner's Perspective	Apr. 1994
Oerlikon Aerospace	Development and Integration of Engineering Processes at Oerlikon Aerospace	Proceedings, INCOSE Seventh Annual International Symposium, Los Angeles, August 3-7, 1997	International Council on Systems Engineering (INCOSE)	Aug. 1997
Ogden SW Development Activity (MSG/SO) at Hill AFB	The Honor Roll	Cross Talk - The Journal of Defense Software Engineering	Functions of Defense	Nov/Dec 1995
Pentastar Electronics, Inc.	The Honor Roll	Cross Talk - The Journal of Defense Software Engineering	Functions of Defense	Nov/Dec 1995
PROCASE Corporation	From Chaos to SEI Level 2 in 18 months	From Chaos to SEI Level 2 in 18 months	PROCASE Corporation	N/A
TYBRIN Corporation	The Honor Roll	Cross Talk - The	Functions of	Nov/Dec

		Journal of Defense Software Engineering	Defense	1995 14)
United Airlines, Informatiom Services Division	United Airlines Press Release	United Web Site	Corporate Communicatio ns	October 24, 1997 15)
Vector Research, Inc.	Vector Research, Incorporated, (VRI) Receives SEI CMM Level 2 Recertification	http://www.vectorho me.com/new/wn_sei. htm	Vector Research Incorporated	Jun. 12, 1998 Level 3 Companies

Level 3 Companies

Air Force, Standard Systems Group	AF coders earn 3rd star	Government Computer News	Cahners Publication, Volume 16, Number 26	Sep.1997 17)
Andersen Consulting Teleworks, Manila	Solution Centers recognized for Quality Leadership	Business Wire	Chicago, Business Wire	Oct. 28, 1997 18)
Andersen Consulting Teleworks, Minneapolis	Solution Centers recognized for Quality Leadership	Business Wire	Chicago, Business Wire	Oct. 28, 1997 19)
AT&T	CMM Level 3 Certification Awarded To Three Keane Application Outsourcing Clients	http://www.keane.co m/ whatsnew/02-25-98b.shtml	Keane, Inc.	Feb. 25, 1998 20)
Bellcore Software Systems	Bellcore Software Systems Center Acheives CMM Level 3	Bellcore Web Site http://www.bellcore. com/ DISCOVER/PRESS /cmm.html	Bellcore	N/A 21)
Blue Cross Blue Shield of Maryland	Keane Client Blue Cross Blue Shield of Maryland Attains CMM Level 3 Certification; Fifth Keane Application Outsourcing Client to Reach This Level	PR Newswire	PR Newswire Association, Inc.	Aug. 11, 1998 22)
Boeing Wichita Information Systems	Boeing Wichita's I/S unit reaches CMM Level 3	http://www.adtmag.c om	Application Development Trends	April 1998 23)
Carrier	CMM Level 3 Certification Awarded To Three Keane Application Outsourcing Clients	http://www.keane.co m/ whatsnew/02-25-98b.shtml	Keane, Inc.	Feb. 25, 1998 24)
Defense Systems and Electronics Group at Texas Instruments	Software Process Improvement in DSEG - 1989-1994	Reprint from Texas Instruments Technical Journal	Texas Instruments	Mar/Apr 1995 25)
GDE Systems (subsidiary of Tracor, Inc.)	The Honor Roll	Cross Talk - The Journal of Defense Software Engineering	Functions of Defense	Nov/Dec 1995 26)
Grumman Data	How Grumman Data Reached ML 3	Application Development Trends v2, #3	Practitioner's Perspective	Mar. 1995 27)
GTE Government	Software Process	SEPG 1996 Conference		May 1996

Systems at Mountain View, CA and Tempe, AZ	Models--Tailored to Fit; Tailored for Sucess!			28)
Hughes Missile Systems Company	HMSC Software Assessed, Level 3 Rating Awarded	Hughes Missile Systems Company, Engineering Report	Hughes Missile Systems Company Engineering	Nov. 1996 29)
Keane Inc. Public Service Electric and Gas Outsourcing Contract	Keane Client PSE&G Awarded CMM Level 3 Certification; Clients Gains Verified Measure of Excellence	http://www.keane.com/whatsnew/04-29-98.shtml	Keane Inc.	Apr. 29, 1998 30)
Litton Data System Division	The Honor Roll	Cross Talk - The Journal of Defense Software Engineering	Functions of Defense	Nov/Dec 1995 31)
Lockheed Martin Management & Data Systems	Lockheed Martin Achieves SEI Level 3 Recognition	PRNewswire	NewsNet	Sep. 1996 32)
McDonnell Douglas Aerospace (St. Louis)	The Honor Roll	Cross Talk - The Journal of Defense Software Engineering	Functions of Defense	Nov/Dec 1995 33)
McDonnell Douglas Space & Defense Systems & Transport Aircraft	The Honor Roll	Cross Talk - The Journal of Defense Software Engineering	Functions of Defense	Nov/Dec 1995 34)
Network Systems & Technologies (P) Ltd.	NeST Achieves CMM Level-3	www.nestindia.com	Network Systems & Technologies (P) Ltd.	Apr.8,1998 35)
NIIT	NIIT Software Services awarded SEI Level 3	http://www.niitusa.com/news/news023.htm	NIIT (USA), Inc.	Dec. 19, 1997 36)
NYSEG	CMM Level 3 Certification Awarded To Three Keane Application Outsourcing Clients	http://www.keane.com/ whatsnew/02-25-98b.shtml	Keane, Inc.	Feb. 25, 1998 37)
Ogden Air Logistics Center Software Engineering Division at Hill AFB	The Honor Roll	Cross Talk - The Journal of Defense Software Engineering	Functions of Defense	Nov/Dec 1995 38)
PRT Group Inc. New York; PRT Barbados Ltd.	Software Company in Carribbean Gets World Grading For Quality	The New York Carriban News Vol XVI	The New York Carriban News Vol XVI	Dec. 16, 1997 39)
Raytheon Electronic Systems	IEEE Names Raytheon as Leader in SW Industry	News Release	Raytheon Company	Aug. 1995 40)
Sacramento Air Logistics Center Softwae Div. @ McClellon AFB	The Honor Roll	Cross Talk - The Journal of Defense Software Engineering	Functions of Defense	Nov/Dec 1995 41)
SAIC Systems and Software Engineering Support (SSES)	SAIC Project Profile	http://www.saic.com/gov/profiles/Proj30.html	SAIC	Feb. 1997 42)
Science Applications International	EPA's Systems Development Center	Press Release	SAIC	Mar. 10, 1998 43)

Corporation, Environmental Protection Agency's Systems Development Center	Receives SEI Level 3 Appraisal			
Sodalia	CMM 3 livello in Italia	http://www.pantheon .it/mailgate/ it.discussioni.iso900 0/	Italia Online	Oct. 4, 1997 44)
Software Eng. Div. of Hughes Aircraft - Fullerton, CA	Software Process Improvement at Hughes Aircraft	IEEE Software	N/A	Jul. 1991 45)
Telos Federal Systems TFS & Software Eng. Directorate SED	The Honor Roll	Cross Talk - The Journal of Defense Software Engineering	Functions of Defense	Nov/Dec 1995 46)
Texas Instruments Defense Systems and Electronics Group	The Honor Roll	Cross Talk - The Journal of Defense Software Engineering	Functions of Defense	Nov/Dec 1995 47)
Tracor, Inc.	Tracor to Acquire Cordant and Form New Information Sytems Unit	PR NEWSWIRE	NewsNet	Sep. 3, 1996 48)
TRW	A Practical Implementation of Technology Change Management	Proceedings, 1997 Conference on Software Process	University Of Irvine	Jan. 23, 1997
TYBRIN Corporation	TYBRIN Achieves SEI CMM Level 3 -- 1996 SBA National Small Business Prime Contractor of the Year	www.tybrin.com	TYBRIN Corporation	N/A
U.S. Army Information Software Development Center, Ft. Lee, Va	The Honor Roll	Cross Talk - The Journal of Defense Software Engineering	Functions of Defense	Nov/Dec 1995
Vitro Corporation (subsidiary of Tracor, Inc.)	Tracor's Vitro Corp Achieves SEI Level 3 Recognition	PRNewswire	NewsNet	Aug. 1996
Wang Southeast Operation's, Montgomery Alabama	Wang's Southeast Operations achieves rating in record time; joins elite group with SEI CMM Level 3 Rating	Wang, Billerica Massachusetts	Wang	Aug. 8, 1997
Warner Robins Air Logistics Center Avionics Mgmt. Directorate	The Honor Roll	Cross Talk - The Journal of Defense Software Engineering	Functions of Defense	Nov/Dec 1995
Xerox Corporate Engineering Center, Centro de Desenvolvimento de Sistemas de Vitoria	Xerox Brazilian Software Development Center Achieves Software Engineering Institute's Capability Maturity Model Level 3	Xerox Press Release, Webster N.Y.	Press Release	Feb. 3, 1998

Level 4 Companies

Citibank, Citicorp Overseas Software Ltd. Division	Citibank's Software Subsidiary is SEI CMM Level 4 Certified	Newsbytes News Network	N/A	Jul. 9, 1997
CITIL (Citicorp Information Technology Industries Limited)	CITIL's March to Maturity: How CITIL Reached Level 4	Software Engineering Symposium Proceedings	Software Engineering Institute	Sep. 1996
Computer Sciences Corporation's Integrated Systems Division	CSC Federal Business Unit Earns SEI Software Level 4 Maturity Rating	Computer Sciences Corporation http://www.csc.com	PRNewswire	Jun. 18, 1998
DSQ	DSQ at CMM Level 4	Business Line	The Hindu	Jun. 22, 1998
Honeywell India Software Operation	Honeywell's SW Unit at Bangalore SEI Level 4 Certified	Newsbytes News Network	NewsNet	Mar. 24, 1997
Infosys Technologies Limited	Infosys achieves SEI CMM Level 4	Computer World, Media Transasia India Ltd.	Newstrack	Jan. 16, 1998
Lockheed Martin Federal Systems, Gaithersburg	Lockheed Martin Unit Attains Level 4 SW-CMM Certification	http://www.prnewswire.com	PRNewswire	Dec. 1, 1997
Lockheed Martin Ocean, Radar & Sensor Systems	Lockheed Martin Ocean, Radar & Sensor Systems Receives Prestigious Software Rating	http://www.prnewswire.com	PRNewswire	Dec. 5, 1997
Loral Federal Systems	The Honor Roll	Cross Talk - The Journal of Defense Software Engineering	Functions of Defense	Nov/Dec 1995
Oklahoma City Air Logistics Center Directorate of Aircraft Managment Software Division Test Software and Industrial Plant Equipment Branches	TBD	Tinker Take Off	Tinker AFB	Nov. 22, 1996
Telos Corp., Software Engineering Center Fire Support, Lawton Ok	Telos Achieves CMM Level 4 Certification	Press Release	Telos Corporation	Nov. 25, 1997
Wipro Infotech Group Global R&D Division	Wipro's Global R&D Division is SEI Level 4 Certified	Newsbytes News Network	Newsnet	Mar. 31, 1997

Level 5 Companies

Boeing Defense & Space Group	Boeing SW Dev. Team Joins Computing Elite as Defense & Space Group Team Earns Top SEI Rating	PRNewswire	NewsNet	Aug. 1996
IBM Federal Systems Company	Journey To A Mature Software Process	IBM Systems Journal, v 33	Billings et al.	Nov. 1994
Lockheed Martin Feðeral Systems, Owego	Lockheed Martin Federal Systems, Owego Attains Highest Level foe Software Development Capability	http://www.prnewswire.com	PRNewswire	Dec. 22, 1997
Motorola India Electronic Ltd. (MIEL)	Motorola India Self-Assesses at Level 5	IEEE Software, v11, No.2	IEEE	Mar. 1994
Ogden Air Logistics Center Software Engineering Division at Hill AFB	AF gets Top CMM Rating	GCN, Goverment Computer News (http://www.gcn.com)		

(C)   Example of Existing Organization Structure

C1: Company's

Companies Organization Structure Selected:
        a) DEF-Corp
        b) ABC-Malaysia
    .   c) JKL-Malaysia.

C2: IT Position Within the Company's Organization

(a)   DEF-Corp Organization Structure

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                        ┌──────────────────┐
                        │       WHO        │
                        │ (World Head Office)│
                        └──────────────────┘
          ┌──────────────────┼──────────────────┐
 ┌──────────────┐    ┌──────────────────────┐   ┌──────────────┐
 │      RO      │    │         RO           │   │      RO      │
 │(Europe & Africa)│ │(Asia, Pacific, Middle East)│ │(The America)│
 └──────────────┘    └──────────────────────┘   └──────────────┘
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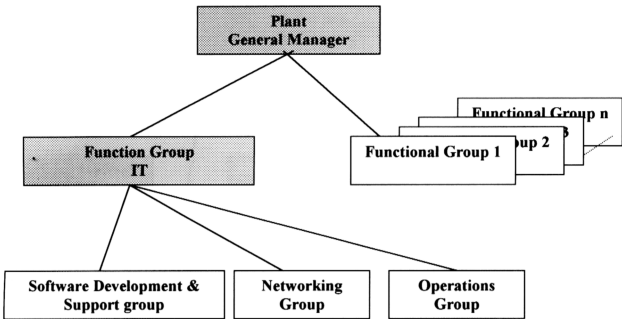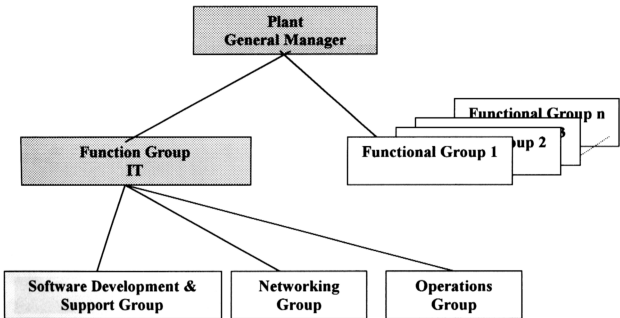
```
            ┌──────────────┐      ┌──────────────┐
            │  Functional  │      │     Area     │
            │    Group     │      │    Group     │
            └──────────────┘      └──────────────┘
```

```
 ┌──────────┐   ┌──────────────┐   ┌──────────────────┐   ┌──────┐
 │  GHI-    │   │   Finance    │   │    RO Finance    │   │      │
 │  Corp    │   │  (Regional)  │   │(Functional Groupp)│  │      │
 └──────────┘   └──────────────┘   └──────────────────┘   └──────┘
```

```
    ┌──────┐  ┌──────────────┐  ┌──────┐          ┌──────────────┐
    │      │  │ Area Region  │  │      │          │  RO Service  │
    │      │  │   (Asean)    │  │      │          │  (Service    │
    └──────┘  └──────────────┘  └──────┘          └──────────────┘
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┌──────────────┐ ┌──────────────┐ ┌──────────────┐ ┌──────────────┐
│      CO      │ │      CO      │ │      CO      │ │      CO      │
│(Country Office)│ │(Country Office)│ │(Country Office)│ │(Country Office)│
│   Thailand   │ │ JKL-Malaysia │ │  Singapore   │ │  Indonesia   │
└──────────────┘ └──────────────┘ └──────────────┘ └──────────────┘
```

```
         ┌──────┐  ┌──────────────┐  ┌──────┐
         │      │  │   IT Dept    │  │      │
         │      │  │(Function Grp)│  │      │
         └──────┘  └──────────────┘  └──────┘
```
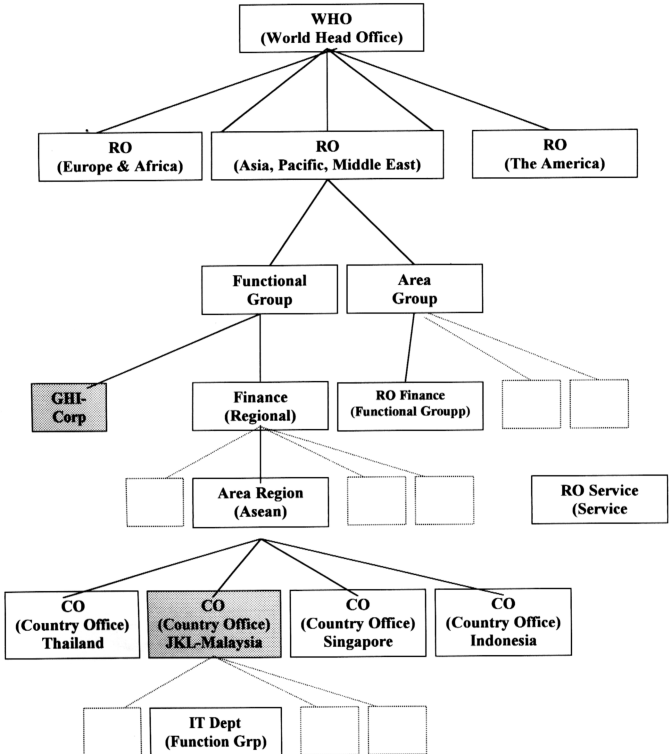
(This organization structure can't be reproduce without the prior approval of DHL)

(b)   ABC-Malaysia Organization Structure

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                    ┌─────────────────┐
                    │      Plant      │
                    │ General Manager │
                    └─────────────────┘
                       /          \
        ┌──────────────────┐   ┌──────────────────────────────┐
        │  Function Group  │   │        Functional Group n     │
        │       IT         │   │      ┌──────────────────┐  3  │
        └──────────────────┘   │   up 2│ Functional Group 1│   │
           /      |      \     └──────────────────────────────┘
┌──────────────────┐ ┌────────────┐ ┌────────────┐
│ Software Development & │ │ Networking │ │ Operations │
│   Support group   │ │   Group    │ │   Group    │
└──────────────────┘ └────────────┘ └────────────┘
```

(c)   JKL-Malaysia Organization Structure (quite similar to ABC-Malaysia)

```
                    ┌─────────────────┐
                    │      Plant      │
                    │ General Manager │
                    └─────────────────┘
                       /          \
        ┌──────────────────┐   ┌──────────────────────────────┐
        │  Function Group  │   │        Functional Group n     │
        │       IT         │   │      ┌──────────────────┐  3  │
        └──────────────────┘   │   up 2│ Functional Group 1│   │
           /      |      \     └──────────────────────────────┘
┌──────────────────┐ ┌────────────┐ ┌────────────┐
│ Software Development & │ │ Networking │ │ Operations │
│   Support Group   │ │   Group    │ │   Group    │
└──────────────────┘ └────────────┘ └────────────┘
```

(d)   GHL-Corp Organization Structure (typical of an software house)
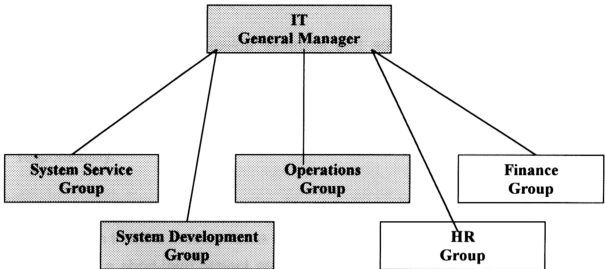
(D)   Companies Referred to, by this research.

Company's Name	Location	Parent Company	Firm's prime Business	Staff Strength
ABC-Malaysia	Malaysia	In US	Semiconductor	5,000
DEF-Corp	Brussels	-	Air Express	26,000
GHI-Corp	Malaysia	DEF-Corp	Air Express	500
JKL-Malaysia	Malaysia	DEF-Corp	Software[7] provider	150
MNO-Corporation	India	-	Software	2,000

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[7] *Provide Software solution to the Asia Pacific and Middle East (AP & ME) country office of DEF corporations.*

(E)   SEI Roles and Responsibilities

A manager's role is to provide technical and administrative direction and control to individuals performing tasks or activities within the manager's area of responsibility. The traditional functions of a manager includes planning, resourcing, organizing, directing, and controlling work within an area of responsibility.

A senior manager fulfills a management role at a high enough level in an organization that the primary focus is the long-term vitality of the organization, rather than a short-term project and contractual concerns and pressures. In general, a senior manager for engineering would have responsibility for multiple projects. A senior manager also provides and protects resources for long-term improvement of the software process (e.g., a software engineering process group). Senior management, as used in the CMM, can denote any manager who satisfies the above description, up to and including the head of the whole organization. As used in the key practices, the term senior management should be interpreted in the context of the key process area and the projects and organization under consideration. The intent is to include specifically those senior managers who are needed to fulfill the leadership and oversight roles essential to achieving the goals of the key process area.

A project manager fulfills the role with a total business responsibility for an entire project; the project manager is the individual who directs, controls, administers, and regulates a project building on a software or hardware/software system. The project manager is the individual ultimately responsible to the customer. In a project-oriented organizational structure, most of the people working on a project would report to the project manager, although some disciplines might have a matrix reporting relationship. In a matrix organizational structure, it may be only the business staff who reports to the project manager. The engineering groups would then have a matrix reporting relationship.

A <u>project software manager</u> fulfills the role with total responsibility for all the software activities for a project. The project software manager is the individual the project manager deals with in terms of software commitments and who controls all the software resources for a project. The software engineering groups on a project would report to the project software manager, although some activities such as tools development might have a matrix reporting relationship. In a large project, the project software manager is likely to be a second-, third-, or fourth-line manager. In a small project or functions with a single project, the project software manager might be the first-line software manager or might be at a higher level.

A <u>first-line software manager</u> fulfills the role with direct management responsibility (including providing technical direction and administering the personnel and salary functions) for the staffing and activities of a single organizational unit (e.g., a functions or project team) of software engineers and other related staff.

A <u>software task leader</u> fulfills the role of a leader of a technical team for a specific task, who has technical responsibility and provides technical direction to the staff working on the task. The software task leader usually reports to the same first-line software manager as the other people who are working on the task.

Several terms are used in the CMM to denote the individuals who perform the various technical roles described in various key practices of the CMM. The <u>staffs</u> are individuals, including task leaders, who are responsible for accomplishing an assigned function, such as software development or software configuration management, but who are not managers.

The <u>software engineering staff</u> are the software technical people (e.g., analysts, programmers, and engineers), including software task leaders, who perform the software development and maintenance activities for the project, but who are not managers.

The term "individuals" as used in the key practices is qualified and bounded by the context in which the term appears (e.g., "the individual involved in managing the software subcontract").