

日本IT団体連盟

国際オンラインセミナー「デジタル社会を形成するデータ基盤と人材」

セッション1：ACM/IEEE-CS新カリキュラム標準CC2020とコンピテンシに基づいた産学連携の展望

お断り：資料は2022年3月15日、IEEE EDUNINE2022でのpaperプレゼン資料ベースのため英文ページ多数あります。

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0. 自己紹介

1. 日本IBM株式会社

- 銀行担当SE
- IT戦略コンサルタント

2. 独立法人情報処理推進機構(IPA)、IT人材育成本部

- iCD(i Competency Dictionary)開発
- iCDグローバル展開推進
- CC2020開発メンバー

3. VJP株式会社

- ベトナム人技術者による案件支援、オフショア案件の開拓・支援

4. iCD協会(iCD Association)

- 理事、グローバル連携部会主査としてSFIA等グローバル連携推進
- SFIA V7、V8 日本語翻訳

5. 早稲田大学グローバルSWエンジニアリング研究所

- 招聘研究員

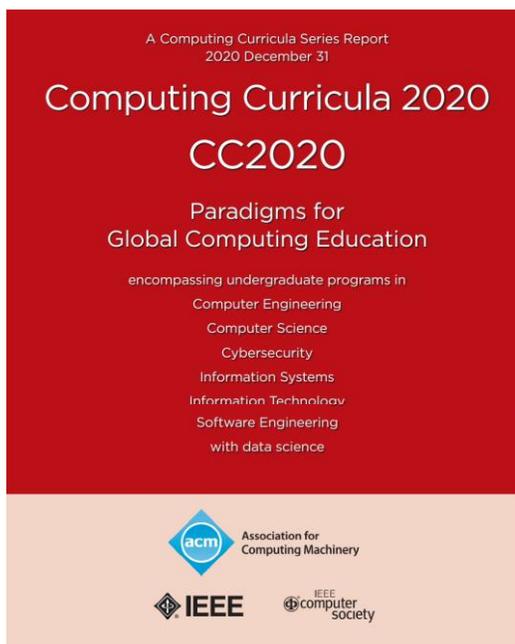
“The Competency-based Computing Curricula 2020 and SFIA V7 comparison focusing on Digital Transformation Age”

1. Paper Overview

University



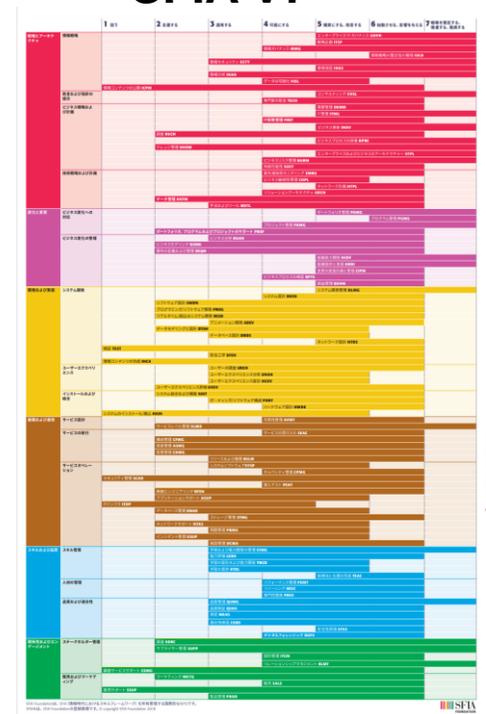
CC2020



Industry



SFIA V7



compare



Competency vs Competency

Competency = “I can do this”

Undergraduate IT Curriculum Global Standard(ACM/IEEE-CS)

IT Skill Framework Global de facto Standard(SFIA Foundation)

2. What is CC2020

CC2005

Computing Curricula 2005

The Overview Report
covering undergraduate degree programs in
 Computer Engineering
 Computer Science
 Information Systems
 Information Technology
 Software Engineering

A volume of the *Computing Curricula Series*

The Joint Task Force for Computing Curricula 2005

A cooperative project of
 The Association for Computing Machinery (ACM)
 The Association for Information Systems (AIS)
 The Computer Society (IEEE-CSS)

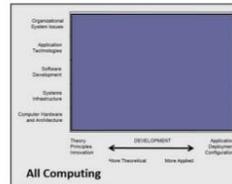
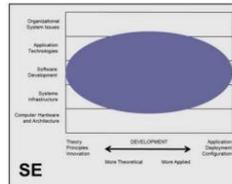
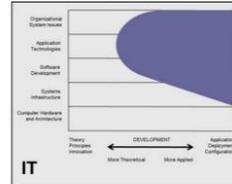
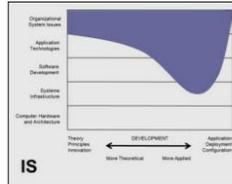
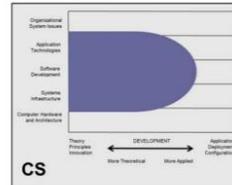
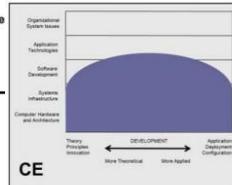
30 September

a task force of 50 people from 20 countries



knowledge-based

competency-based



CC2020

(Announced 2021 Feb.)

A Computing Curricula Series Report
 2020 December 31

Computing Curricula 2020

CC2020

Paradigms for
 Global Computing Education

encompassing undergraduate programs in
 Computer Engineering
 Computer Science
 Cybersecurity
 Information Systems
 Information Technology
 Software Engineering
 with data science

acm Association for Computing Machinery
 IEEE IEEE Computer Society

Computing Disciplines

CE

CS

IS

IT

SE

CSEC

DS

Competency = Knowledge + Skills + Dispositions

- Knowledge—"know-what"
- Skills—"know-how"
- Dispositions—"know-why"

- Computer Engineering Curricula 2016 (CE2016)
- Computer Science Curricula 2013 (CS2013)
- Information Systems 2010 (IS2010)
- Information Technology Curricula 2017 (IT2017)
- Software Engineering Curricula 2014 (SE2014)
- Cybersecurity Curricula 2017 (CSEC2017)
- (• Data Science Curricula 2021 (DS2021))

3. What is SFIA (Skills Framework for the Information Age)

- 産業界のITスキル・グローバルデファクト標準
 - 200か国以上で使用
 - 11か国語に翻訳
- 殆どの使用は無料。ビジネス活用は有料
- オーストラリア、ニュージーランド、サウジアラビアはSFIAを国家ITスキル標準に採用

History

2021 – SFIA V8

2018 – SFIA V7

2015 – SFIA V6

2011 – SFIA V5

2008 – SFIA V4

2005 – SFIA V3

2003 – SFIA Foundation Formed

2001 – SFIA V2

2000 – SFIA V1

1990 – 1998 Various UK initiatives

3. What is SFIA : Contents

6 Categories

- Strategy and architecture (27)
- Change and transformation(12)
- Development and implementation(20)
- Delivery and operation(20)
- Skills and quality(14)
- Relationships and engagement(9)

7 Level of Responsibilities(LoR)

		1. Know	2. Assist	3. Apply	4. Handle	5. Ensure, advise	6. Initiate, influence	7. Lead strategy, inspire, motivate	
Strategy and architecture	Information technology				Information governance IIGM	Information security IISG	Information systems coordination IISC	Information systems integration IISI	
					Information security IISG	Information systems integration IISI	Information systems integration IISI	Information systems integration IISI	
					Information security IISG	Information systems integration IISI	Information systems integration IISI	Information systems integration IISI	
	Advice and guidance				Specialist advice IISA	Specialist advice IISA	Specialist advice IISA	Specialist advice IISA	Specialist advice IISA
					Specialist advice IISA	Specialist advice IISA	Specialist advice IISA	Specialist advice IISA	Specialist advice IISA
					Specialist advice IISA	Specialist advice IISA	Specialist advice IISA	Specialist advice IISA	Specialist advice IISA
	Business strategy and planning				Business strategy IBSM	Business strategy IBSM	Business strategy IBSM	Business strategy IBSM	Business strategy IBSM
					Business strategy IBSM	Business strategy IBSM	Business strategy IBSM	Business strategy IBSM	Business strategy IBSM
					Business strategy IBSM	Business strategy IBSM	Business strategy IBSM	Business strategy IBSM	Business strategy IBSM
	Technological strategy and planning				Technological strategy ITSM	Technological strategy ITSM	Technological strategy ITSM	Technological strategy ITSM	Technological strategy ITSM
					Technological strategy ITSM	Technological strategy ITSM	Technological strategy ITSM	Technological strategy ITSM	Technological strategy ITSM
					Technological strategy ITSM	Technological strategy ITSM	Technological strategy ITSM	Technological strategy ITSM	Technological strategy ITSM
Change and development				Business change IBCM	Business change IBCM	Business change IBCM	Business change IBCM	Business change IBCM	
				Business change IBCM	Business change IBCM	Business change IBCM	Business change IBCM	Business change IBCM	
				Business change IBCM	Business change IBCM	Business change IBCM	Business change IBCM	Business change IBCM	
Development and implementation				Software development ISDM	Software development ISDM	Software development ISDM	Software development ISDM	Software development ISDM	
				Software development ISDM	Software development ISDM	Software development ISDM	Software development ISDM	Software development ISDM	
				Software development ISDM	Software development ISDM	Software development ISDM	Software development ISDM	Software development ISDM	
Delivery and operation				System design ISDM	System design ISDM	System design ISDM	System design ISDM	System design ISDM	
				System design ISDM	System design ISDM	System design ISDM	System design ISDM	System design ISDM	
				System design ISDM	System design ISDM	System design ISDM	System design ISDM	System design ISDM	
Skills and quality				Skills management ISDM	Skills management ISDM	Skills management ISDM	Skills management ISDM	Skills management ISDM	
				Skills management ISDM	Skills management ISDM	Skills management ISDM	Skills management ISDM	Skills management ISDM	
				Skills management ISDM	Skills management ISDM	Skills management ISDM	Skills management ISDM	Skills management ISDM	
Relationships and engagement				Supplier management ISDM	Supplier management ISDM	Supplier management ISDM	Supplier management ISDM	Supplier management ISDM	
				Supplier management ISDM	Supplier management ISDM	Supplier management ISDM	Supplier management ISDM	Supplier management ISDM	
				Supplier management ISDM	Supplier management ISDM	Supplier management ISDM	Supplier management ISDM	Supplier management ISDM	

102 Skills

SFIA Skill = Competency

Skills Framework for the Information Age version 7 www.sfia-online.org

3. What is SFIA : SFIA View



- Digital transformation skills in SFIA
- Big Data/Data Science skills in SFIA
- DevOps skills in SFIA
- Bodies of Knowledge
- SFIA skills profiles for EU ICT professional role
- SFIA for professional bodies
- SFIA for governments and government agencies
- SFIA for education and training
- SFIA for employers
- Licensing SFIA
- Get help
- Get accredited
- News
- About us

45 Skills

Click on image to see full size.

Home / Tools and resources / SFIA Views / Digital transformation skills in SFIA

Digital transformation skills in SFIA

Digital transformation aims to improve operating processes, making them easier to use and flexible for information.

The SFIA framework provides a set of tools and competencies for using SFIA to manage digital transformation.

Level of Responsibility	1	2	3	4	5
	Follow	Assist	Apply	Enable	Ensure, advise, initiate
Enablers				Emergence	
Change and governance				Market research	Product management
Culture and skills				Security	Resource
Strategy and innovation				Competency planning	Strategy, culture and change
				Professional performance	Performance
				Knowledge management	Information security
				Data management	Information security
				Partners, engagement and impact	Project management
				Emergence	Relationships
				User experience analysis	User experience design
				User experience evaluation	Analytics
				Customer service support	Data science
				Business modeling	Systems design
				Requirements definition and management	Architecture
				Success analysis	Supplier management
				Methods and tools	



- Software engineering competencies
- Digital transformation skills in SFIA
- Big Data/Data Science skills in SFIA
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44 Skills

Click on image to see full-size interactive

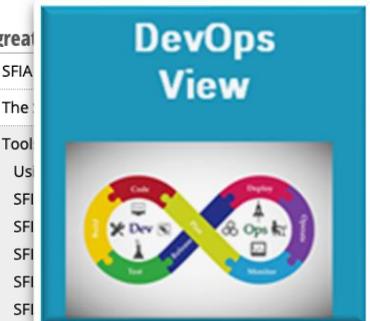
Home / Tools and resources / SFIA Views / Big Data/Data Science skills in SFIA

Big Data/Data Science skills in SFIA

Big data that contains a great deal of information has the capability to analyze patterns, trends, and statistics, and with ever-higher velocity. Data science is the process of using statistical methods to analyze and interpret data.

The SFIA framework provides a set of tools and competencies for using SFIA to manage big data/data science skills.

Level of Responsibility	1	2	3	4	5
	Follow	Assist	Apply	Enable	Ensure, advise, initiate
Governance				Information governance	Strategic planning
				Design planning	Strategy, culture and change
				Data management	Information security
				Information assurance	Information security
				Information security	Information security
				Methods and tools	Information security
				Knowledge management	Information security
				Design implementation and management	Information security
				Competency planning	Information security
				Learning delivery	Information security
				Performance management	Information security
				Custom architecture	Information security
				System development and management	Information security
				Database design	Information security
				Business design	Information security
				Programming/software development	Information security
				Business process testing	Information security
				Testing	Information security
				Analytics	Information security
				Data visualization	Information security
				Information content authoring	Information security
				Information content publishing	Information security
				Database administration	Information security
				Availability management	Information security
				Capacity management	Information security
				Quality management	Information security
				Continuity management	Information security
				Quality assurance	Information security
				Information security	Information security
				Security administration	Information security
				Business risk management	Information security
				Continuity management	Information security



- Software engineering competencies
- Digital transformation skills in SFIA
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26 Skills

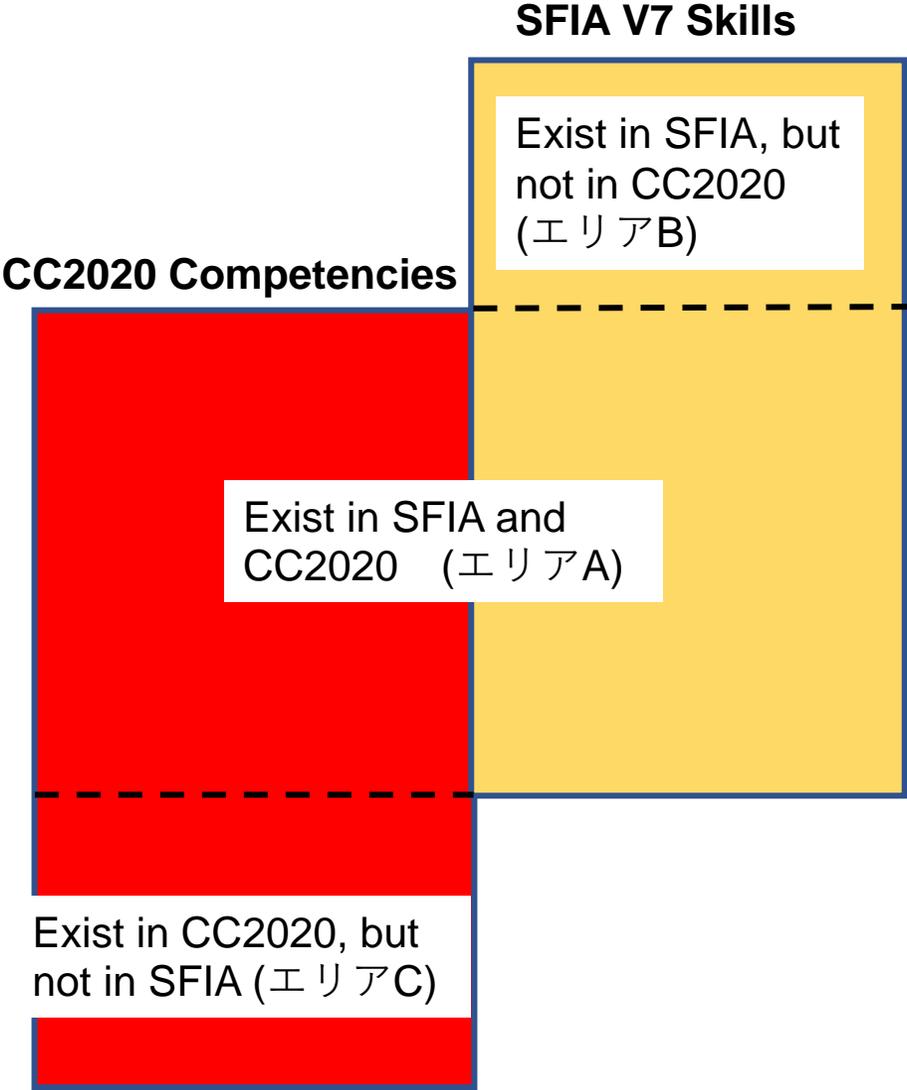
Level of Responsibility	1	2	3	4	5	6	7
	Follow	Assist	Apply	Enable	Ensure, advise	Initiate, influence	Set strategy, inspire, mobilize
Automation					Organizational capability development		
					Relationship management		
					Measurement		
					Competency assessment		
					IT management		
					Systems development management		
					Learning delivery		
					Configuration management		
					Programming/software development		
					Systems integration and build		
					Release and deployment		
					Database administration		
					IT infrastructure		
					Methods and tools		
					Product management		
					Requirements definition and management		
					Information security		
					User experience evaluation		
					Change management		
					Incident management		
					Problem management		
					Performance management		
					Professional development		
					Knowledge management		



44 Skills

4. Paper Introduction

4-1: CC2020 vs SFIA V7 Comparison



4. Paper Introduction

4-2 Three RQs(Research Questions)

RQ1: CC2020とSFIAはどのくらいマッチングしているか

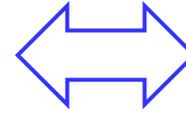
RQ2: アンマッチしない領域とその理由はなにか。

アンマッチしない領域につき大学側と産業界側はどう考えるべきか

RQ3: CC2020はDigital Transformationに対しどの程度対応しているか

Category	Competency	
<p>Identifying and designing opportunities for IT-enabled organizational improvement</p>	<p>1. Analyze the current fit between IT strategy and organizational strategy and take corrective action to align the two, when necessary.</p>	●
	<p>2. Understand General Systems theory, including its key principles and applications</p>	●
	<p>3. Model organizational processes with at least one modern business process modeling language.</p>	
	<p>4. Extract information systems requirements from future state process models.</p>	
	<p>5. Building on the foundation of risk-based management theory, apply risk analysis to real organizations.</p>	
	<p>6. Determine information systems requirements based on demonstrated needs for organizational controls</p>	
	<p>7. Identify process performance indicators and monitors, applying industry recommendations like ITIL</p>	
	<p>8. Understand emerging technologies to identify innovative business opportunities based on these technologies.</p>	
	<p>9. Develop business proposals based on the use of emerging technologies in an organization.</p>	
	<p>10. Apply entrepreneurial and creative thinking to transform organizations using emerging technologies</p>	
	<p>11. Analyze and document various business stakeholders' information requirements for a proposed system.</p>	
	<p>12. Apply modern industrial practices and techniques on system documentation and user interviewing (i.e. ITIL and PMBOK). Unmatch: SFIA Skill is unclear</p>	
	<p>13. Apply foundational knowledge of human-computer interaction principles to systems and user interface design.</p>	
	<p>14. Apply knowledge of data visualization and representation for an application related to analytics and complex data representation.</p>	

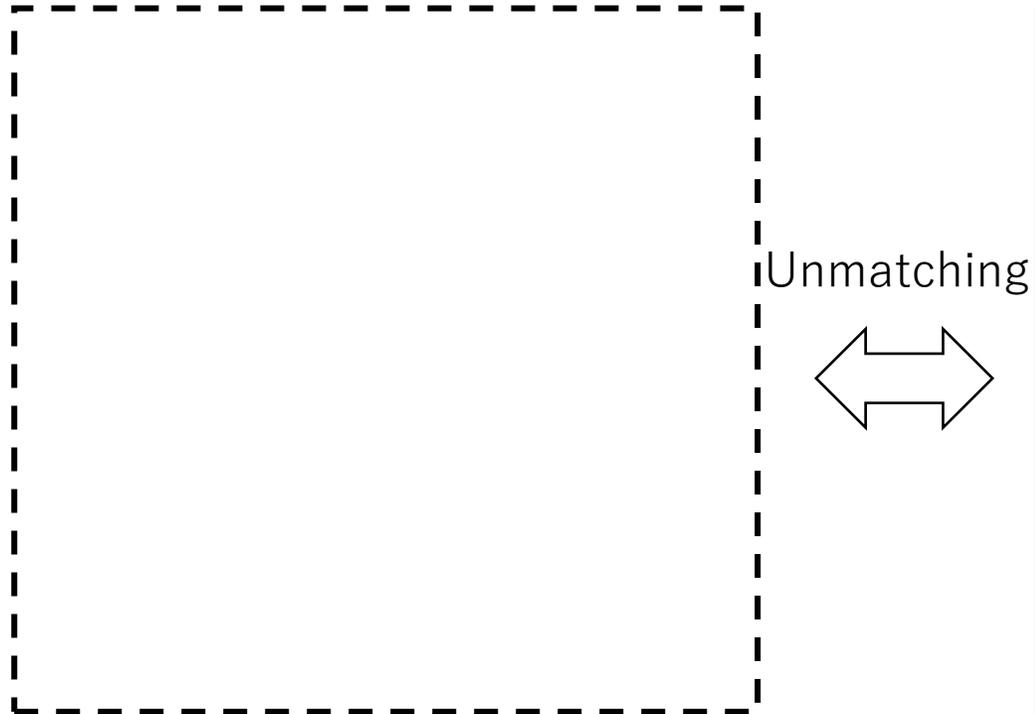
Matching



Strategic planning ITSP

The creation, iteration and maintenance of a strategy in order to align organizational actions, plans and resources with business objectives and the development of plans to drive forward and execute that strategy. Working with stakeholders to communicate and embed strategic management via objectives, accountabilities and monitoring of progress.

エリア A



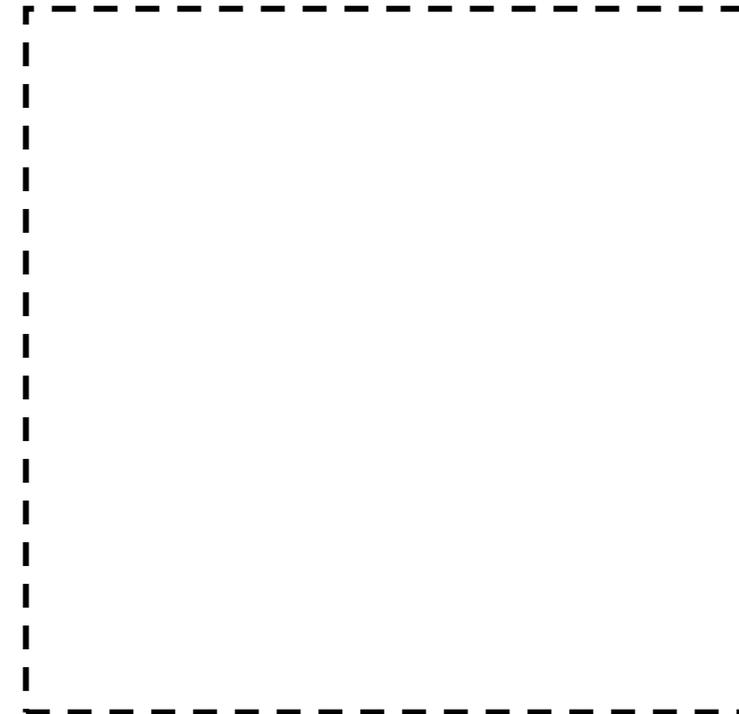
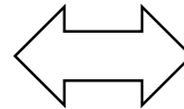
Portfolio management POMG

The development and application of a systematic management framework to define and deliver a portfolio of programmes, projects and/or ongoing services, in support of specific business strategies and objectives. Includes the implementation of a strategic investment appraisal and decision making process based on a clear understanding of cost, risk, inter-dependencies, and impact on existing business activities, enabling measurement and objective evaluation of potential changes and the benefits to be realised. The prioritisation of resource utilisation and changes to be implemented. The regular review of portfolios. The management of the service pipeline (proposed or in development), service catalogue (live or available for deployment) and retired services.

エリア B

Category	Competency
<p>AL-Algorithms and Complexity</p>	<p>A. Present to a group of peers the data characteristics of conditions or assumptions that can lead to different behaviors of specific algorithms and from the analysis, illustrate empirical studies to validate hypotheses about runtime measures.</p>
	<p>B. Illustrate informally the time and space complexity of algorithms and use big-O notation formally to show asymptotic upper bounds and expected case bounds on time and space complexity, respectively.</p>
	<p>C. Use recurrence relations to determine the time complexity of recursively defined algorithms by solve elementary recurrence relations and present the results to a group of scholars.</p>
	<p>D. Determine an appropriate algorithmic approach to an industry problem and use appropriate techniques (e.g., greedy approach, divide-and-conquer algorithm, recursive backtracking, dynamic programming, or heuristic approach) that considers the trade offs between the brute force to solve a problem.</p>
	<p>E. Implement basic numerical algorithm methods (e.g., search algorithms, common quadratic and $O(N \log N)$ sorting algorithms, fundamental graph algorithms, string-matching algorithm) to solve an industry problem and select the appreciate algorithm for a particular context.</p>
	<p>F. Design a deterministic finite state machine for a local engineering firm that accepts a specified language and generates a regular expression to represent the language.</p>

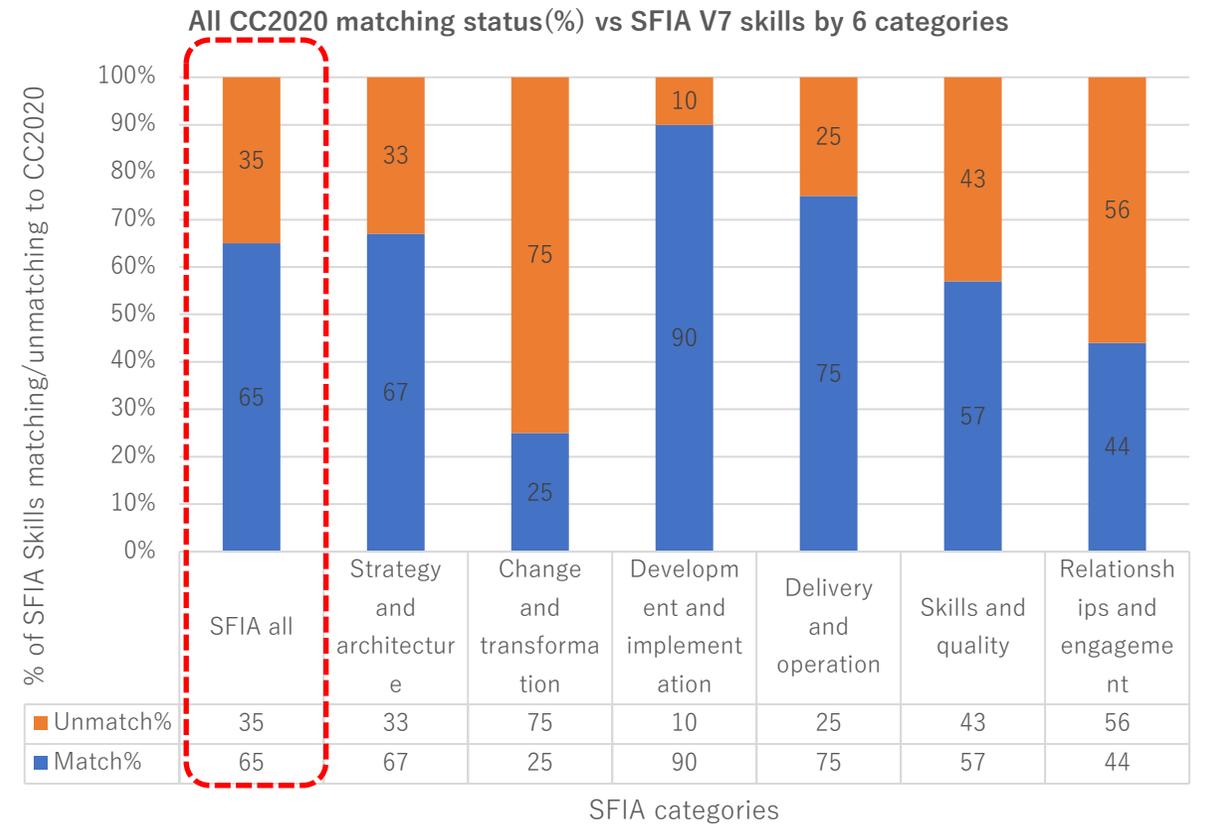
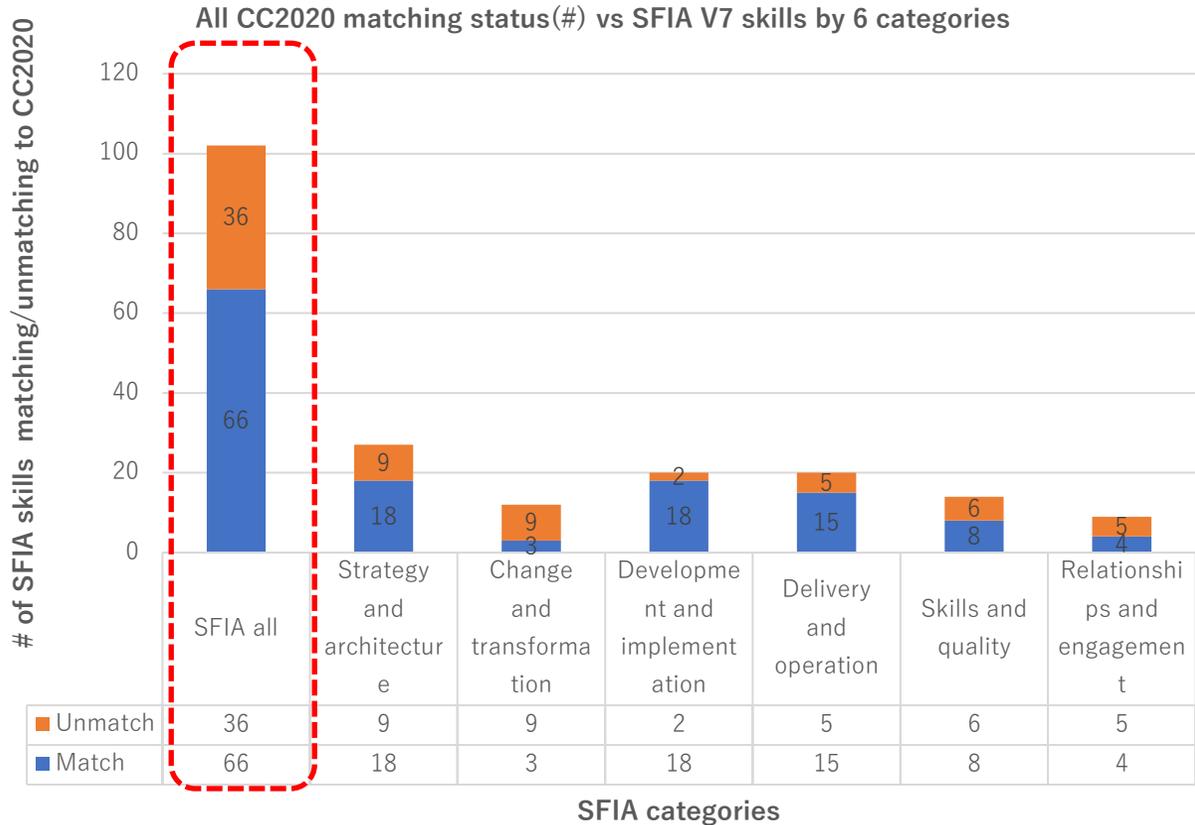
Unmatching



エリア C

4. Paper Introduction

4-3 Results ⇒ RQ1 : CC2020とSFIAはどのくらいマッチングしているか (エリアA)



4. Paper Introduction

4-3 Results⇒RQ2: アンマッチしない領域とその理由はなにか (エリアB)

SFIA 36 skills unmatched to CC2020

Skill Category	Strategy and architecture									Change and transformation							Development and implementation	Delivery and operation				Skills and quality					Relationships and engagement										
Skill Name	Information systems coordination ISCO	Analytics INAN	Data visualization VISL	Information content publishing ICPM	Consultancy CNSL	Specialist advice TECH	Financial management FMIT	Research RSCH	Sustainability strategy SUST	Portfolio management POMG	Programme management PGMG	Business analysis BUAN	Business modelling BSMO	Organizational capability development OCDV	Organisation design and implementation ORDI	Change implementation planning and management CIPM	Business process testing BPTS	Benefits management BENM	Animation development ADEV	Porting/software configuration PORT	Change management CHMG	Release and deployment RELM	Radio frequency engineering RFEN	Problem management PBMG	Incident management USUP	Learning design and development TMCR	Learning delivery ETDL	Teaching and subject formation TEAC	Professional development PDSV	Measurement MEAS	Conformance review CORE	Customer service support CSMG	Marketing MKTG	Selling SALE	Sales support SSUP	Product management PROD	
Unmatched Reason	2	3	3	2	1	2	2	3	2	2	2	1	1	2	2	2	1	1	3	3	2	3	3	3	2	2	2	2	2	1	2	2	2	1	1	1	1

<Unmatched Reasons>

Reason 1: Business-related Skills 10(28%)

Reason 2: Organization-related Skills 18(50%)

Reason 3: Advanced technology-related Skills 8(22%)

4. Paper Introduction

4-3 Results ⇒ RQ2: アンマッチしない領域とその理由はなにか (エリアC)

6 disciplines	Category	SFIA matching	Unmatched Reason	
CE	CE-CAE Circuits and Electronics	x	①	
	CE-CAL Computing Algorithm	x	①	
	CE-CAO Computer Architecture & Organization	x	①	
	CE-DIG Digital Design	x	①	
	CE-ESY Embedded System	x	①	
	CE-NWK Computer Networks	o		
	CE-PPP Preparation for Professional Practice	x	②	
	CE-SEC Information Security	x	①	
	CE-SGP Signal Processing	x	①	
	CE-SPE Systems and Project Engineering	o		
	CE-SRM System Resource Management	o		
	CE-SWD Software Design	o		
	CS	AL-Algorithms and Complexity	x	①
AR-Architecture and Organization		x	①	
CN-Computational Science		x	①	
DS-Discrete Structure		x	①	
BV-Graphics and Visualization		o		
HCI-Human-Computer Interaction		o		
AS-Information Assurance and Security		x	①	
M-Information Management		o		
S-Intelligent Systems		x	①	
NC-Networking and Communication		o		
OS-Operating Systems		x	①	
PBD-Platform-based Development		o		
PD-Parallel and Distributed Computing		x	①	
PL-Programming Languages		o		
SDF-Software Development Fundamentals		o		
SE-Software Engineering		o		
BF-Systems Fundamentals		o		
SP-Social Issues and Professional Practice		o		
IS		Identifying and designing opportunities for IT-enabled organizational improvement	o	
		Analyzing trade-offs	o	
	Designing and improving information systems solution	o		
	Managing ongoing information technology operations	o		
	Leadership and collaboration	o		
	Communication	x	②	
	Negotiation	x	②	
	Analytical and critical thinking, including creativity and ethical analysis	x	②	
IT	Mathematical foundations	x	①	
	TE-CSP Cybersecurity Principles	o		
	TE-GPP Global Professional Practices	o		
	TE-IMA Information Management	o		
	TE-IST Integrated Systems Technology	o		
	TE-NET Networking	o		
	TE-PFT Platform Technologies	o		
	TE-SPA System Paradigms	o		
	TE-SWF Software Fundamentals	o		
	TE-UXD User Experience Design	o		
	TE-WMF Web and Mobile Systems	o		
	Software Requirement	o		
	Software Design	o		
	Software Construction	o		
Software Testing	o			
Software Sustainment	o			
Software Process and Life Cycle	o			
Software Systems Engineering	o			
Software Quality	o			
Software Security	o			
Software Safety	o			
Software Configuration Management	o			
Software Measurement	o			
Human-Computer Interaction	x	④		
Project Management	o			
Behavioral Attributes	o			
CSEC	Data	o		
	Software	o		
	Component	o		
	Connection	o		
	System	o		
	Human	x	④	
	Organizational	o		
	Societal	x	④	

<Unmatched Reasons>

- Reason ①: Fundamental Science Competencies 10(28%)
- Reason ②: SFIA LoR definition, not SFIA skills 4(17%)
- Reason ③: Competency unknown 1 (4%)
- Reason ④: Not Industrial Issues 2 (9%)

4. Paper Introduction

4-3 Results⇒ RQ3: : CC2020はDigital Transformationに対しどの程度対応しているか

- SFIA V7 DX view defines 45 skills⇒CC2020 vs SFIA DX view⇒CC2020 matched 29 skills out of 45 skills(64%)

← SFIA DX View (45 skills) →

Skill Category	Strategy and architecture									Change and transformation					Development and implementation		Relationships and engagement																												
Skill Subcategory	Information strategy			Business strategy and planning			Technical strategy and planning			Business change implementation		Business change management			Systems development	User experience		People management	Stakeholder management	Sales and marketing																									
Skill Name	Enterprise IT governance GOVN	Strategy Planning ITSP	Information governance IRMG	Information security SCTY	Information assurance INAS	Analytics INAN	Data visualization VISL	Demand management DEMM	Financial management FMIT	Innovation INOV	Business process improvement BPRE	Knowledge management KNOW	Enterprise and business architecture STPL	Emerging technology monitoring EMRG	Solution architecture ARCH	Data management DATM	Methods and tools METL	Portfolio management POMG	Programme management PGMG	Project management PRMG	Portfolio, programme and project support PROF	Business analysis BUAN	Business modelling BSMO	Requirements definition and management REQM	Organizational capability development OCDV	Organisation design and implementation ORDI	Change implementation planning and management CIPM	Benefits management BENM	Systems development management DLMG	Systems design DESN	User research URCH	User experience analysis UNAN	User experience design HCEV	User experience evaluation USEV	Competency assessment LEDA	Learning design and development TMCR	Performance management PEMT	Resourcing RESC	Professional development PDSV	Sourcing SORC	Supplier management SUPP	Relationship management RLMT	Customer service support CSMG	Marketing MKTG	Product management PROD

4. Paper Introduction

4-4 Three RQs Conclusions

RQ1: CC2020とSFIAはどのくらいマッチングしているか

- CC2020 は102個のSFIAスキルのうち66スキル (65%)とマッチしている。
- CC2020で、
 - ✓ CEは6スキル(6%)、CSは9スキル(9%)と殆どマッチングしていない。
 - ✓ ISは28 スキルとマッチングしている。
 - ✓ SE とCSECは多くのスキルとマッチングしている。

RQ2:アンマッチしない領域とその理由はなにか。また、アンマッチしない領域につき大学側と産業界側はどう考えるべきか

- エリアBは36 SFIA skills. アンマッチ理由はBusiness-related, Organization-related, Advanced technology-related
- エリアCはCEとCSは多くのアンマッチング、IT, SE, CSEC はほぼマッチング。アンマッチ理由は基礎学問、LoR、人と社会のカリキュラムである。
- エリアB：<産業界>⇒新人研修、OJT, Education Programs、<大学>⇒カリキュラム追加または産業界依存、インターンシップで補う
- エリアC：<産業界><大学>⇒基礎学問として大学カリキュラム継続、カリキュラムを産学でアセス。大学ごとに対応が異なる領域

客観的認識に基づく大学と産業界の協調

RQ3: CC2020はDXスキルにどの程度対応しているか

- CC2020 のSFIA DX view 45スキルのマッチングレベルは、SFIAの全102スキルと同じ程度のマッチングレベルで、DXスキルに特段の対応は無い。

1. SFIA V7 ⇒ SFIA V8

2. SFIA LoR consideration

LoR:Level of Responsibility, 責任レベル

3. Graduate Curriculum(ex. MSIS2016) vs SFIA

4. CC2020 vs DigComp, DISCO, e-CF, DigSC, iCD

5. Matching by Machine Learning

END