

2009年版 組込みソフトウェア産業実態調査 報告書

—海外調査—

平成21年7月

経済産業省 商務情報政策局
情報処理振興課

監修：組込みソフトウェア開発力強化推進委員会

組込みソフトウェア産業実態調査は、経済産業省がわが国の組込みソフトウェア産業の実態を把握するために、組込みソフトウェアに係る全ての企業・個人等を対象として、2003年度より毎年行っているものです。本調査結果を集計した情報は、経済産業省の組込みソフトウェアに係る産業政策の立案や、わが国産業の国際競争力強化政策立案のための基礎資料となります。

本年度の組込みソフトウェア産業実態調査は以下の構成になっております。

1. 経営者及び事業責任者向け
2. プロジェクト責任者向け
3. 技術者個人向け
4. 海外向け

本報告書は「海外調査」報告書です。

調査の対象

1. 情報家電機器や携帯機器、自動車や産業機器等の組込みソフトウェアが搭載された機器(組込み機器)を開発する企業・事業
2. 組込み機器に搭載されるソフトウェア(組込みソフトウェア/OS/ミドルウェア等)を開発・提供する企業・事業
3. 組込み機器の開発に利用されるツール/開発環境を開発・提供する企業・事業
4. 上記企業・事業に対する受託開発サービス、コンサルティングサービス、人材派遣サービス等を提供する企業・事業
5. 組込みソフトウェアや組込みシステム関連の教育・研修等を提供する組織、企業・事業

2009年版組込みソフトウェア産業実態調査は下記の国内向け調査と海外調査で構成されております。

1. 経営者及び事業責任者向け
企業全体のソフトウェア開発に対する取組みや経営課題等についての調査
2. プロジェクト責任者向け
プロジェクトにおけるソフトウェア開発の位置づけや課題・実態についての調査
3. 技術者個人向け
技術者個人のソフトウェア開発・関連業務におけるスキルや動機付け等の意識調査
4. 海外調査：電話インタビューによる聞き取り調査
開発者及び開発責任者向け
ソフトウェア開発に対する取組みや課題・実態についての調査(調査内容は国内調査の1と2を合わせた抜粋調査)
対象国：18カ国
中国、インド、韓国、台湾、タイ、シンガポール、マレーシア、ドイツ、フランス、英国、デンマーク、スウェーデン、ノルウェー、フィンランド、ポーランド、チェコ、ロシア、米国

回答状況

国内調査

1. 経営者及び事業責任者向け： 188事業部門(183社)
2. プロジェクト責任者向け： 345プロジェクト(248社)
3. 技術者個人向け： 770名

海外調査

4. 海外企業インタビュー数：156社(主要な組込み関連企業を選択)

調査期間

2009年2月～2009年3月

注)事業規模、採用実績、事業部門の売上げ、製品数及び不具合数等については、2007会計年度の実績の確定値

国内企業については経済産業省の各地域経済産業局、及び以下の52の工業会・協会等の団体のご協力を得て、各工業会・協会等に加盟している企業の経営者・事業責任者、プロジェクト責任者、及び技術者を対象としました。

また独立行政法人 情報処理推進機構に参画されている方で調査協力可能の方、2008年版調査で協力をお願いして調査可能と回答された個人を対象としました。

日本建設機械工業会
日本分析機器工業会
日本自動車部品工業会
日本電機工業会
日本産業車両協会
日本精密測定機器工業会
日本光学測定機工業会
日本印刷産業機械工業会
日本包装機械工業会
日本陸用内燃機関協会
日本半導体製造装置協会
日本食品機械工業会
コンピュータエンターテイメント協会
家電製品協会
組込みシステム技術協会
情報サービス産業協会
日本医用機器工業会
日本自動認識システム協会
日本冷凍空調工業会
日本測量機器工業会
日本照明器具工業会

日本補聴器工業会
日本自動販売機工業会
日本玩具協会
日本半導体ベンチャー協会
日本理学療法機器工業会
日本暖機器工業会
日本産業機械工業会
日本工作機械工業会
日本眼科医療法機器工業会
日本オーディオ協会
日本遊技機工業会
日本画像医療システム工業会
日本試験機工業会
日本農業機械工業会
日本工作機器工業会
日本ホームヘルス機器協会
ビジネス機械情報システム産業協会
日本エレベータ協会
情報通信ネットワーク産業協会
JasPar
日本アミューズメントマシン工業協会

日本航空宇宙工業会
インターホン工業会
日本電気制御機器工業会
トロン協会
電子情報技術産業協会
日本小型工作機械工業会
日本ガス石油機器工業会
日本時計協会
日本電気計測器工業会
日本ロボット工業会

海外調査について

調査対象国を下記の5地域で表記しました。

中国

インド

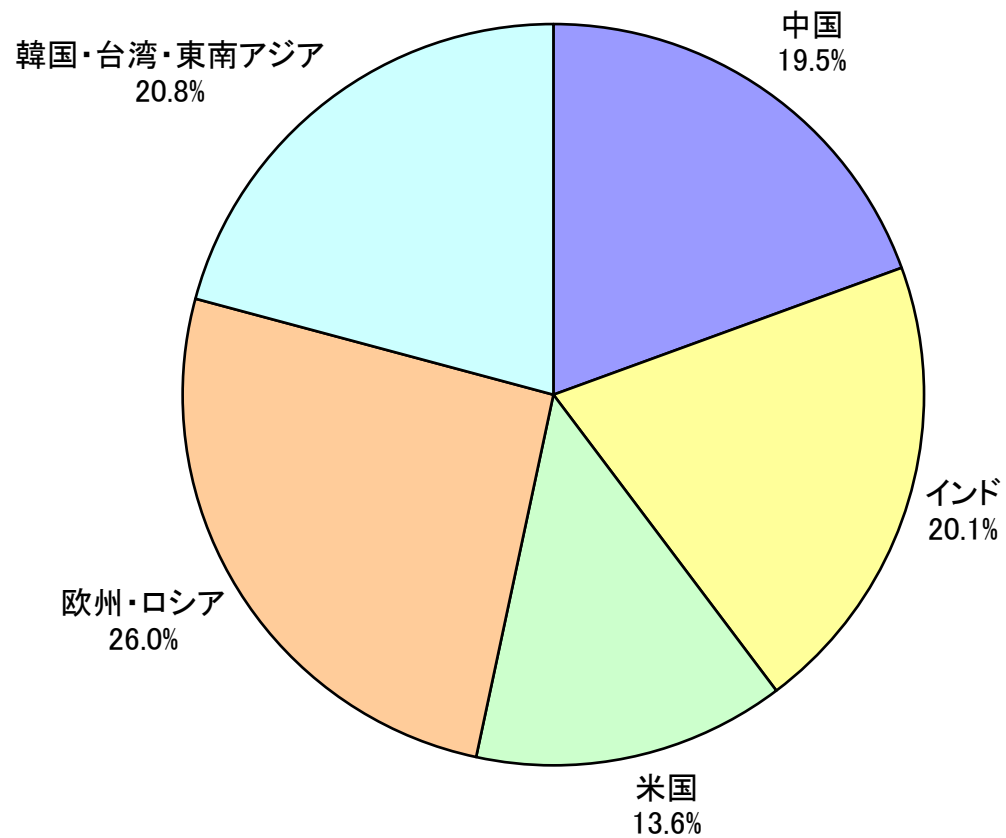
米国

欧州・ロシア:

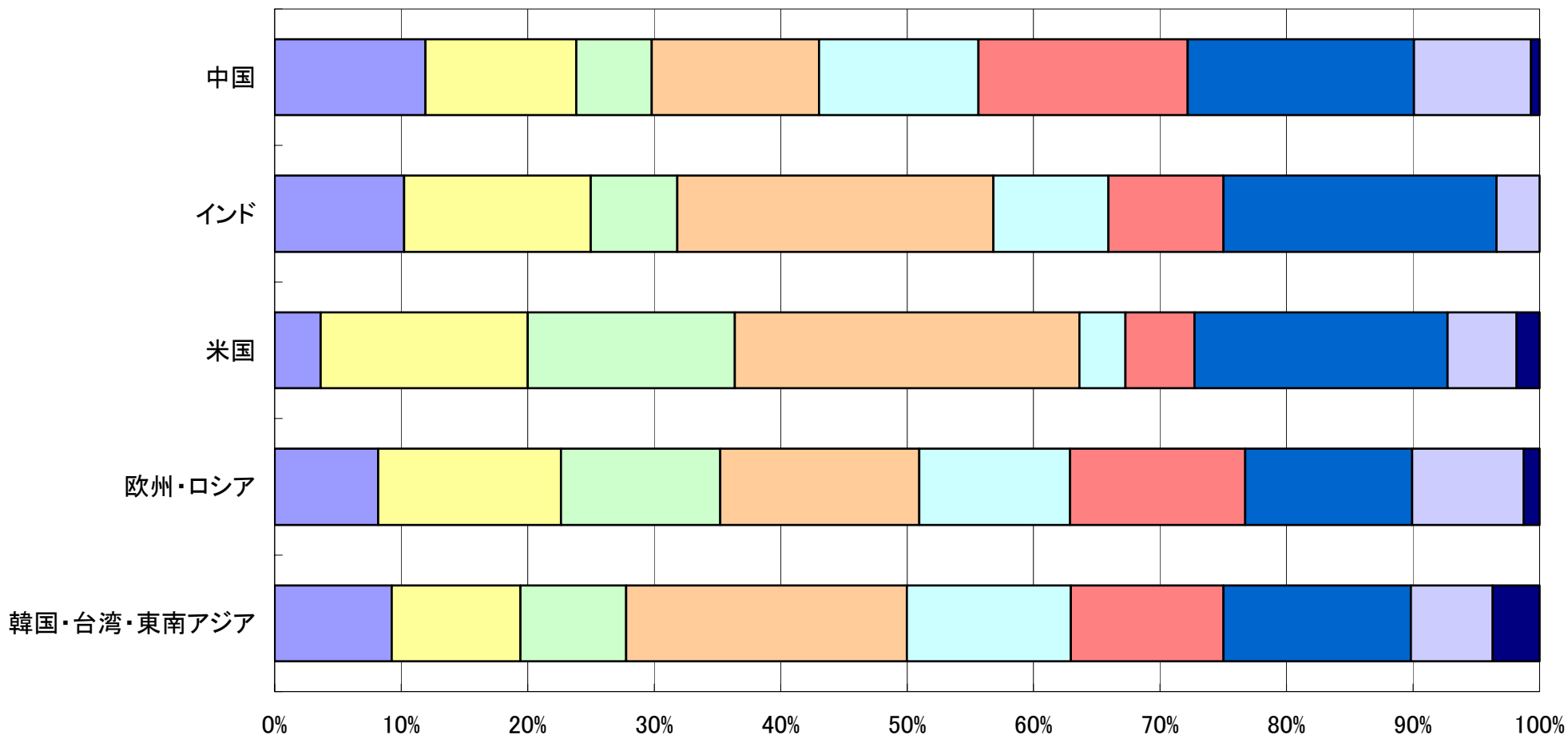
ドイツ、フランス、英国、デンマーク、スウェーデン、ノルウェー、フィンランド、
ポーランド、チェコ、ロシア

韓国・台湾・東南アジア:

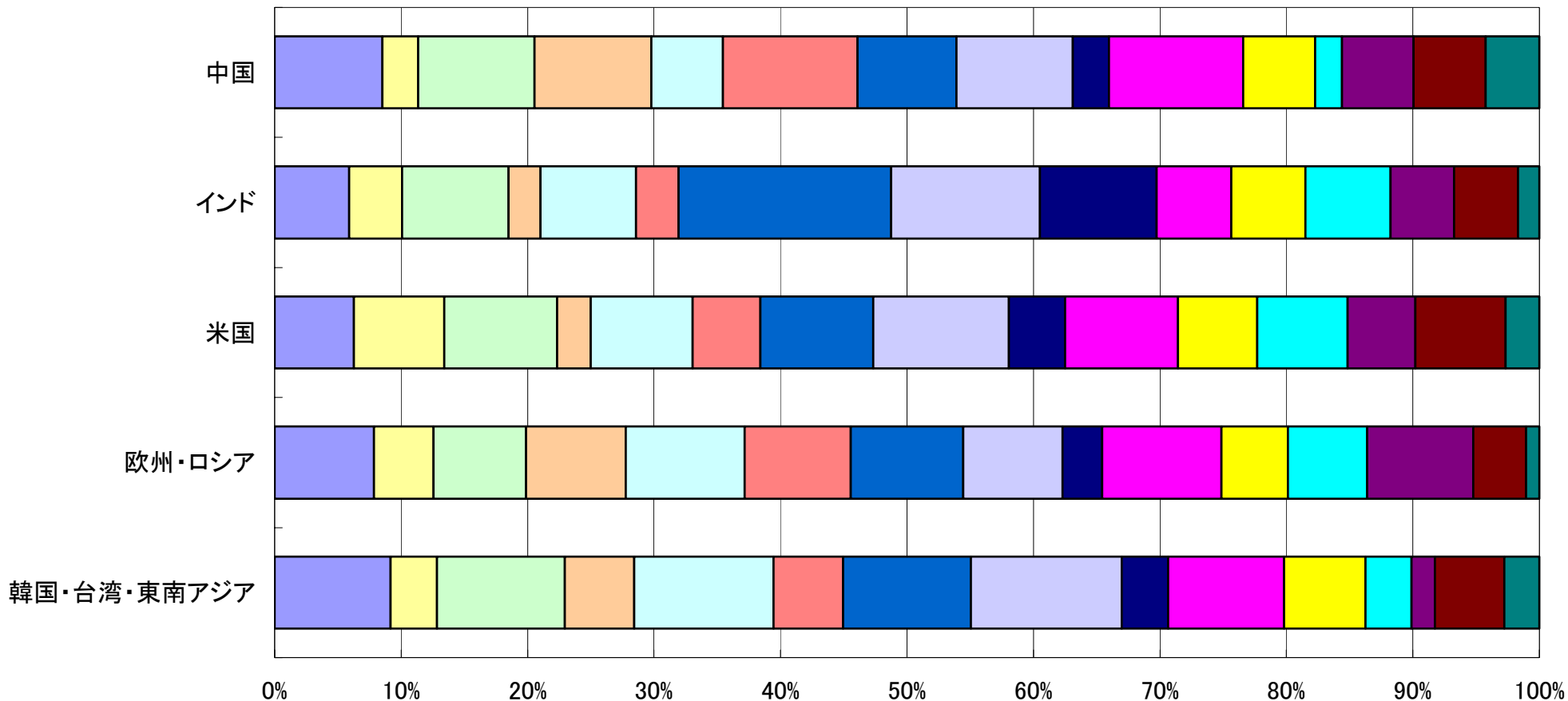
韓国、台湾、タイ、シンガポール、マレーシア



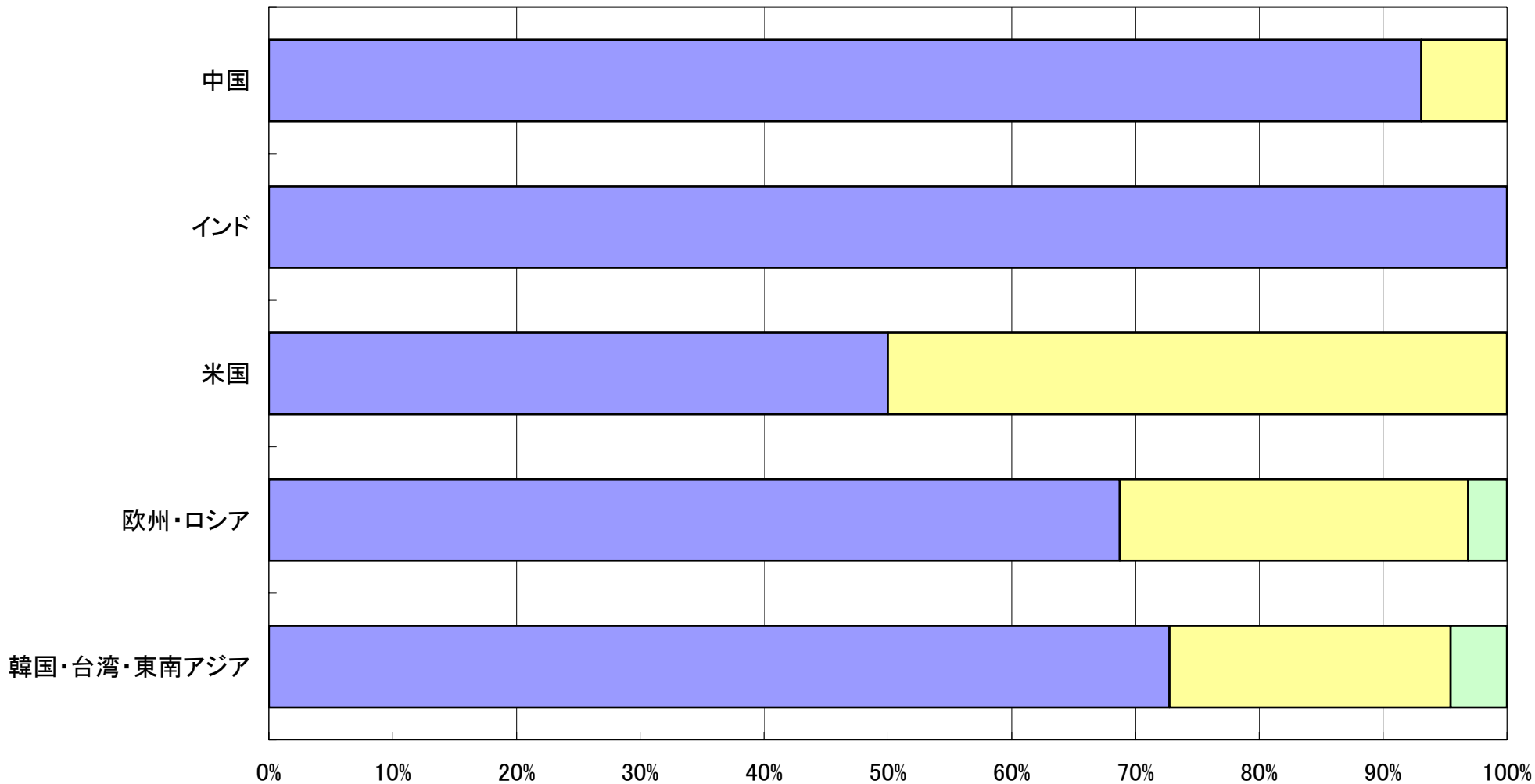
- 組込みソフトウェア受託開発
- 組込み開発サービス
- 組込みコンサルティングサービス
- 組込みソフトウェア製品開発
- 組込み開発環境・ツール開発
- 組込みソフトウェア技術開発
- 組込みハードウェア製品開発
- 組込みに関する教育等
- 組込みに関する上記以外の事業
- その他



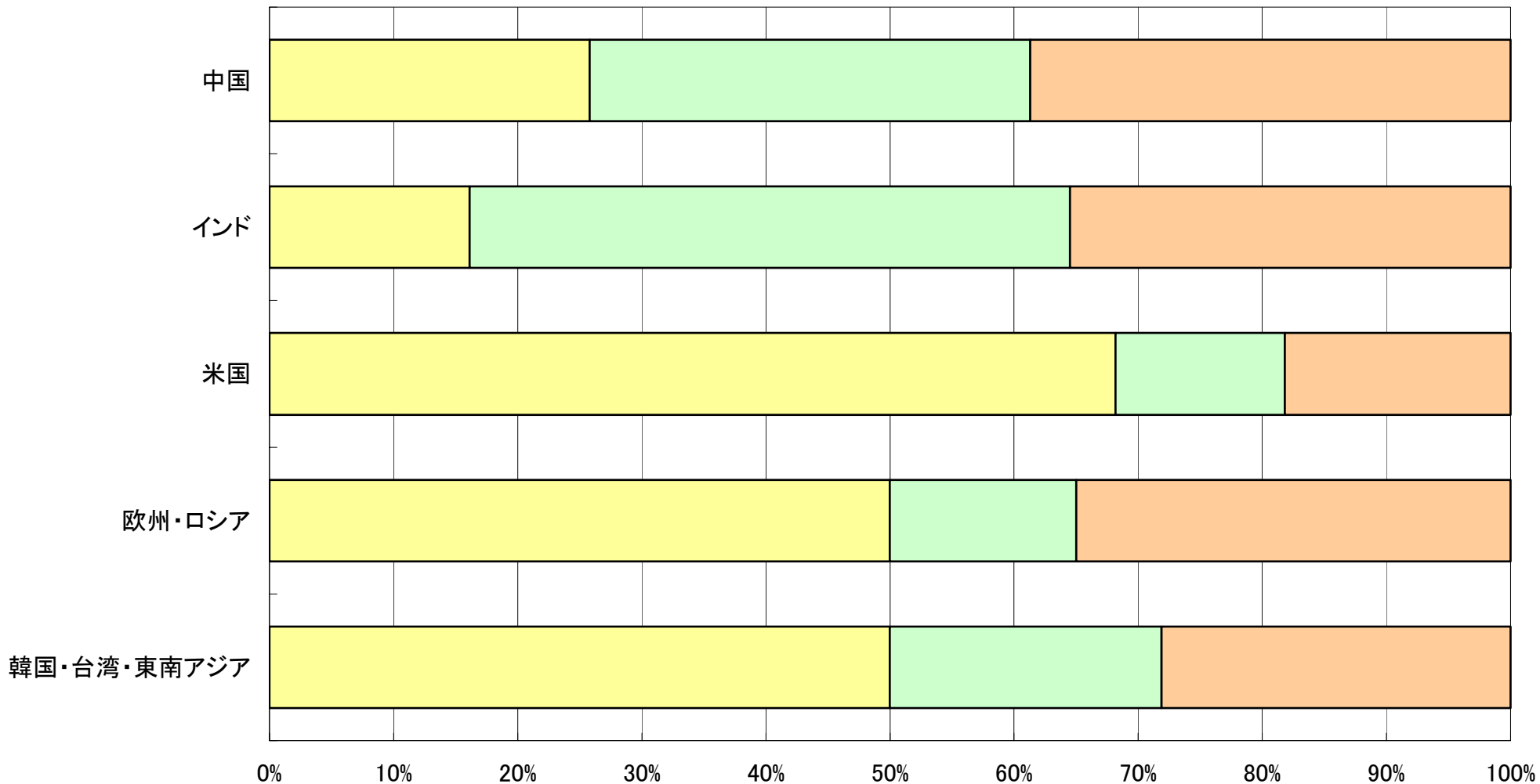
- AV機器
- 家電機器
- 個人用情報機器
- 教育機器、娯楽機器
- コンピュータ周辺機器/OA機器
- 業務用端末機器
- 民生用通信端末機器
- 通信設備機器等
- 運輸機器/建設機器
- 工業制御/FA機器/産業機器
- 設備機器
- 医療機器
- 分析機器・計測機器等
- 軍・防衛
- その他の応用機器製品



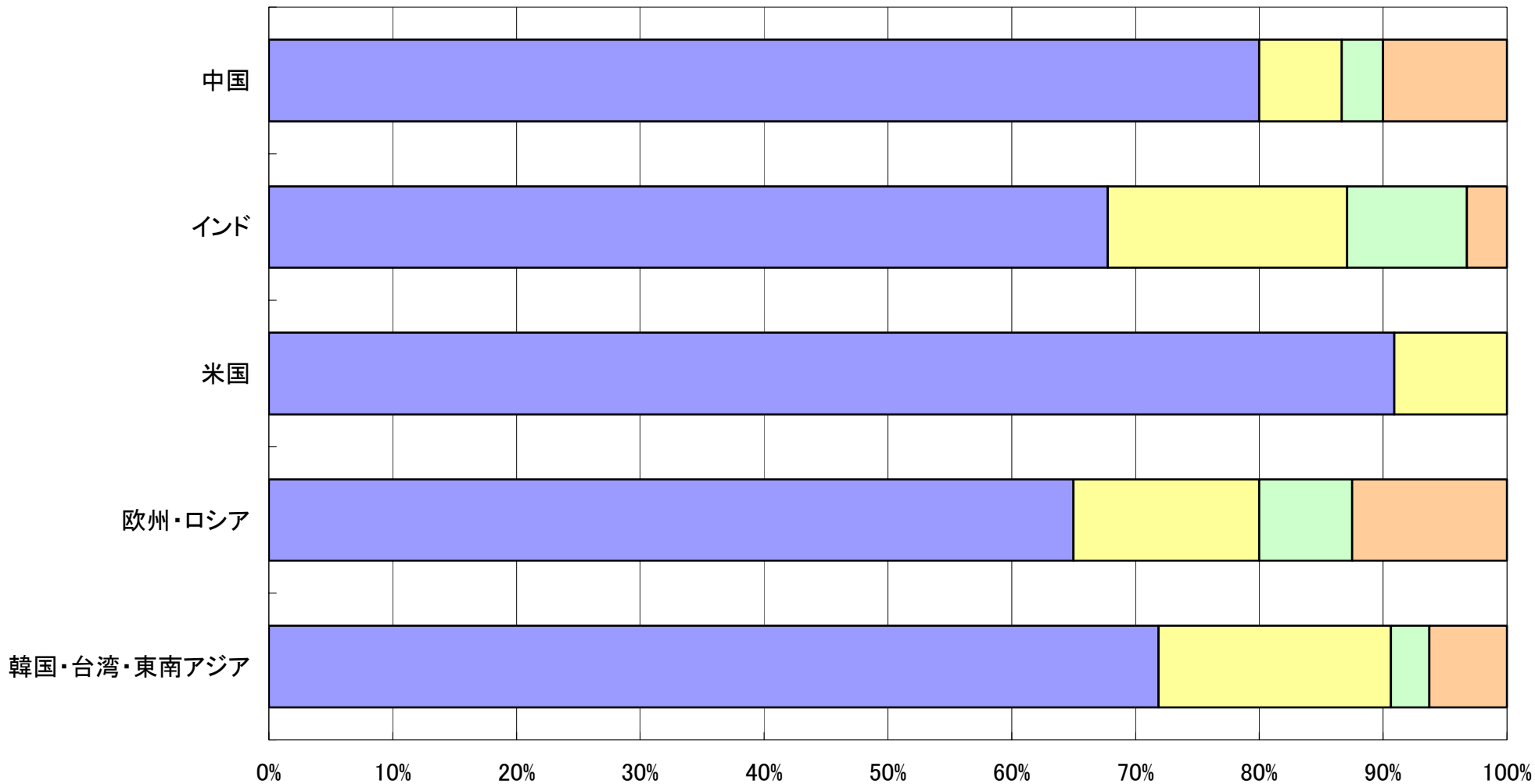
■ 10万ドル未満
 ■ 10～100万ドル未満
 ■ 100～1,000万ドル未満
 ■ 1,000万ドル以上

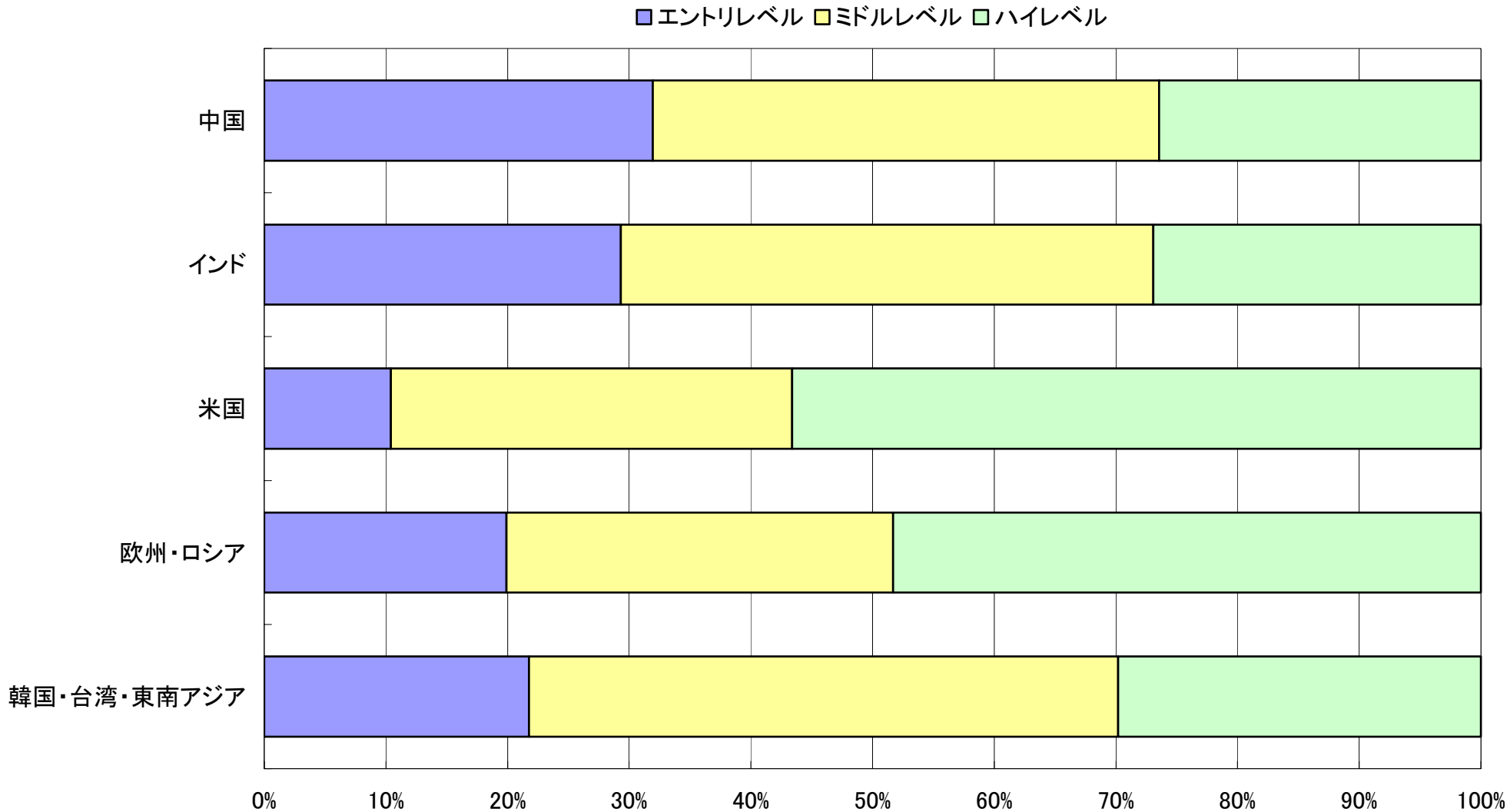


■ いない
 ■ 5人未満
 ■ 5~10人未満
 ■ 10~50人未満
 ■ 50人以上

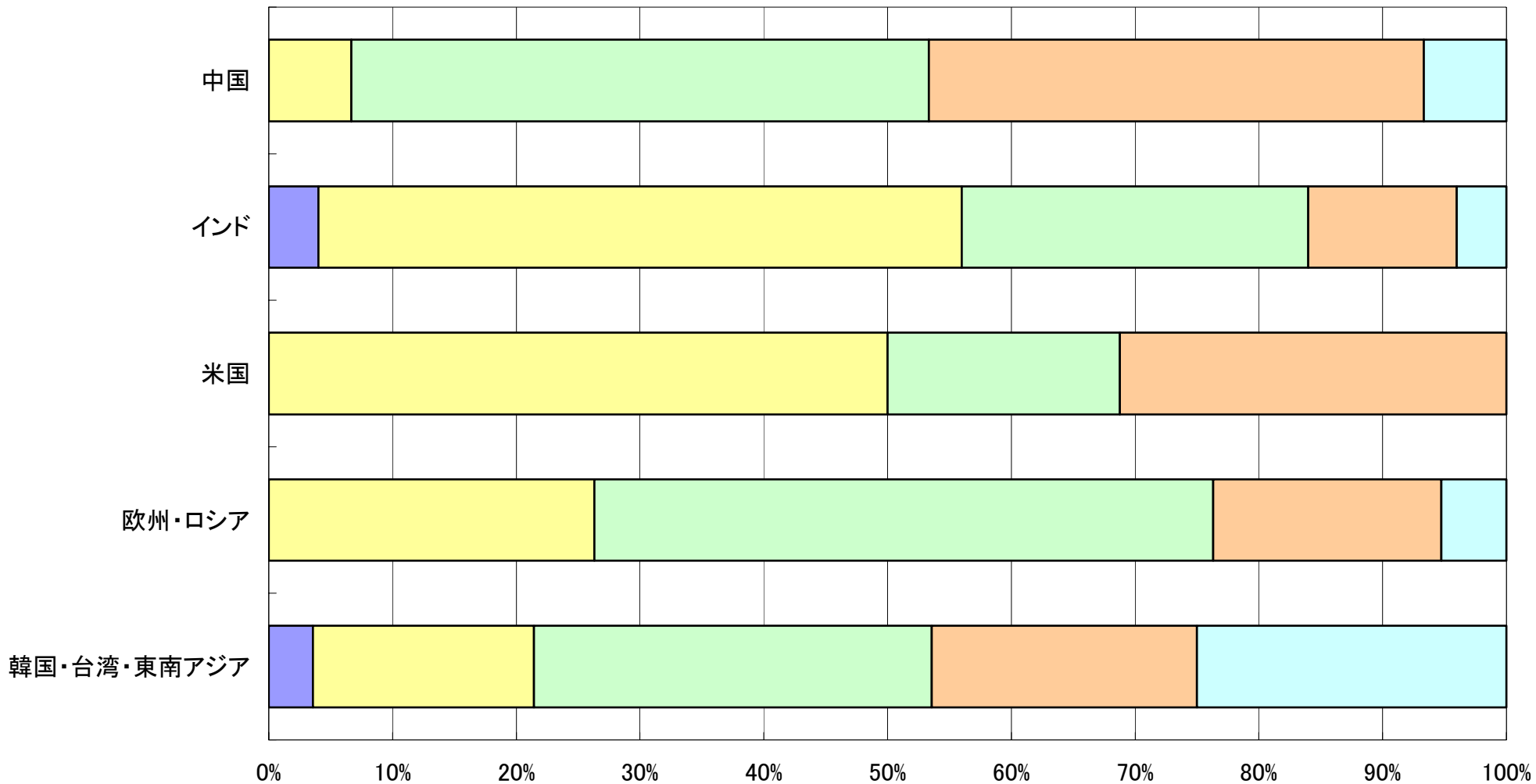


■ いない
 ■ 5人未満
 ■ 5～10人未満
 ■ 10～50人未満
 ■ 50人以上

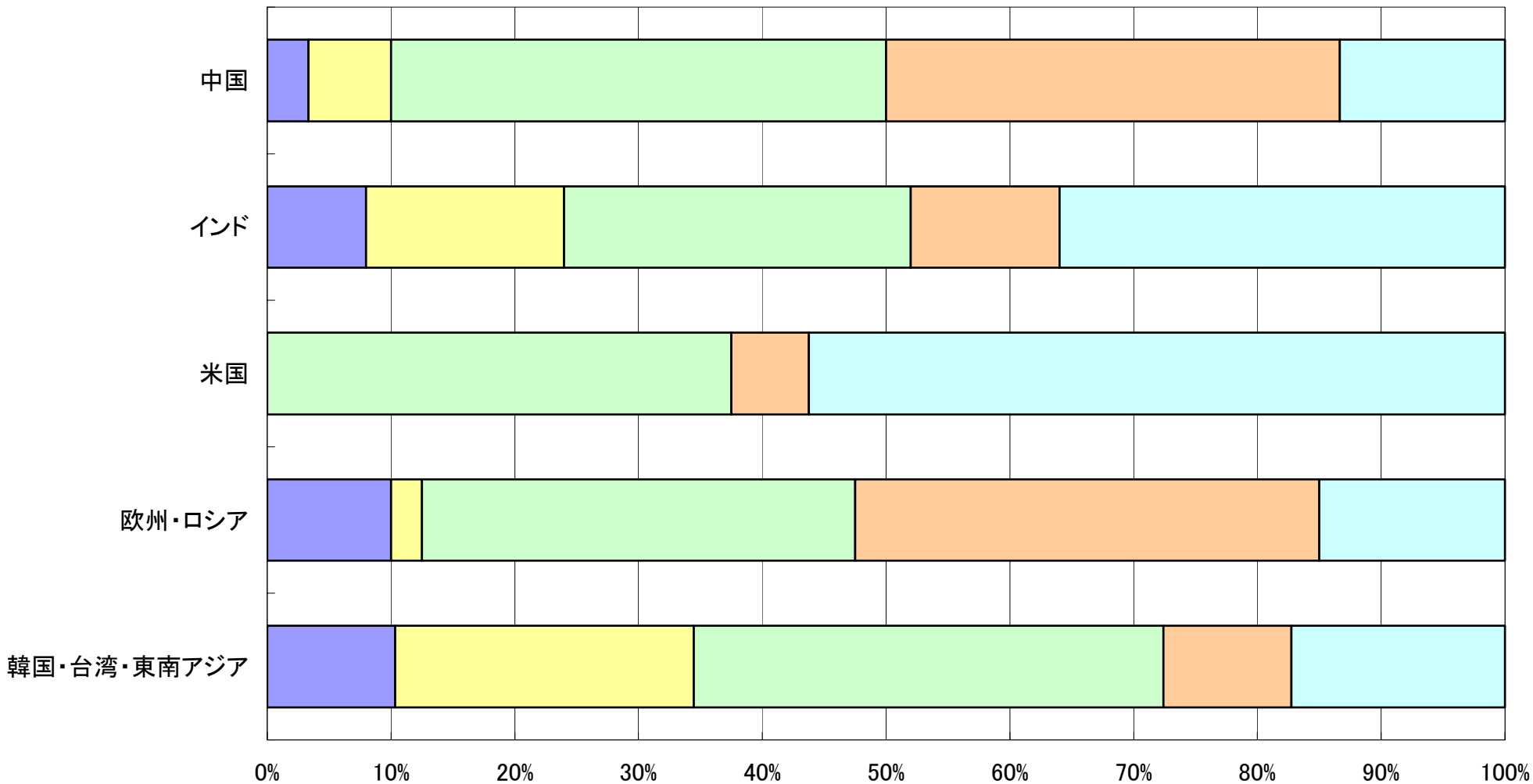


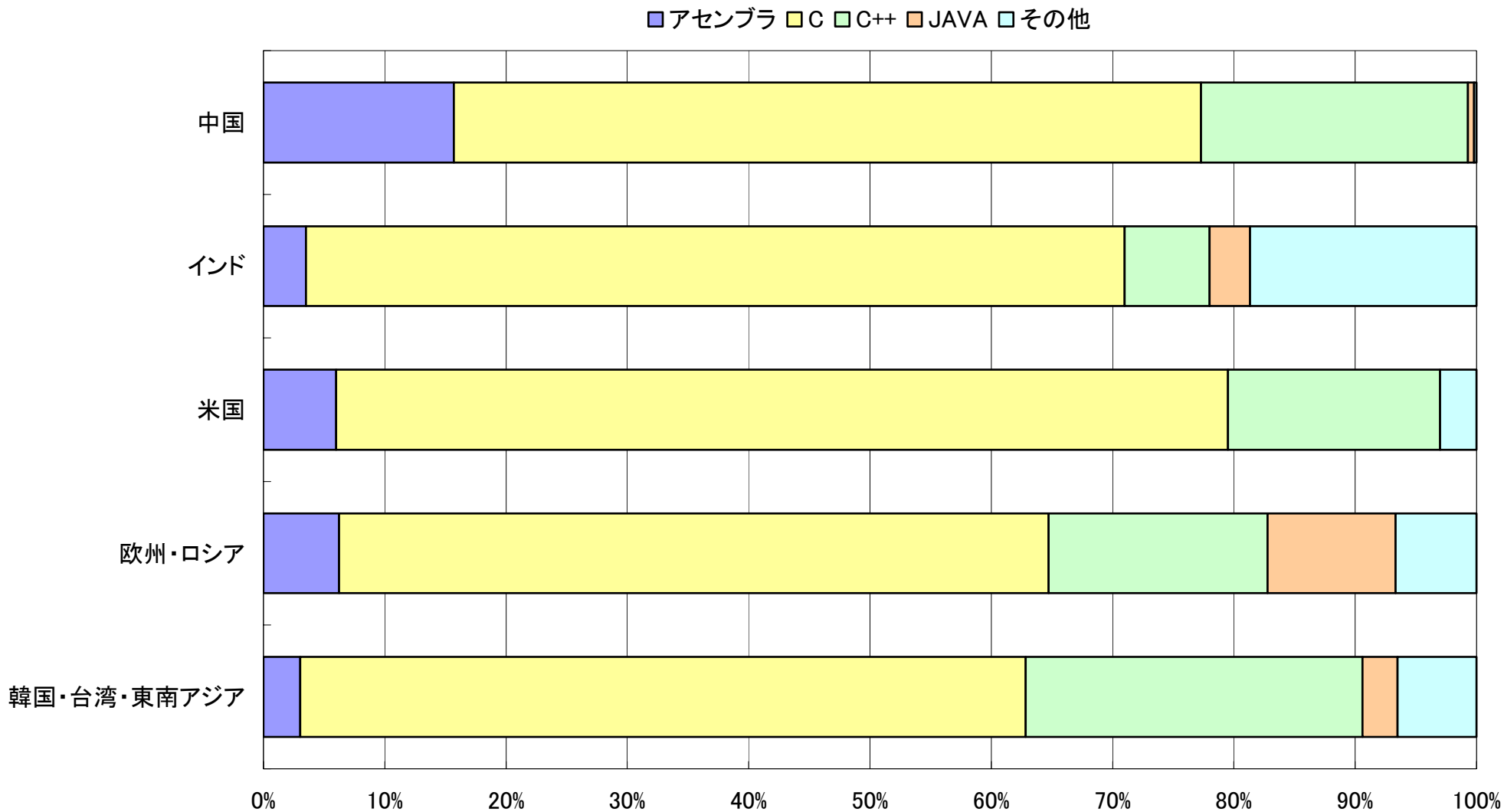


■ 1,000行未満 ■ 1,000～1万行未満 ■ 1万～10万行未満 ■ 10万～100万行未満 ■ 100万行以上

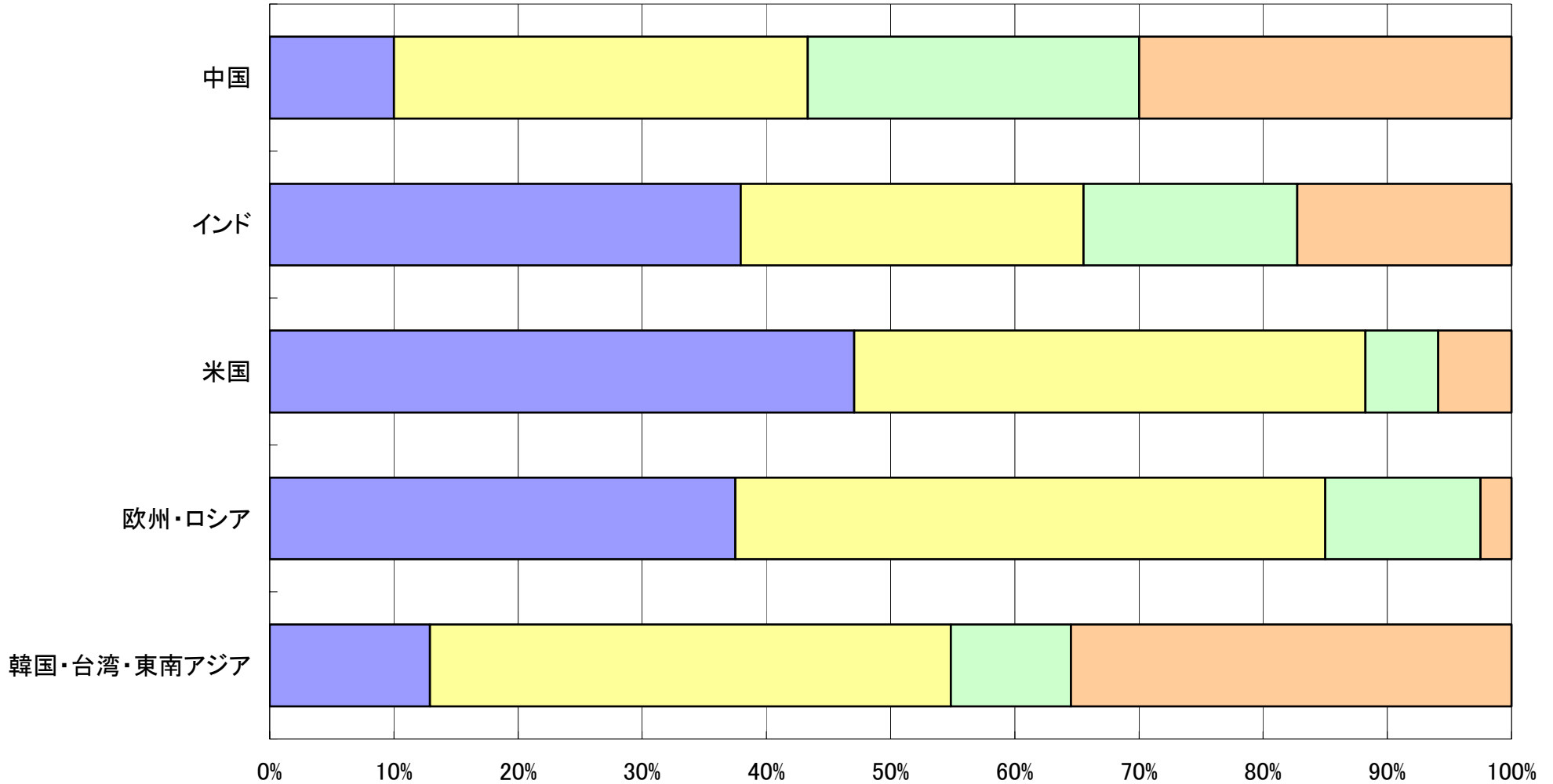


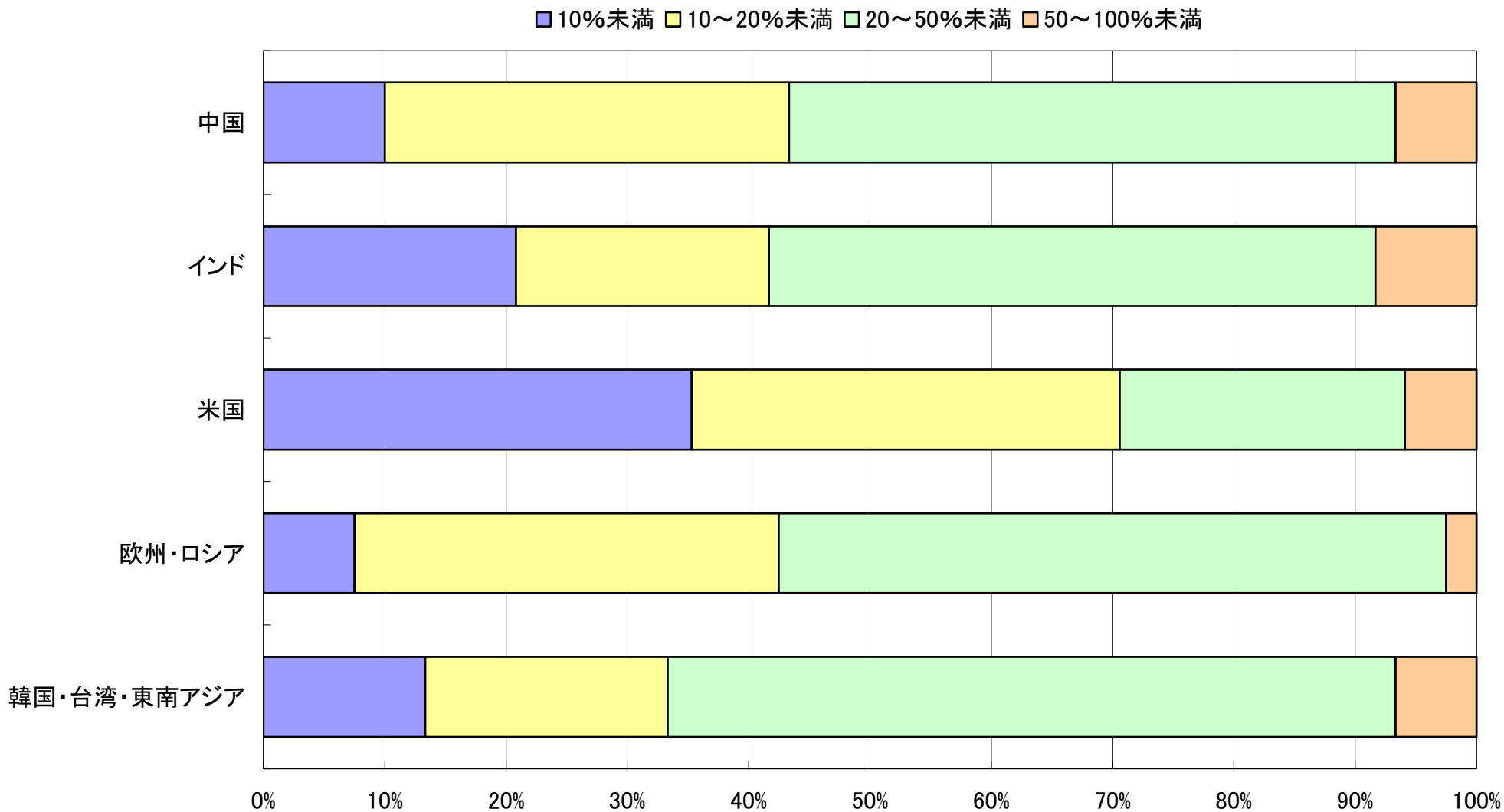
■ 10%未満 ■ 10~20%未満 ■ 20~50%未満 ■ 50~100%未満 ■ 100%



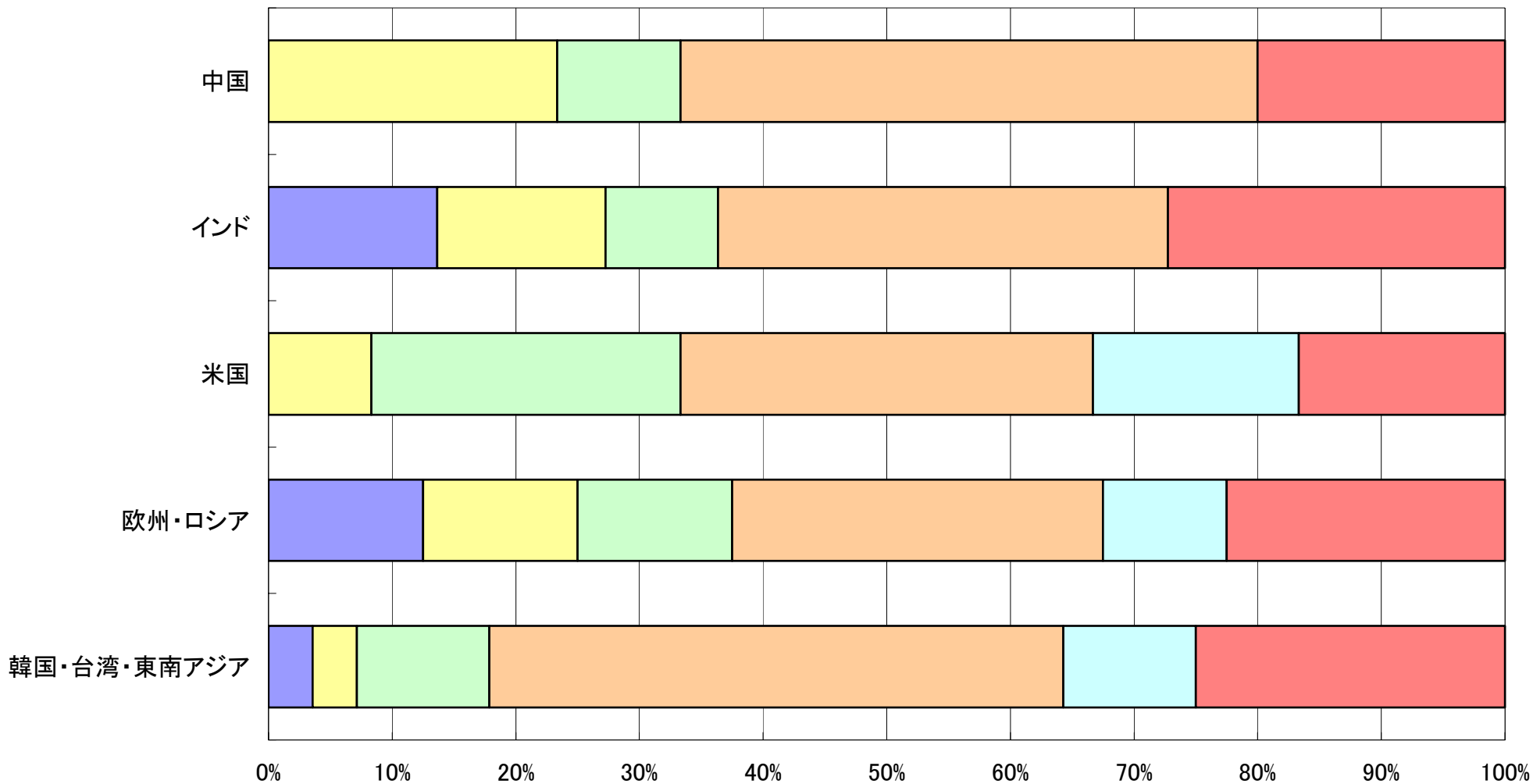


■ 1,000時間未満 ■ 1,000～5,000時間未満 ■ 5,000～10,000時間未満 ■ 10,000時間以上





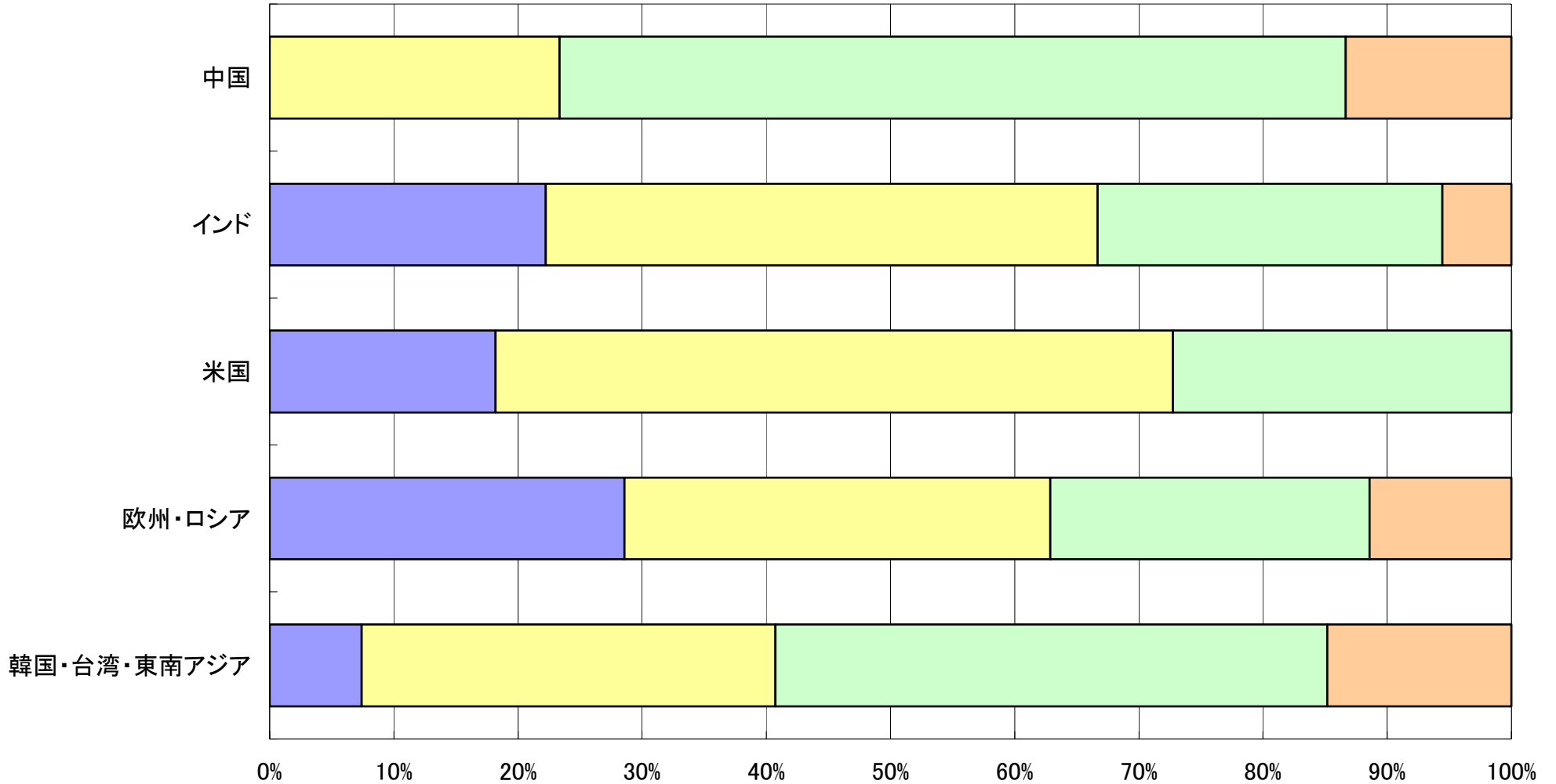
■なし ■5個未満 ■5～10個未満 ■10～50個未満 ■50～100個未満 ■100個以上



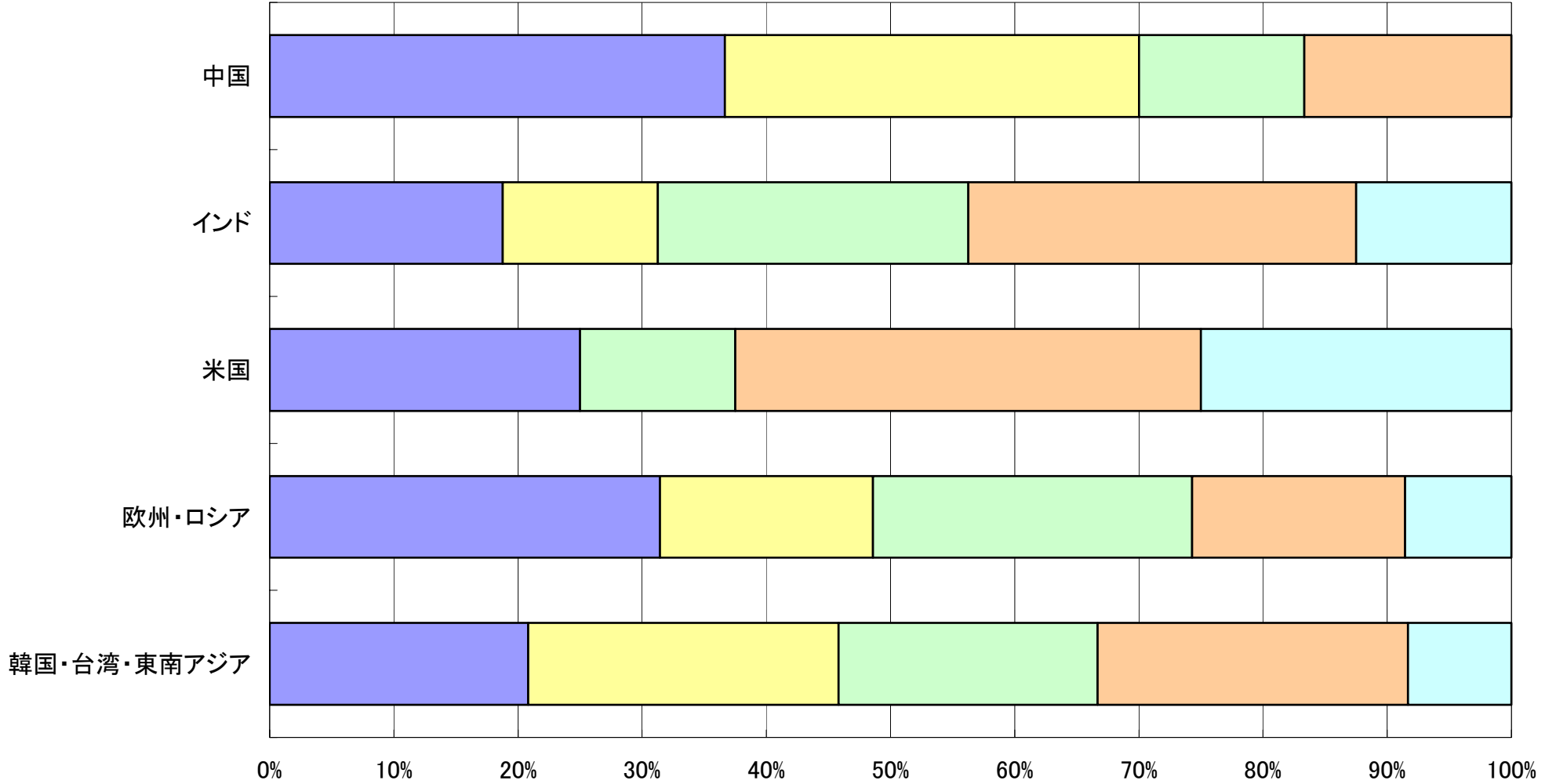
Q11 不具合を修正するのに要した工数の全体工数に対する割合

海外

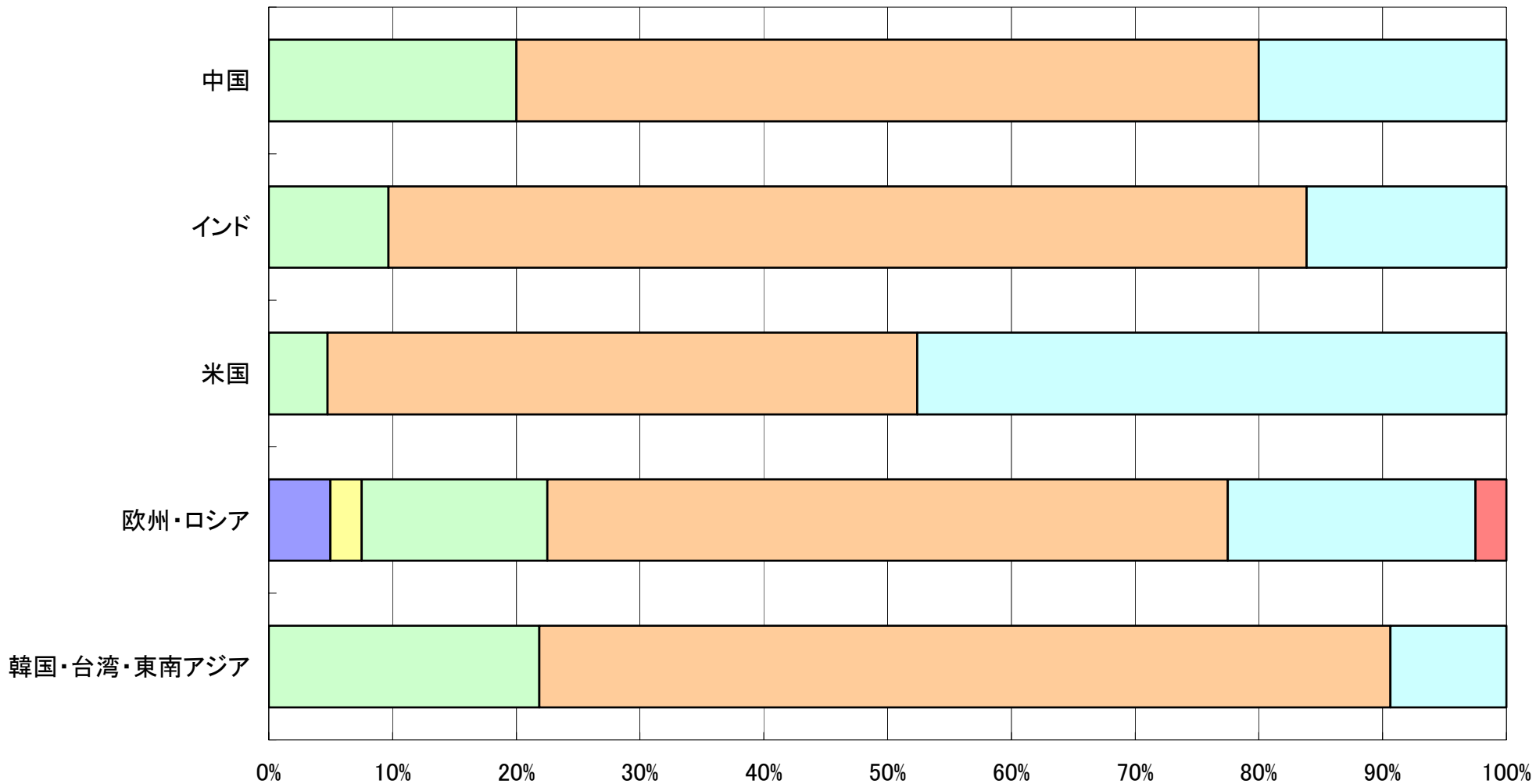
■ 10%未満 ■ 10~20%未満 ■ 20~50%未満 ■ 50~100%未満



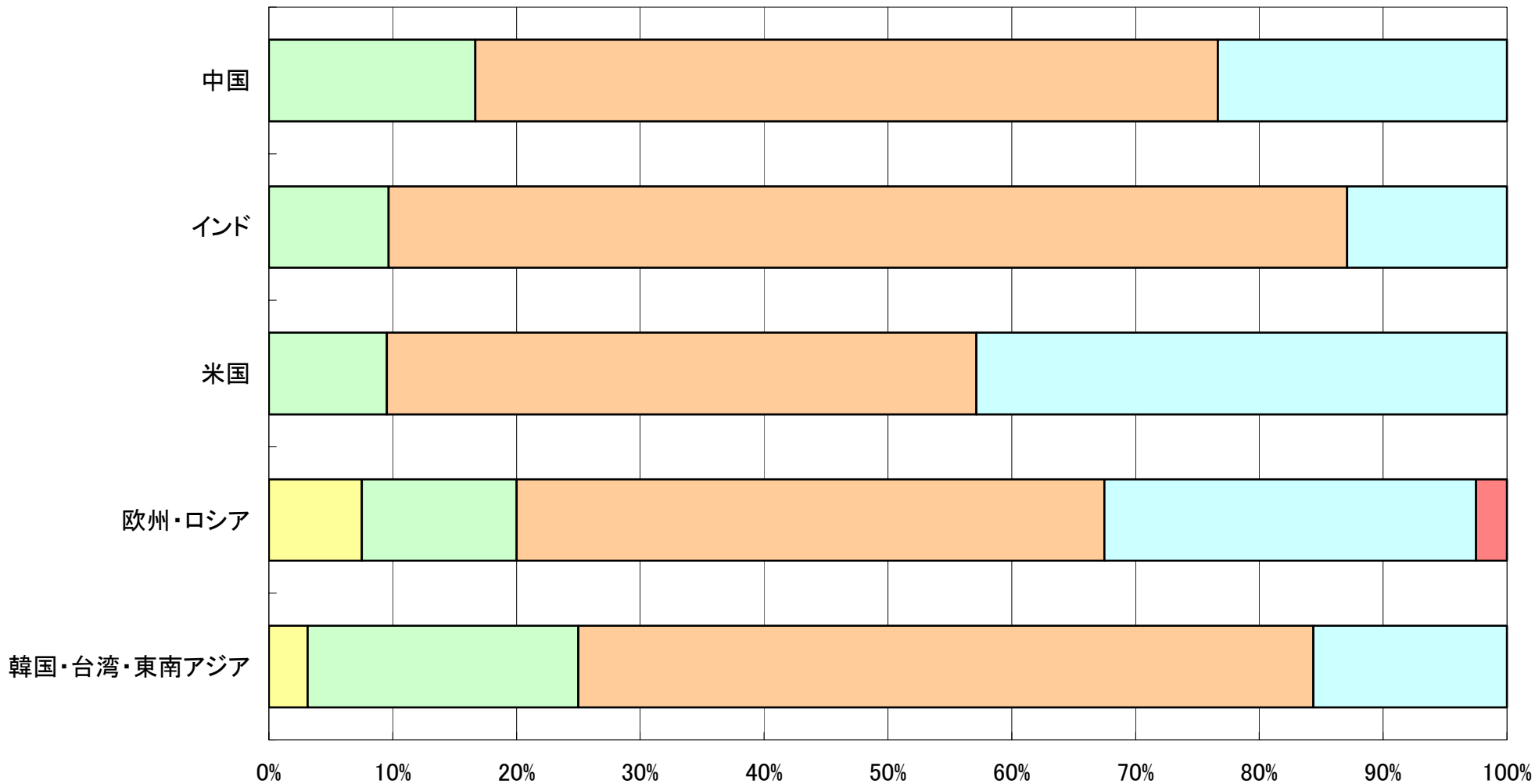
■ 10%未満 ■ 10~20%未満 ■ 20~50%未満 ■ 50~100%未満 ■ 100%



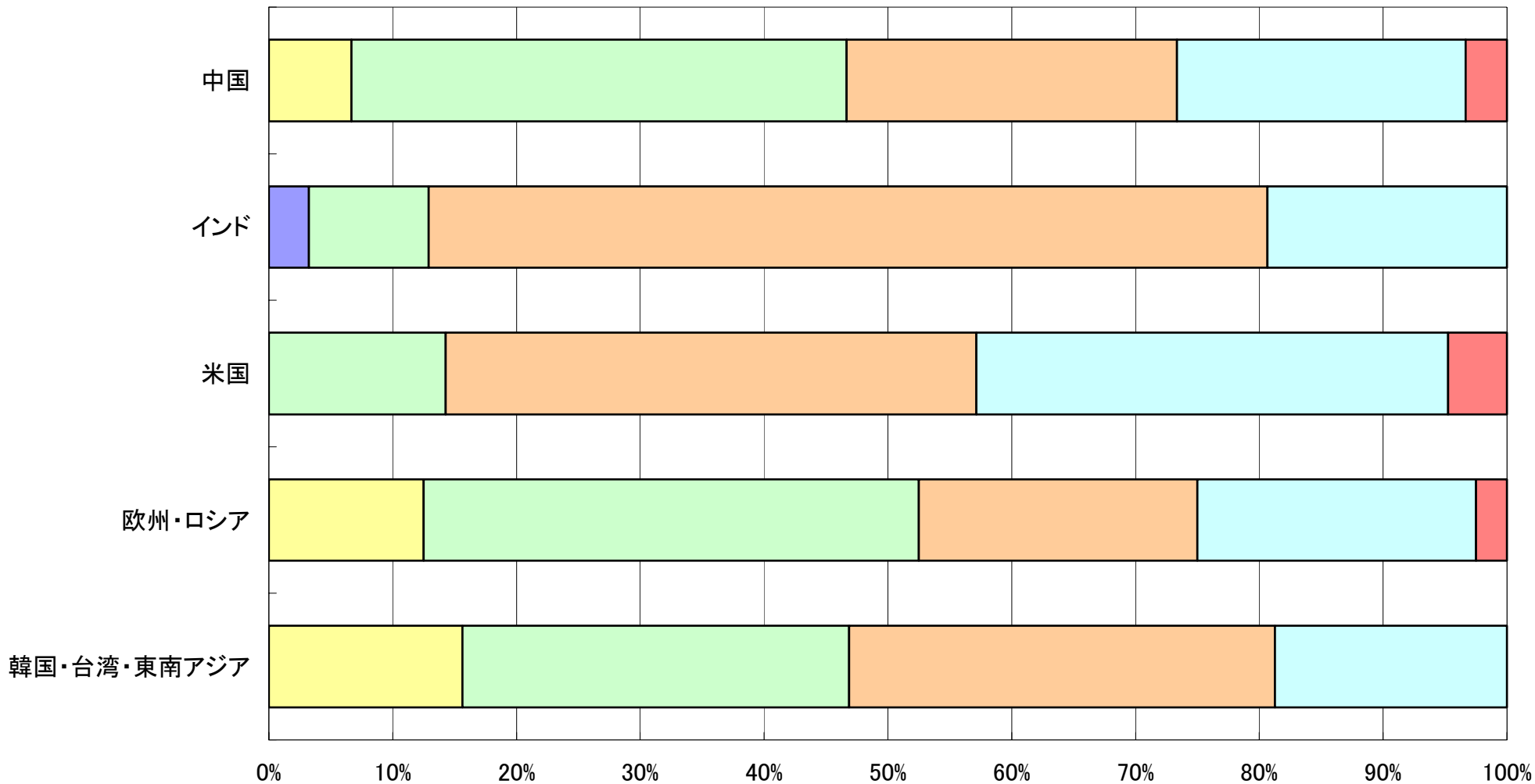
■ 1. Poor performance
 ■ 2
 ■ 3. Fair
 ■ 4
 ■ 5. Excellent performance
 ■ Don't know



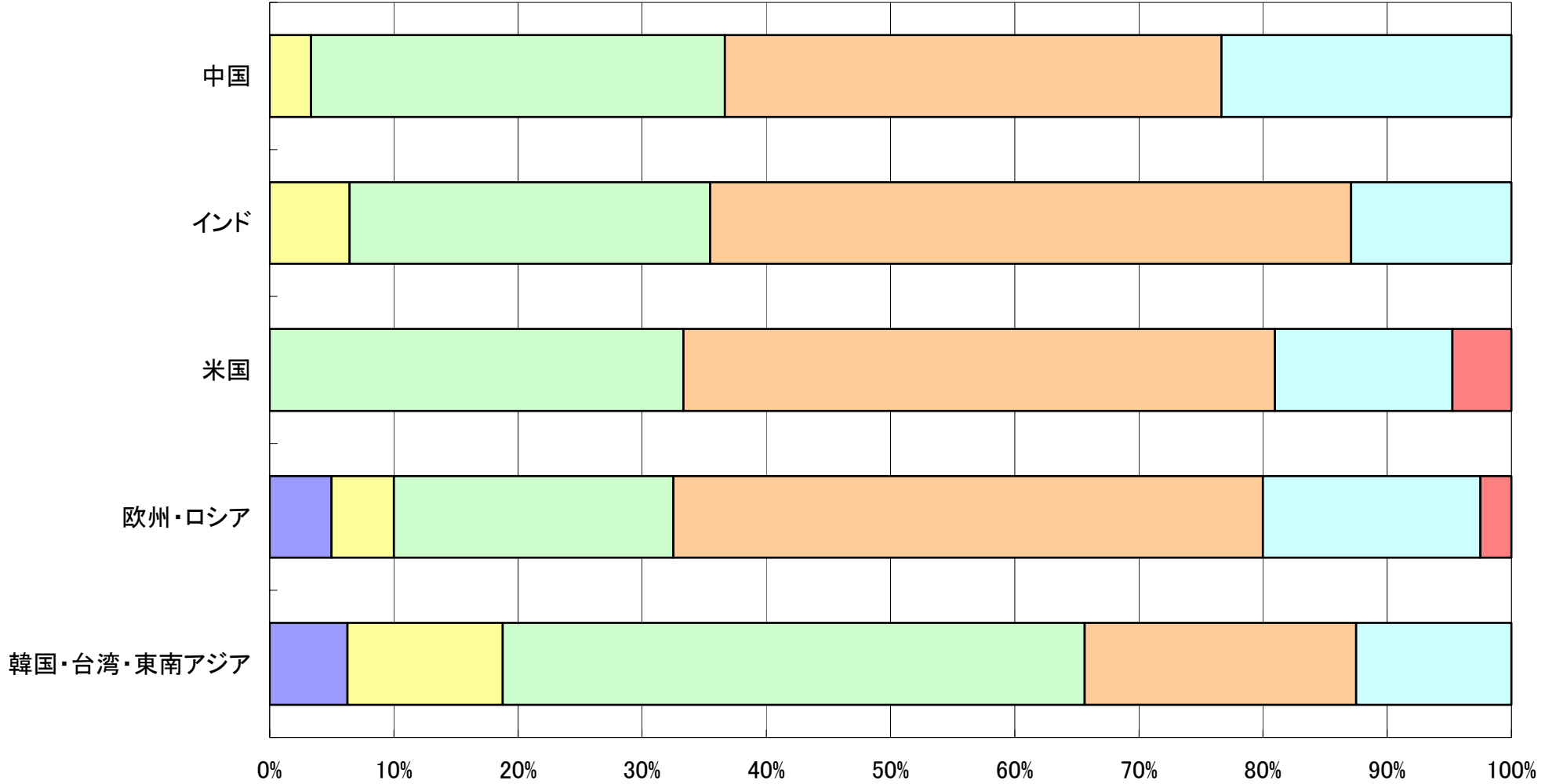
■ 1. Poor performance
 ■ 2
 ■ 3. Fair
 ■ 4
 ■ 5. Excellent performance
 ■ Don't know



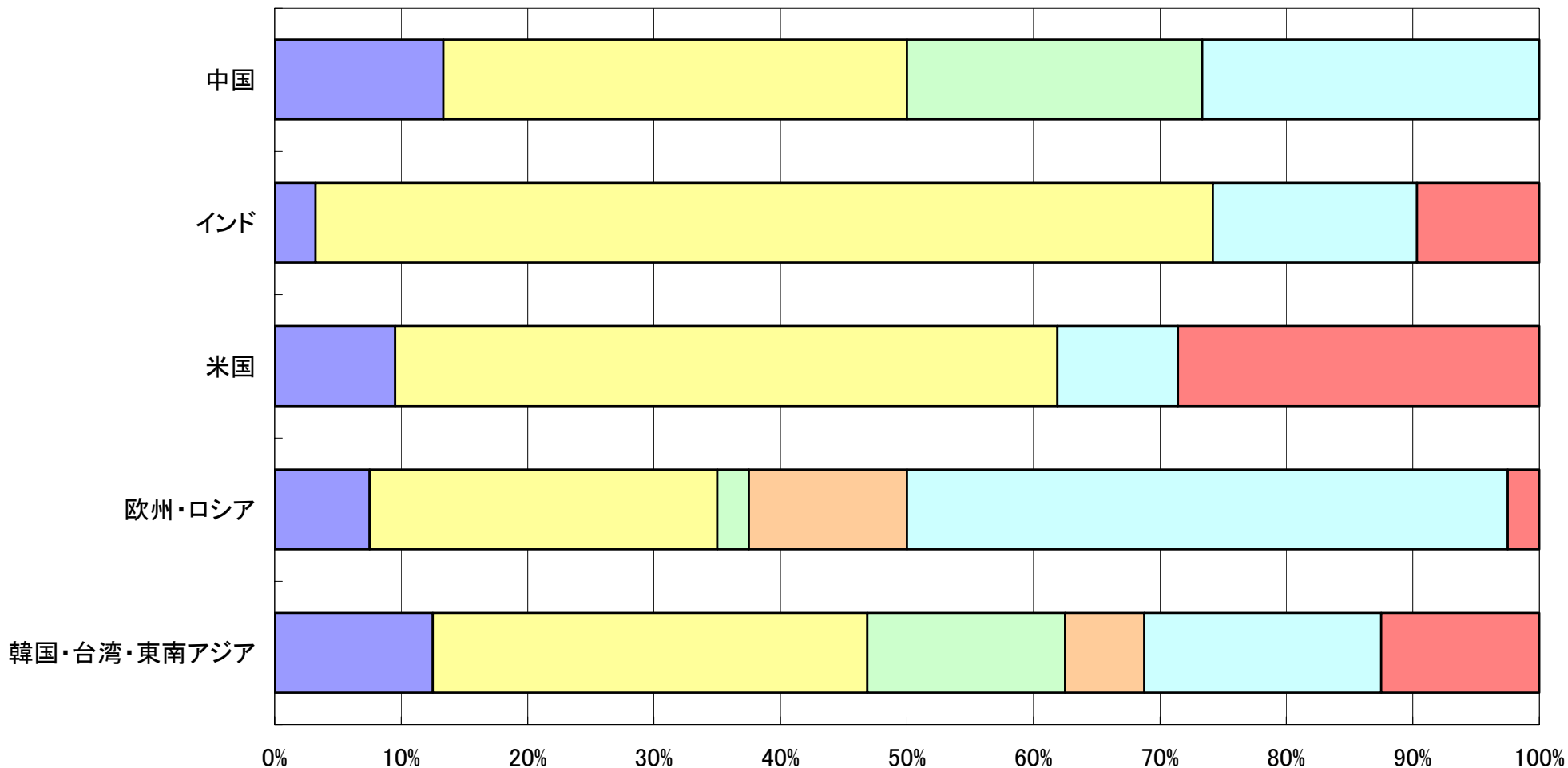
■ 1. Poor performance
 ■ 2
 ■ 3. Fair
 ■ 4
 ■ 5. Excellent performance
 ■ Don't know



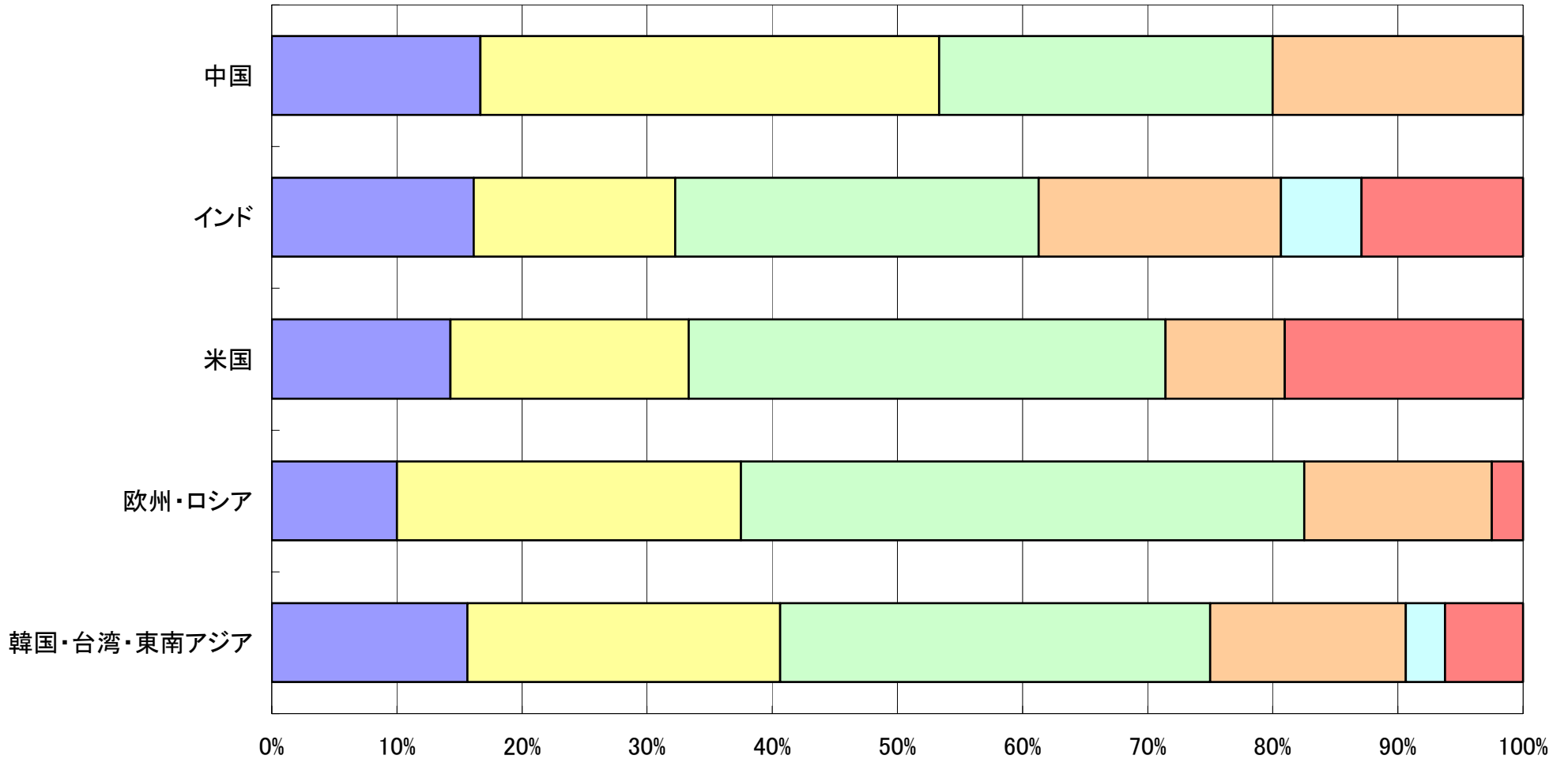
■ 1. Poor performance
 ■ 2
 ■ 3. Fair
 ■ 4
 ■ 5. Excellent performance
 ■ Don't know



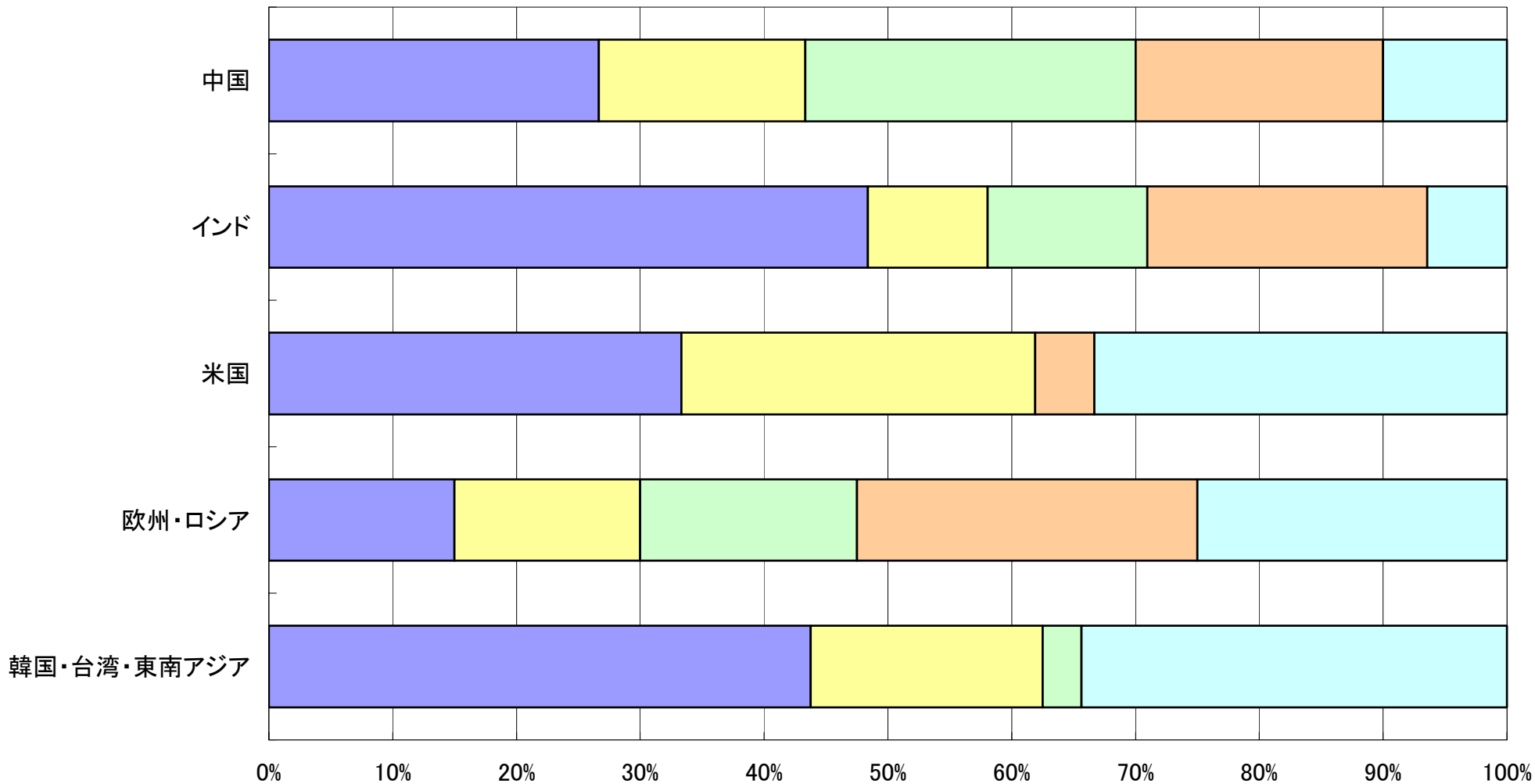
- 過去の計画書を雛型とした
- 全社共通の標準計画書を雛型とした
- 部門共通の標準計画書を雛型とした
- 市販の標準計画書を雛型とした
- 独自に作成した
- 作成しなかった



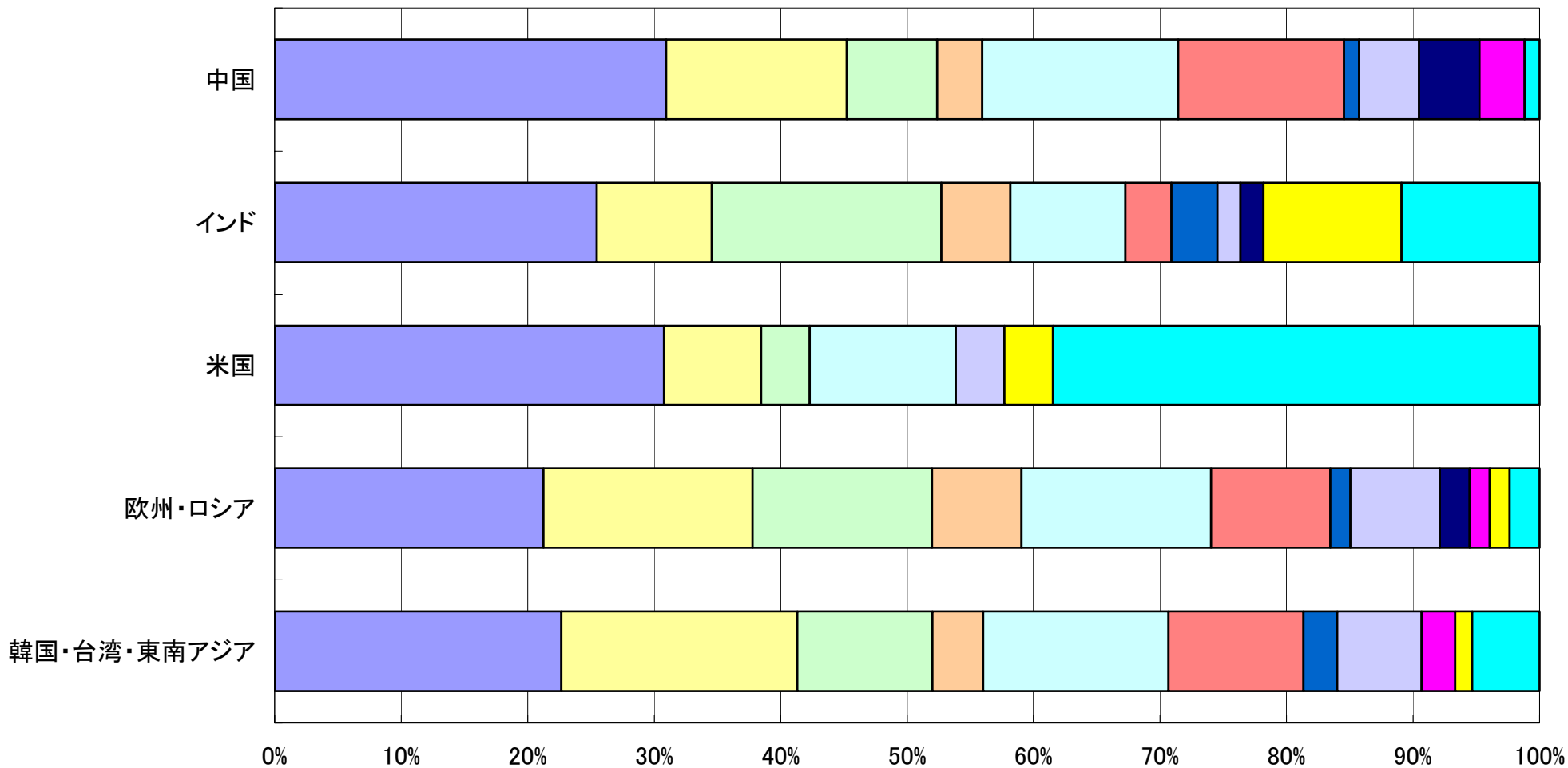
- 社内の見積り基準にもとづいた
- 過去の実績データにもとづいた
- 個人の経験にもとづいた
- 与えられた条件に合わせた
- その他
- 見積りしなかった

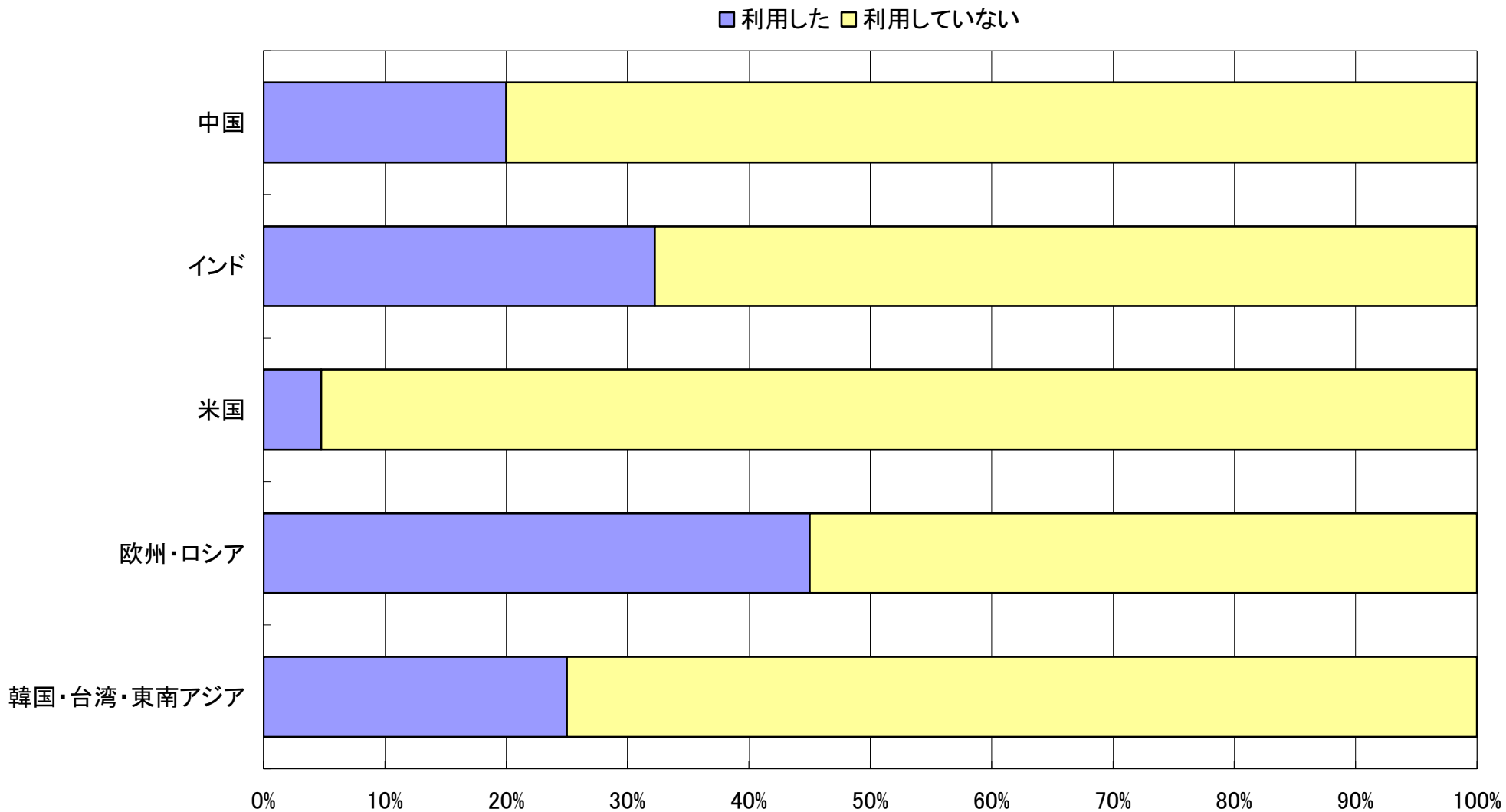


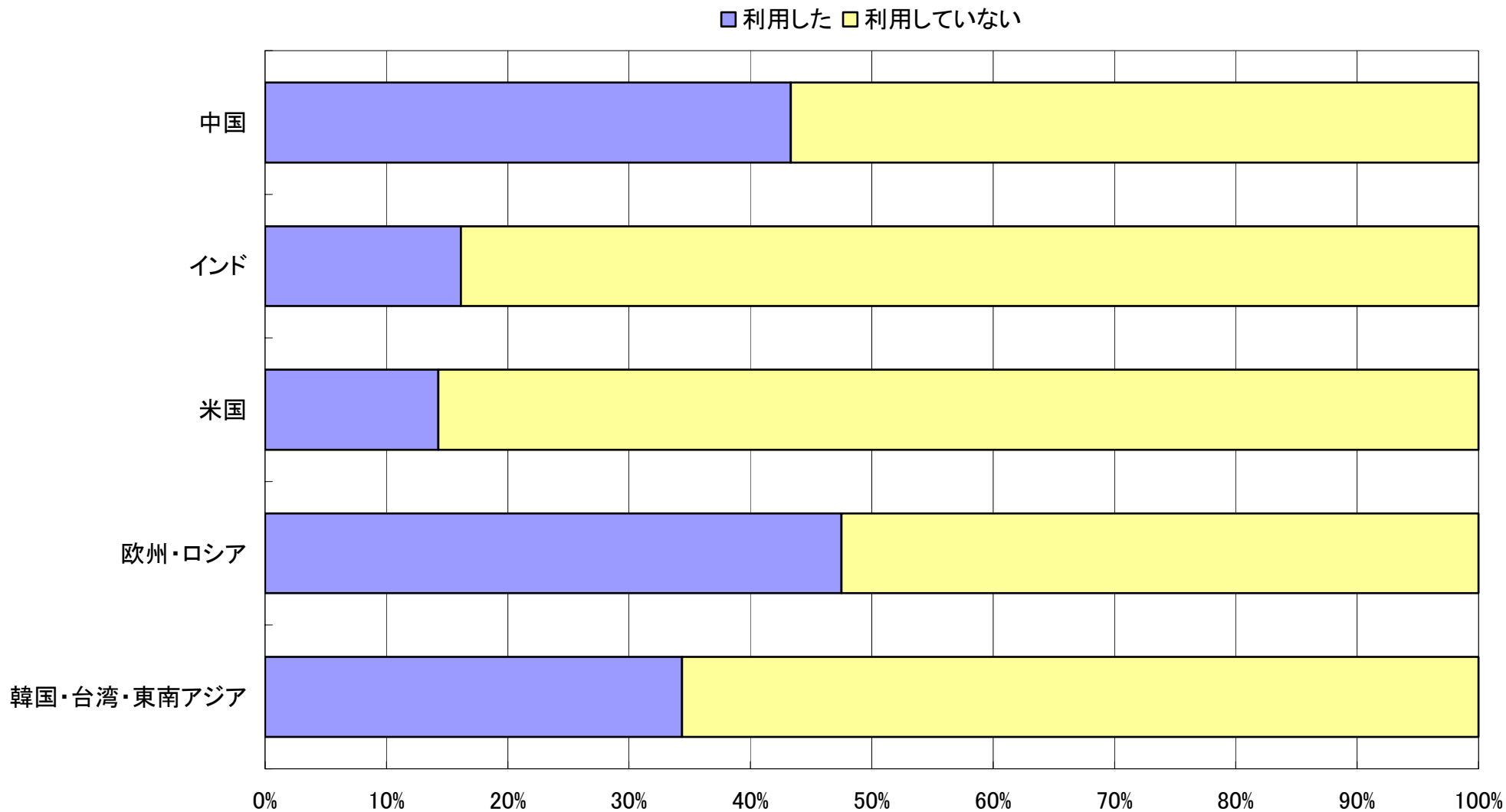
■ 全ての工程で完全に実施
 ■ 全ての工程で部分的に実施
 ■ 一部の工程で完全に実施
 ■ 一部の工程で部分的に実施
 ■ 特に実施していない

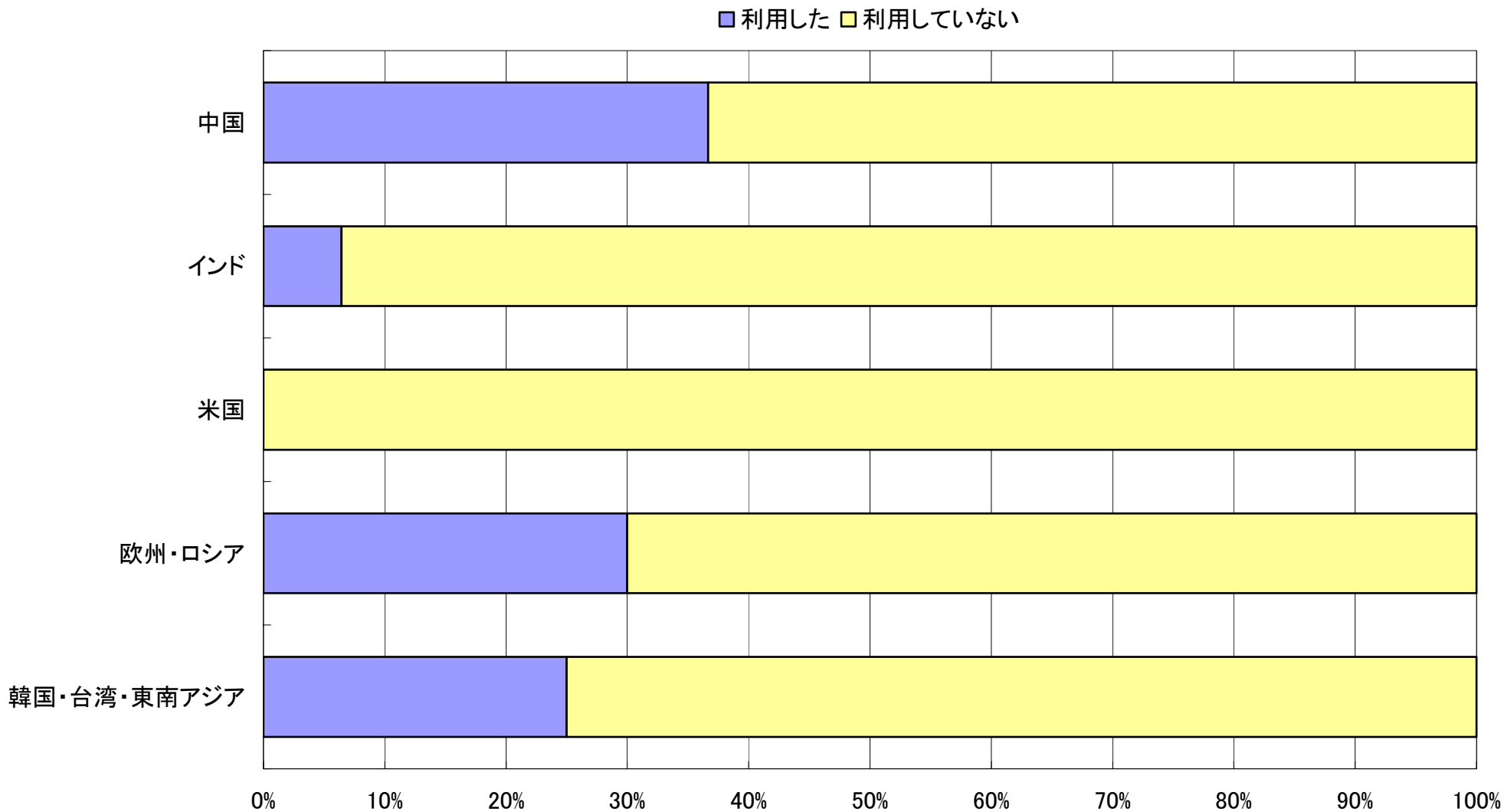


- フローチャート
- タイミングチャート
- UML
- DFD
- 状態遷移図
- 状態遷移表
- SDL
- タスク関連図
- MSC
- ペトリネット
- その他
- 使用していない

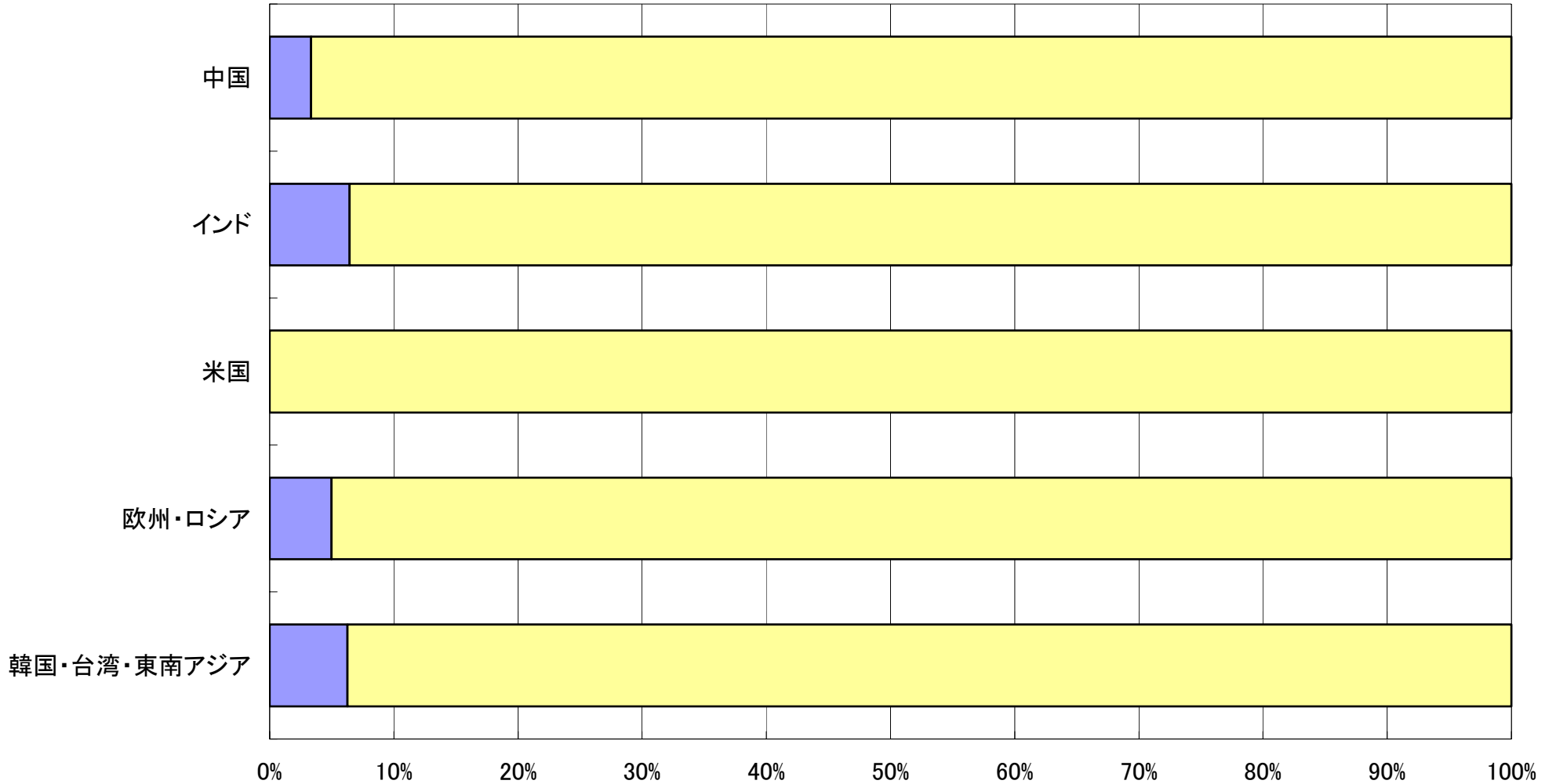


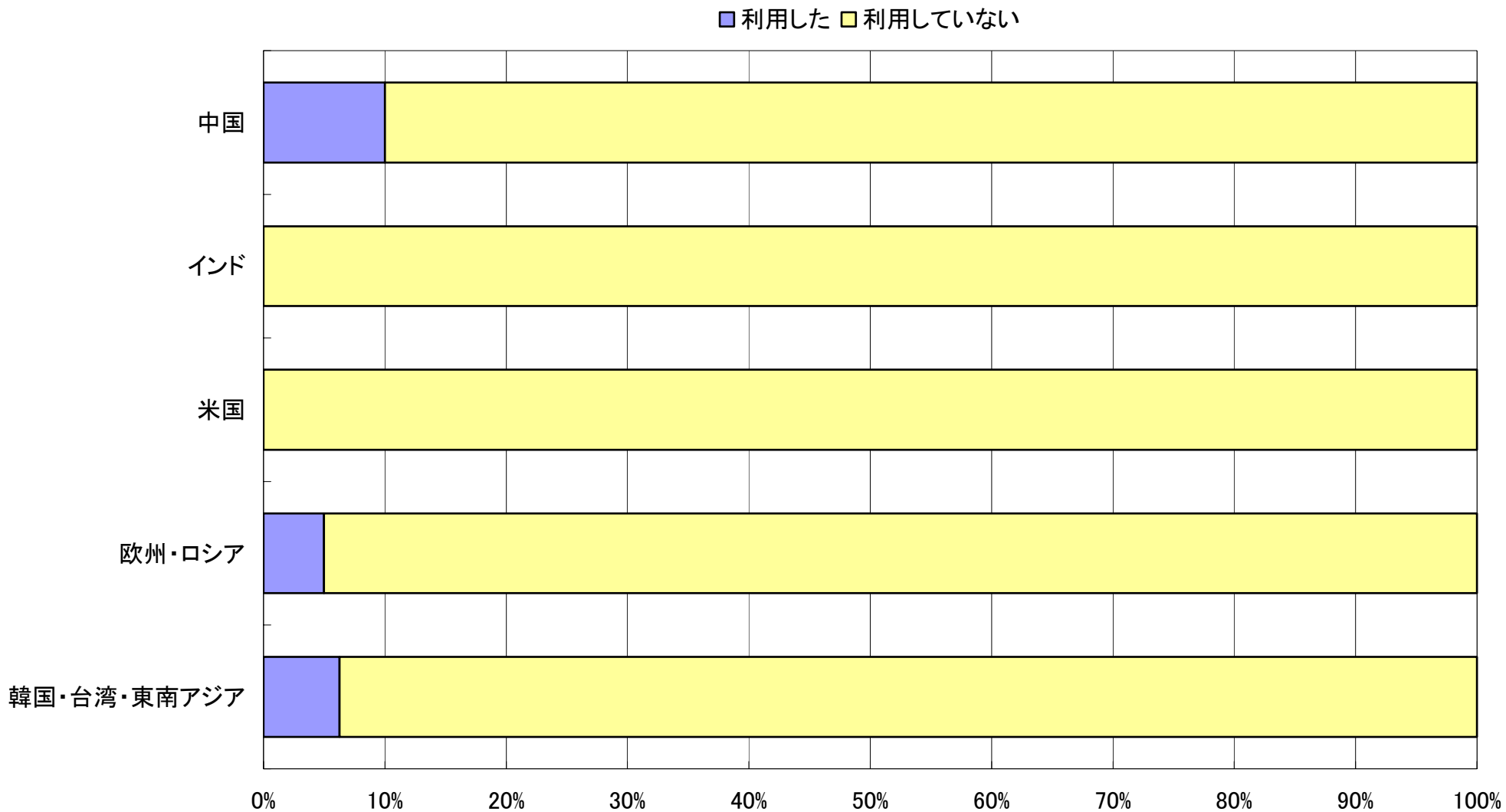


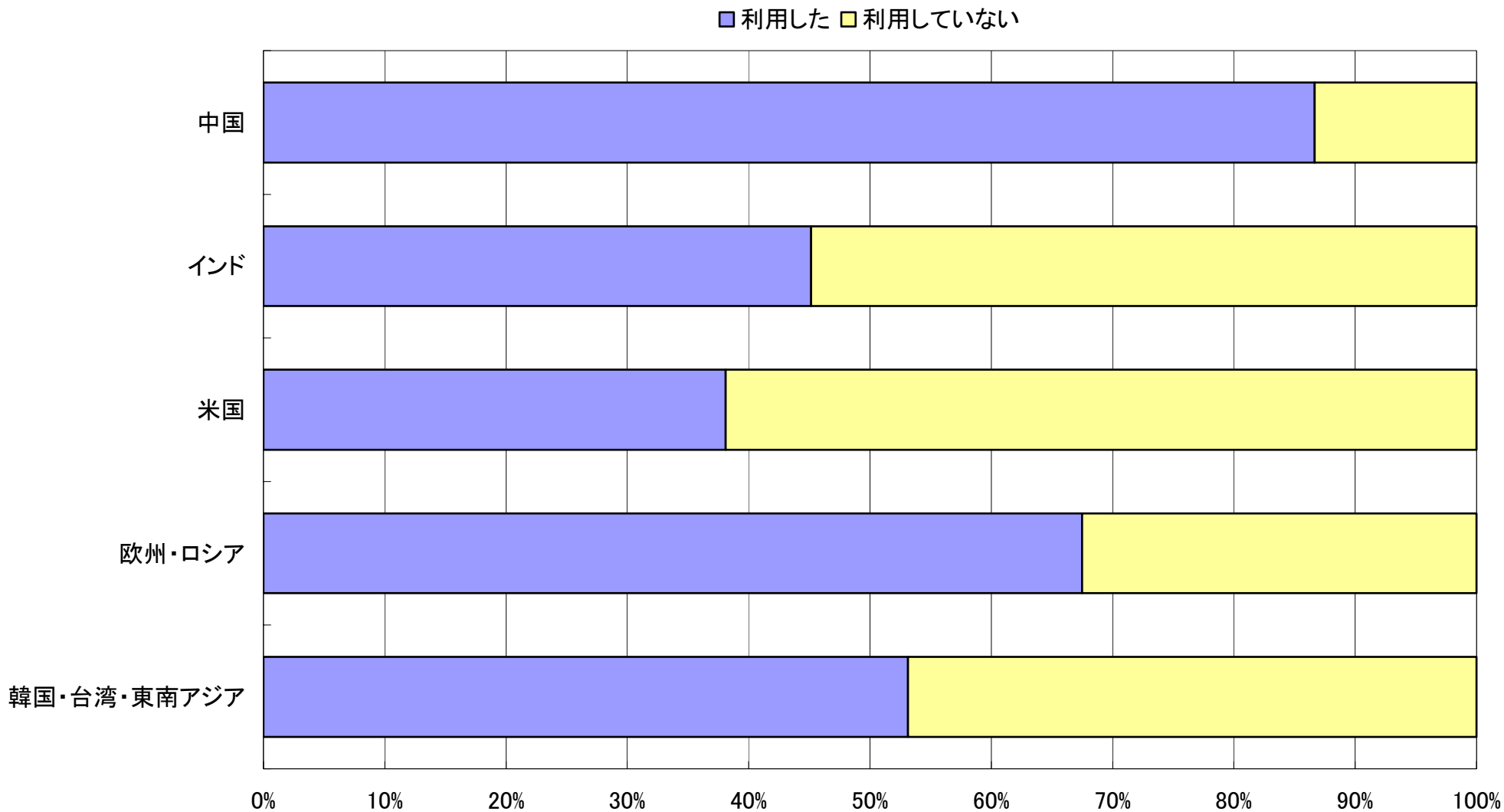


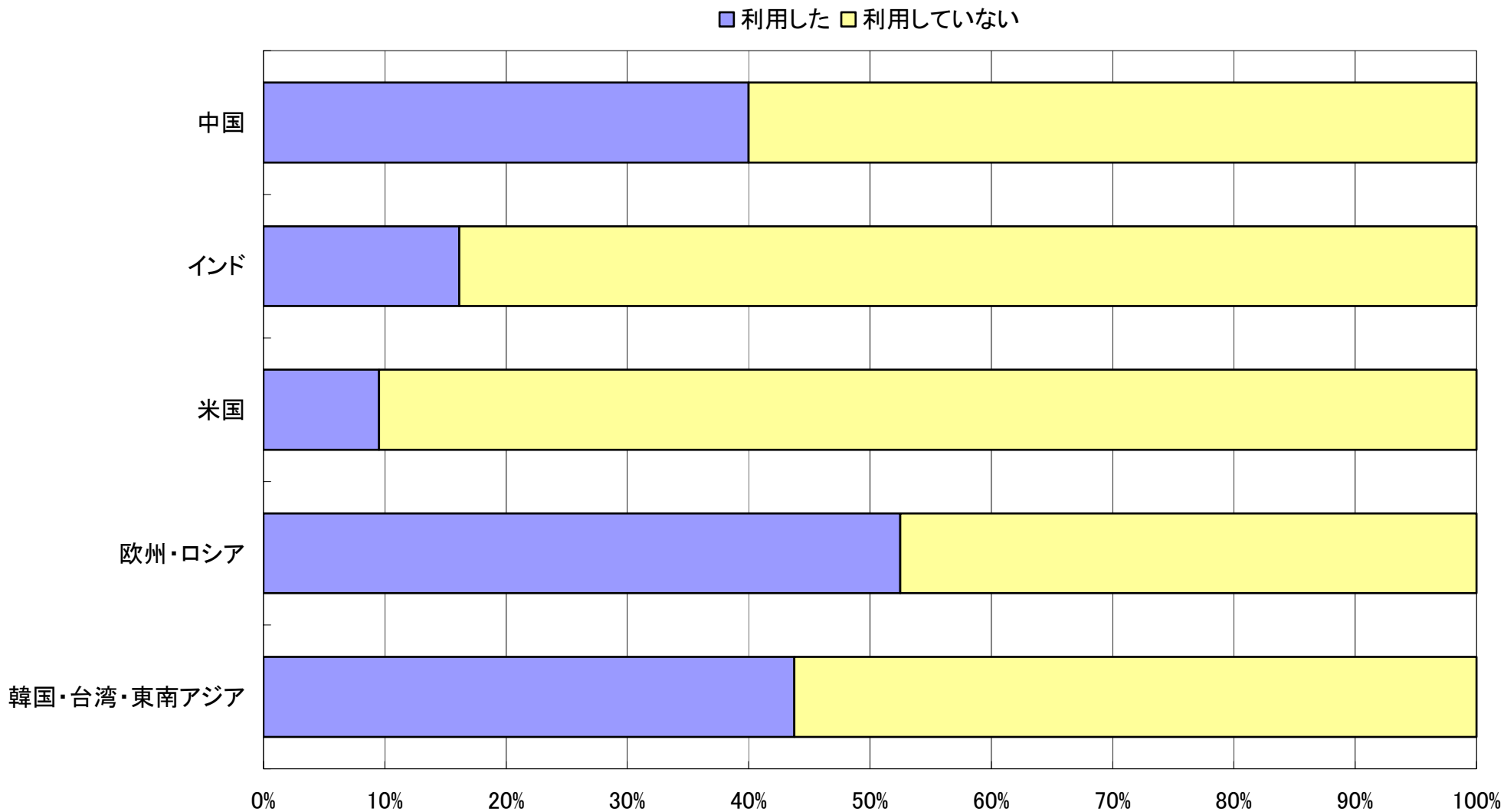


■ 利用した ■ 利用していない

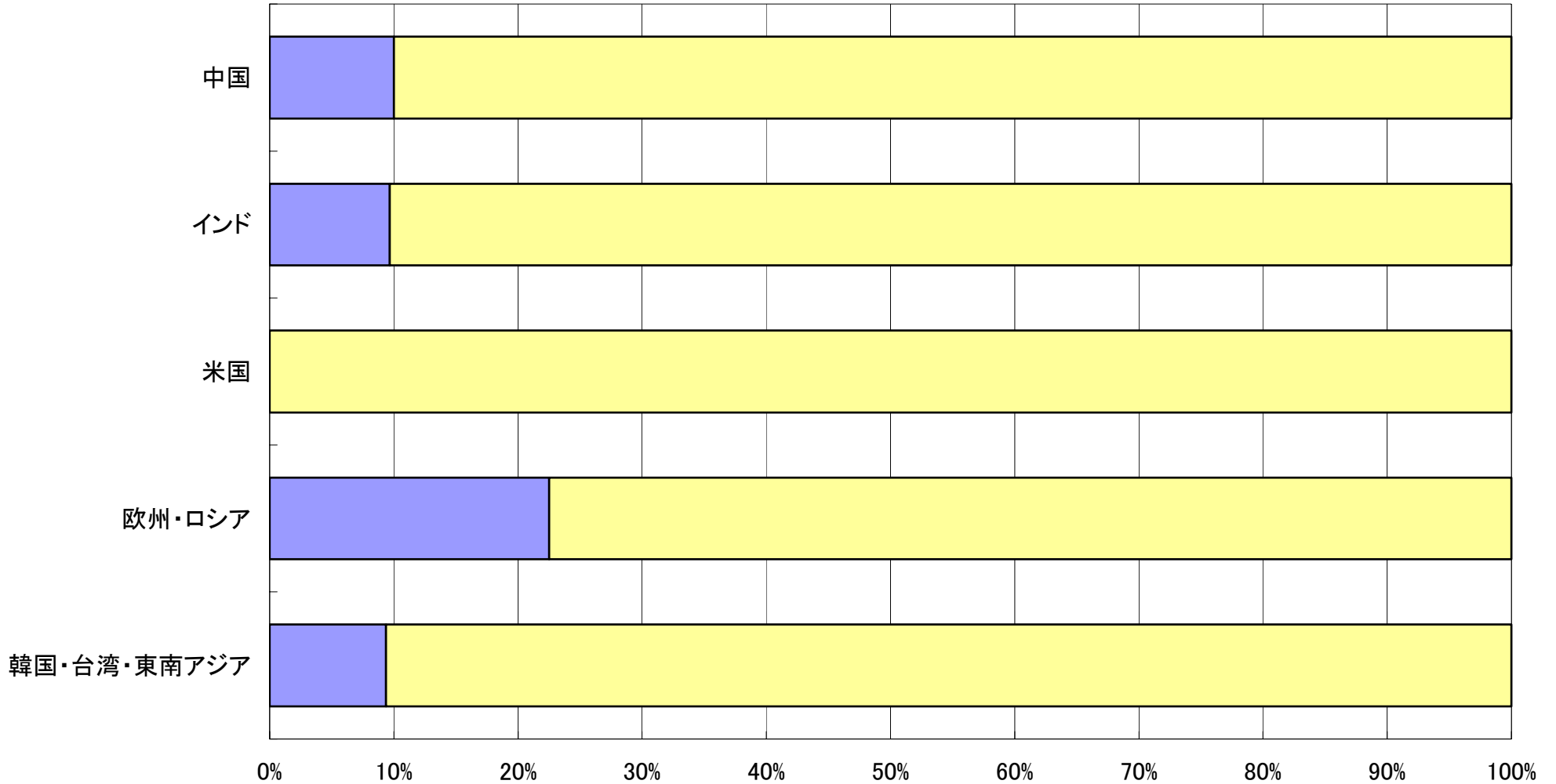




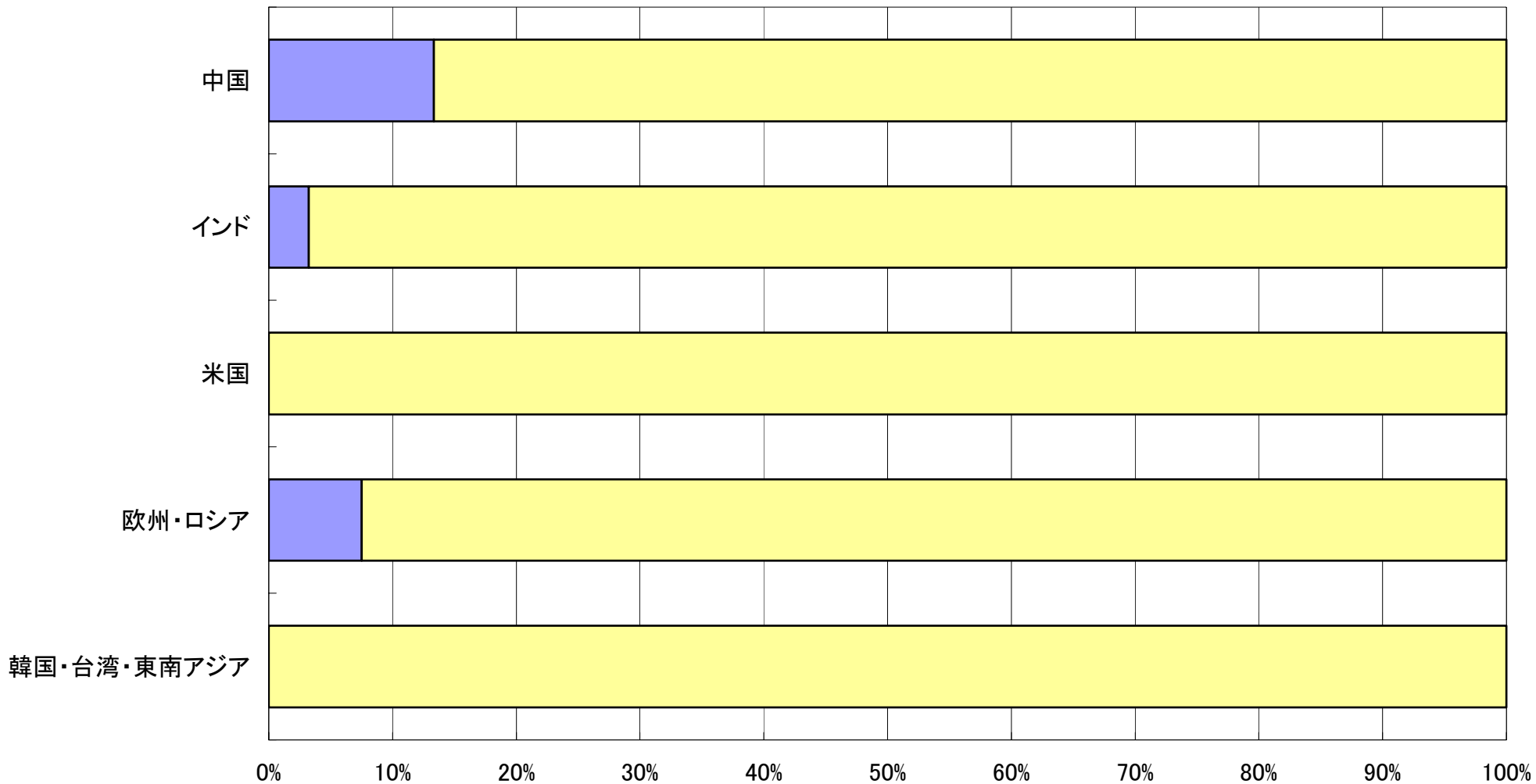


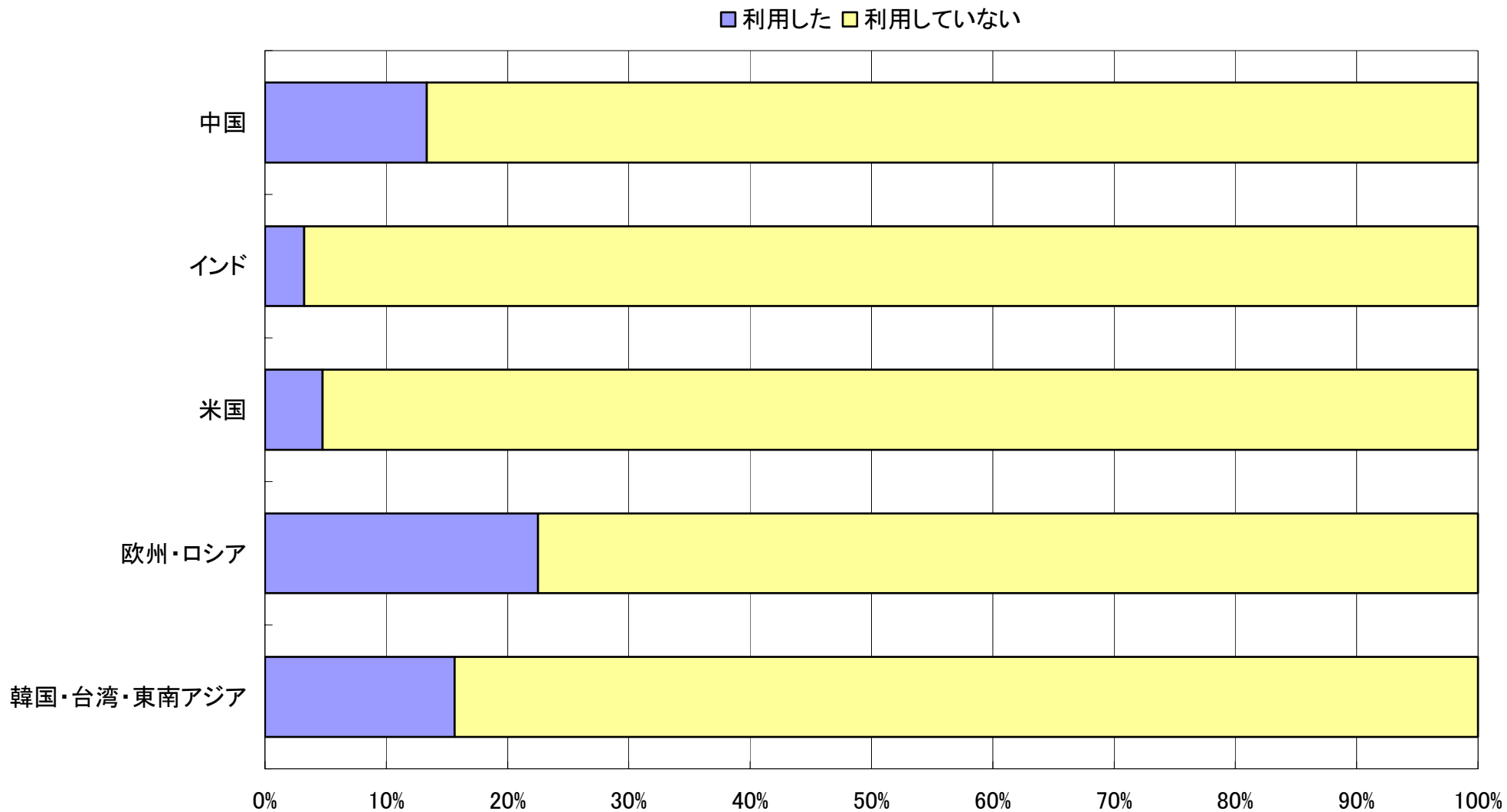


■ 利用した ■ 利用していない

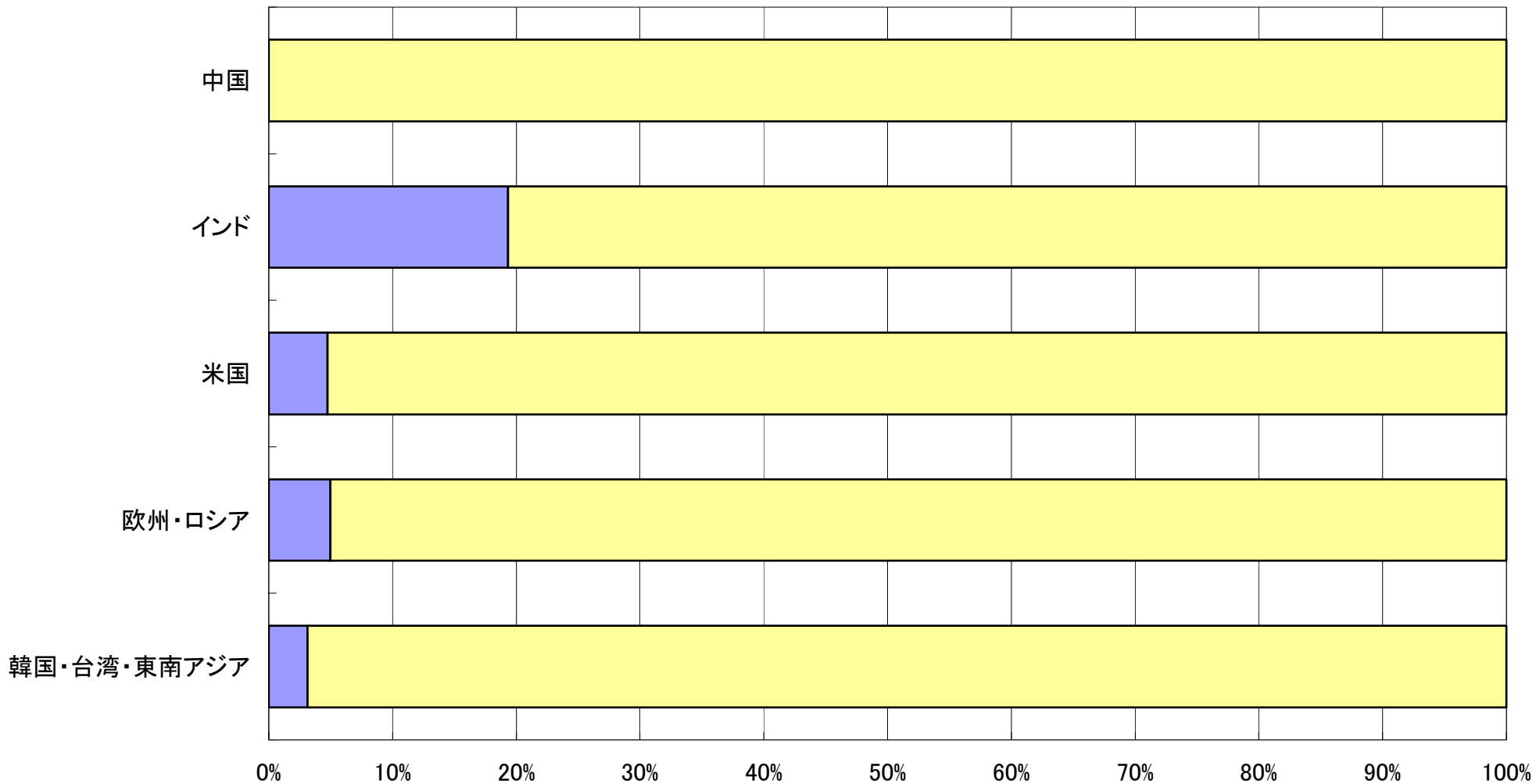


■ 利用した ■ 利用していない

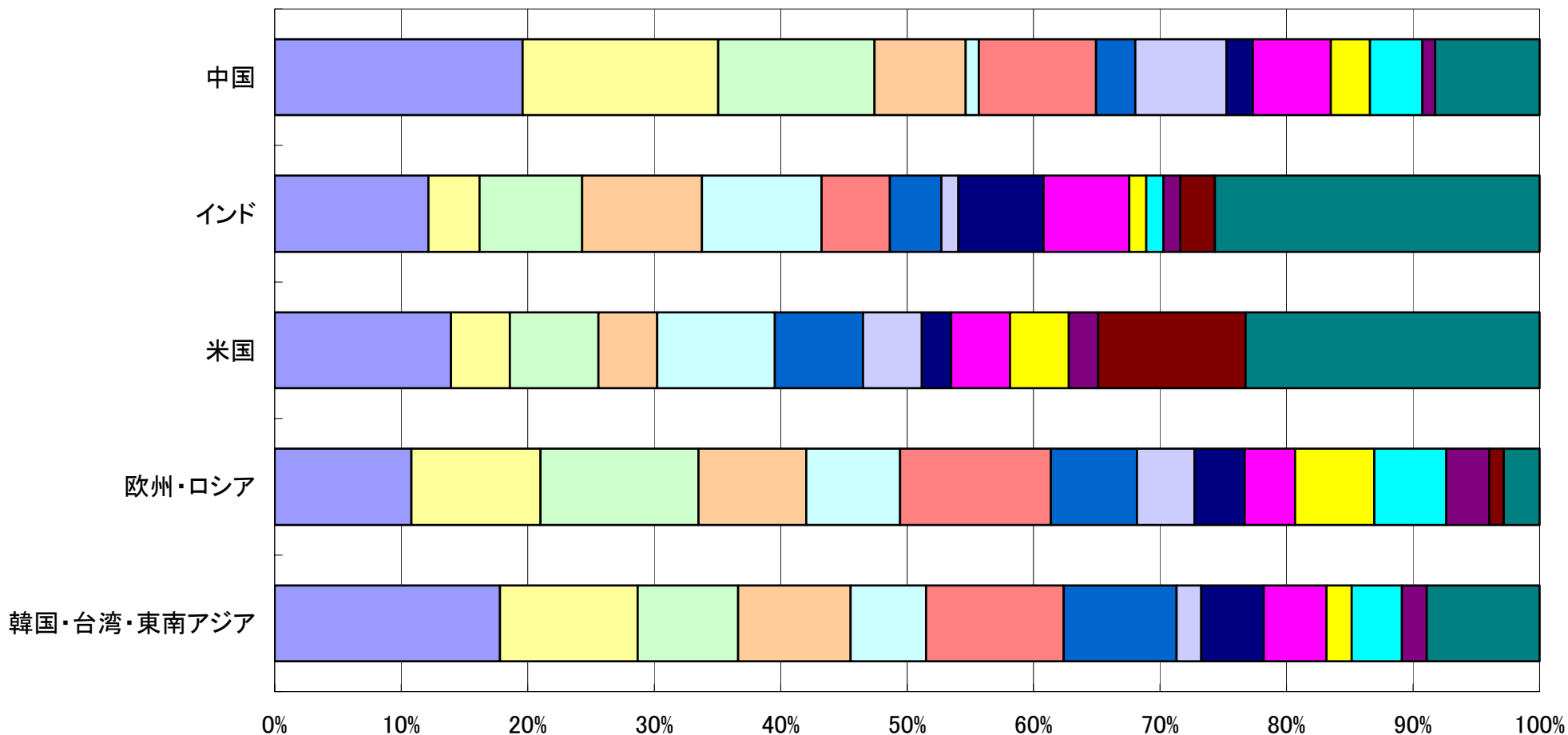


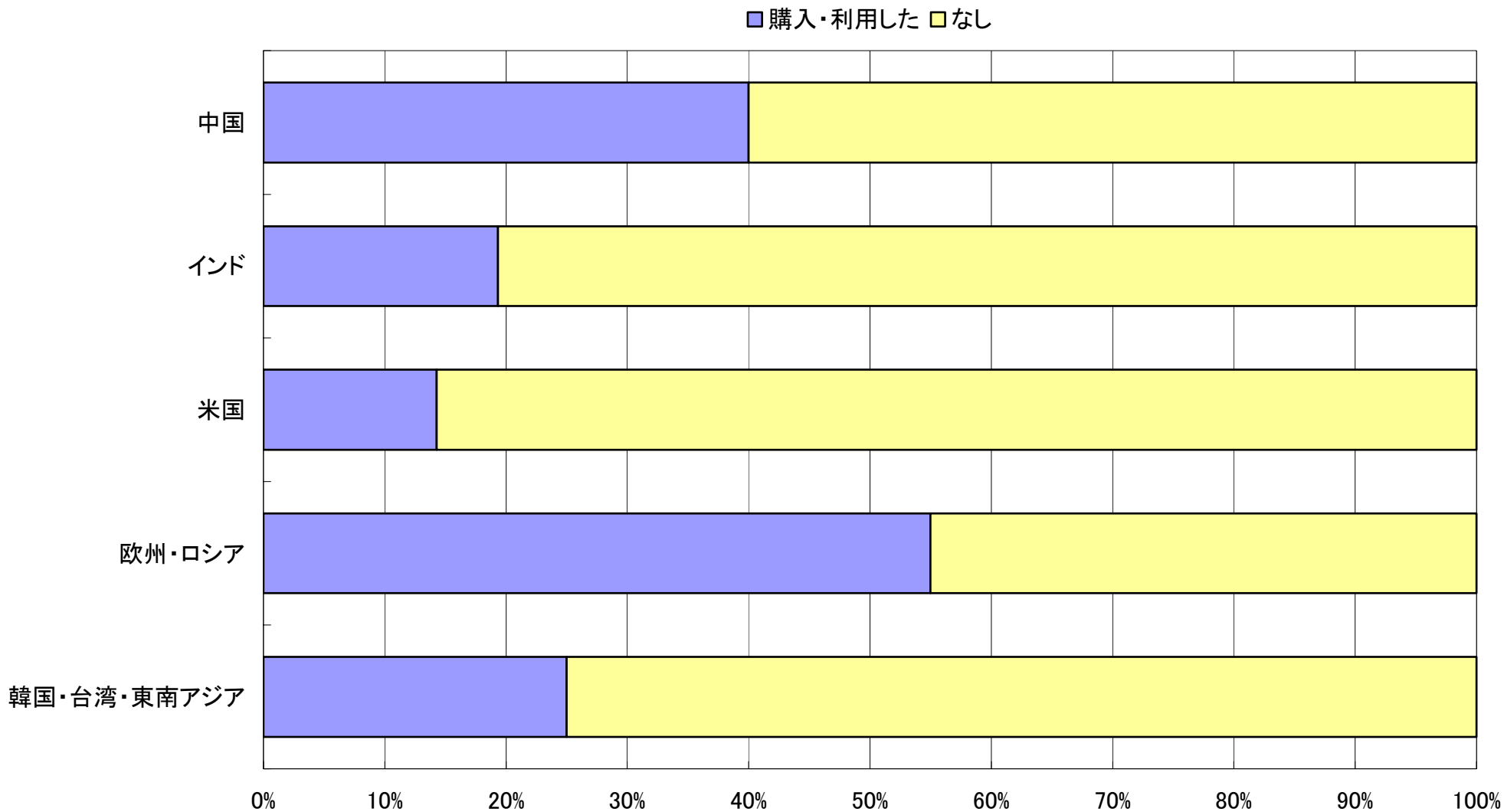


■ 利用した ■ 利用していない

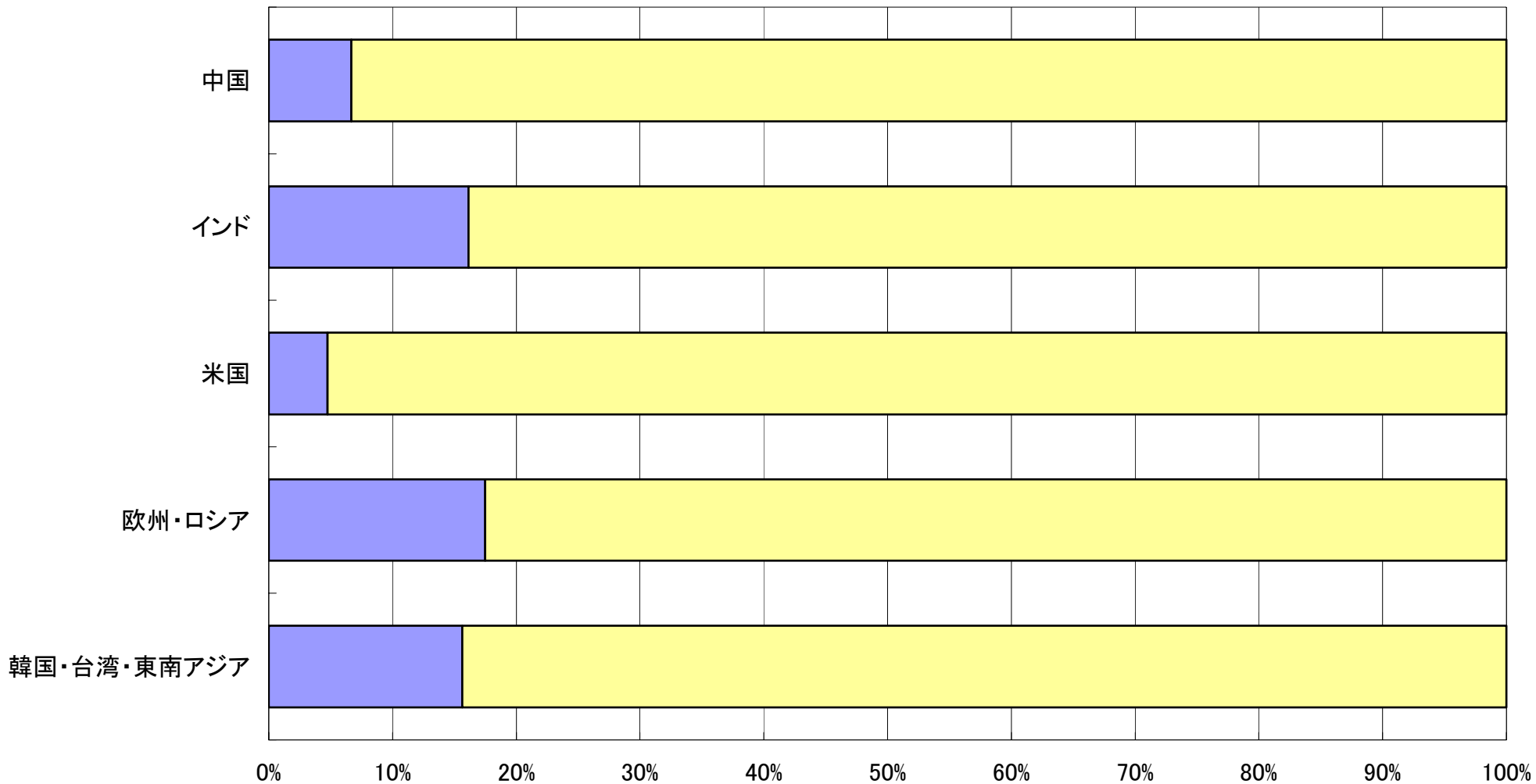


- OS
- デバイスドライバ
- 通信プロトコル
- ユーザインターフェース
- ファイルシステム
- 応用ソフトのモジュール
- 言語処理
- メディア圧縮/伸張
- セキュリティ機能
- 数学ライブラリ
- 文字フォント
- 画像処理・認識
- 音声認識・合成
- その他
- 購入していない

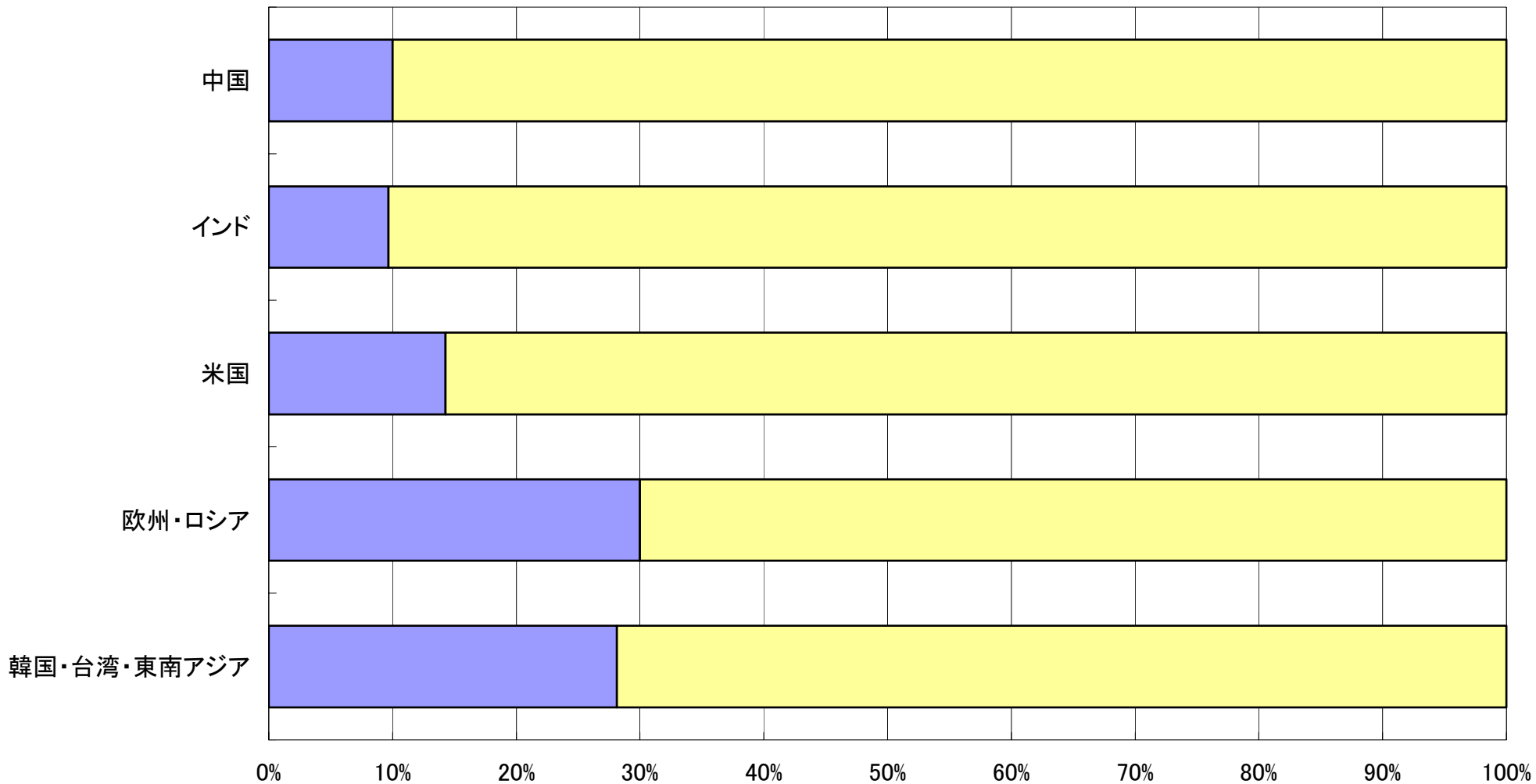




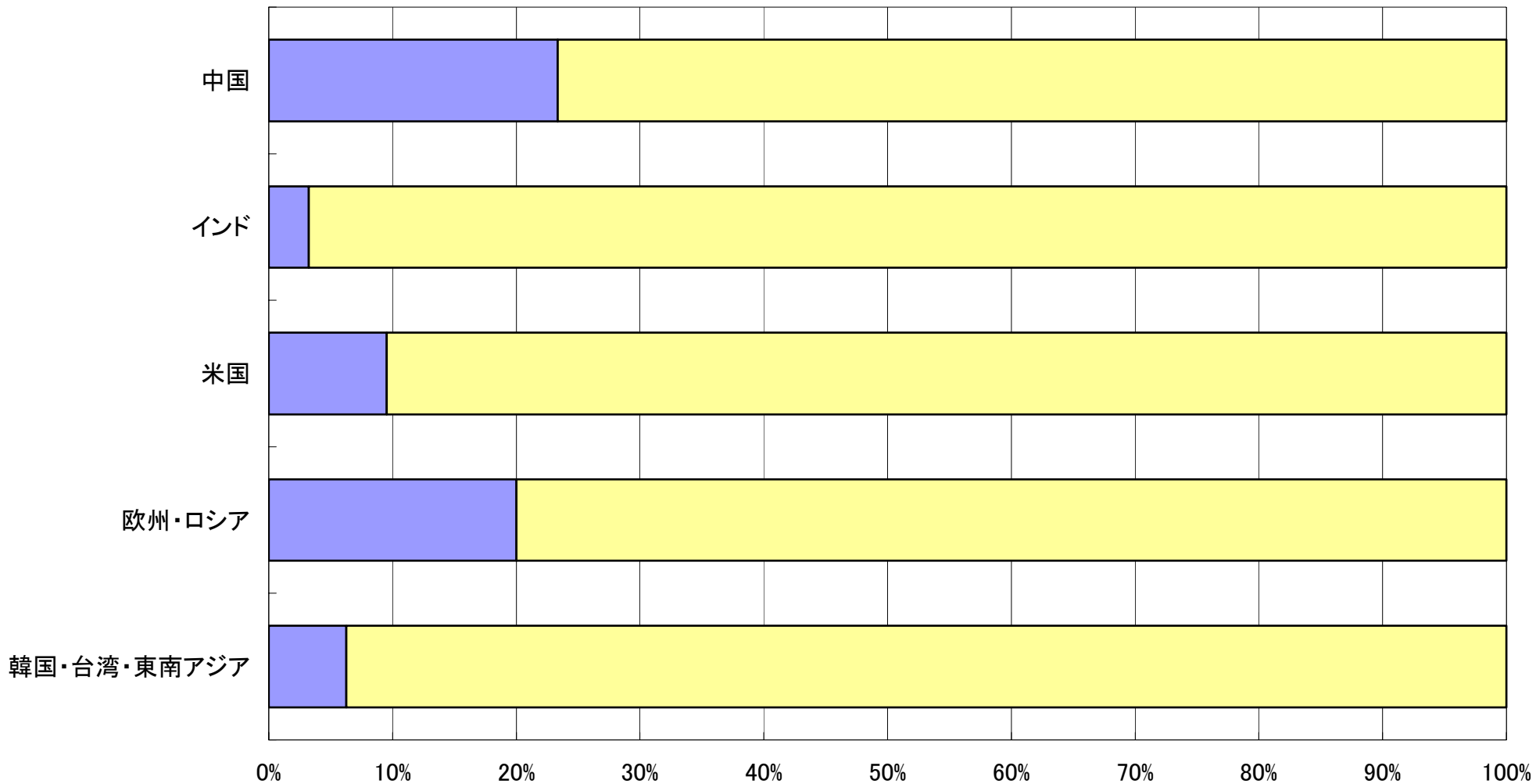
■ 購入・利用した ■ なし

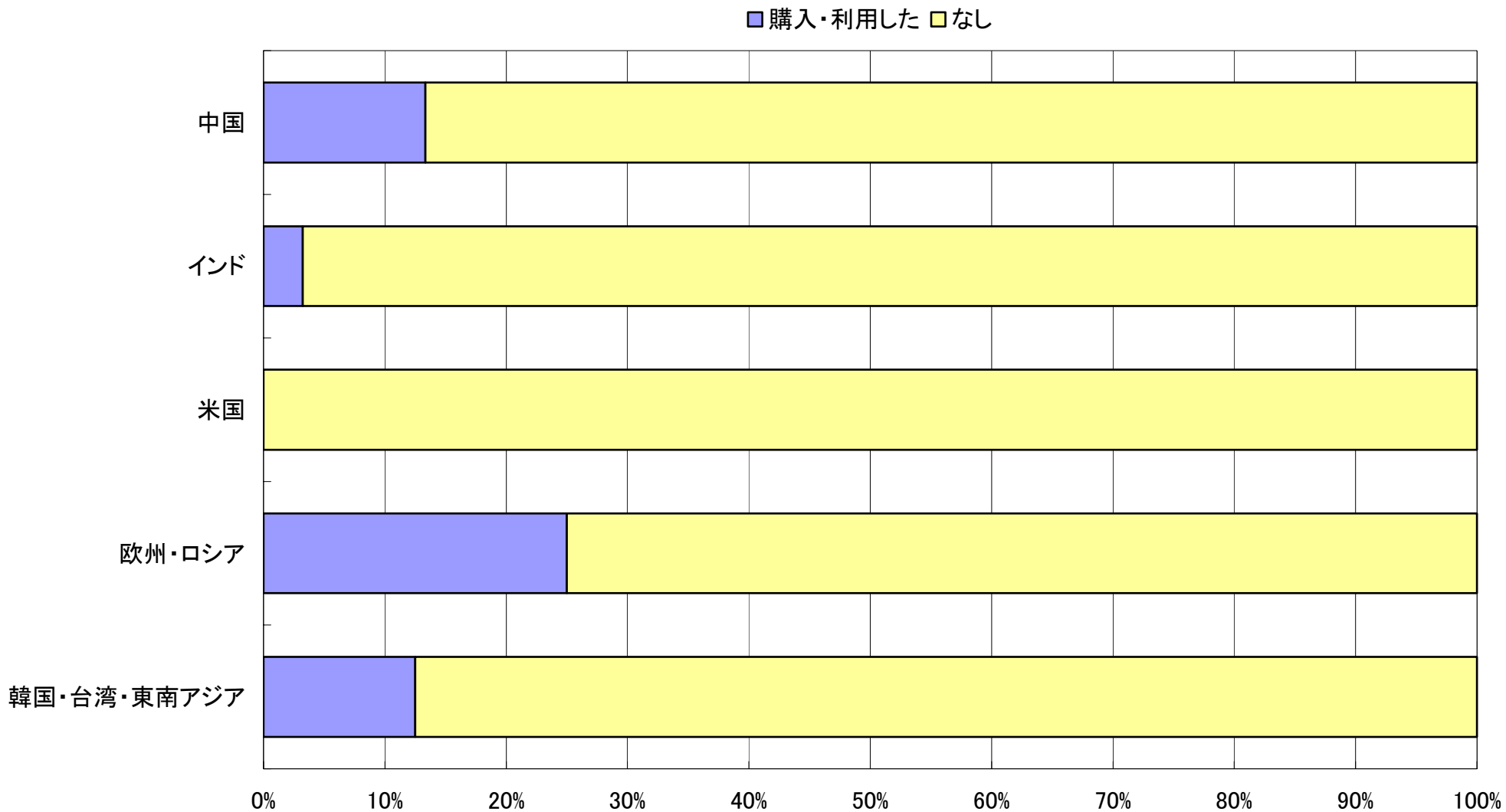


■ 購入・利用した ■ なし

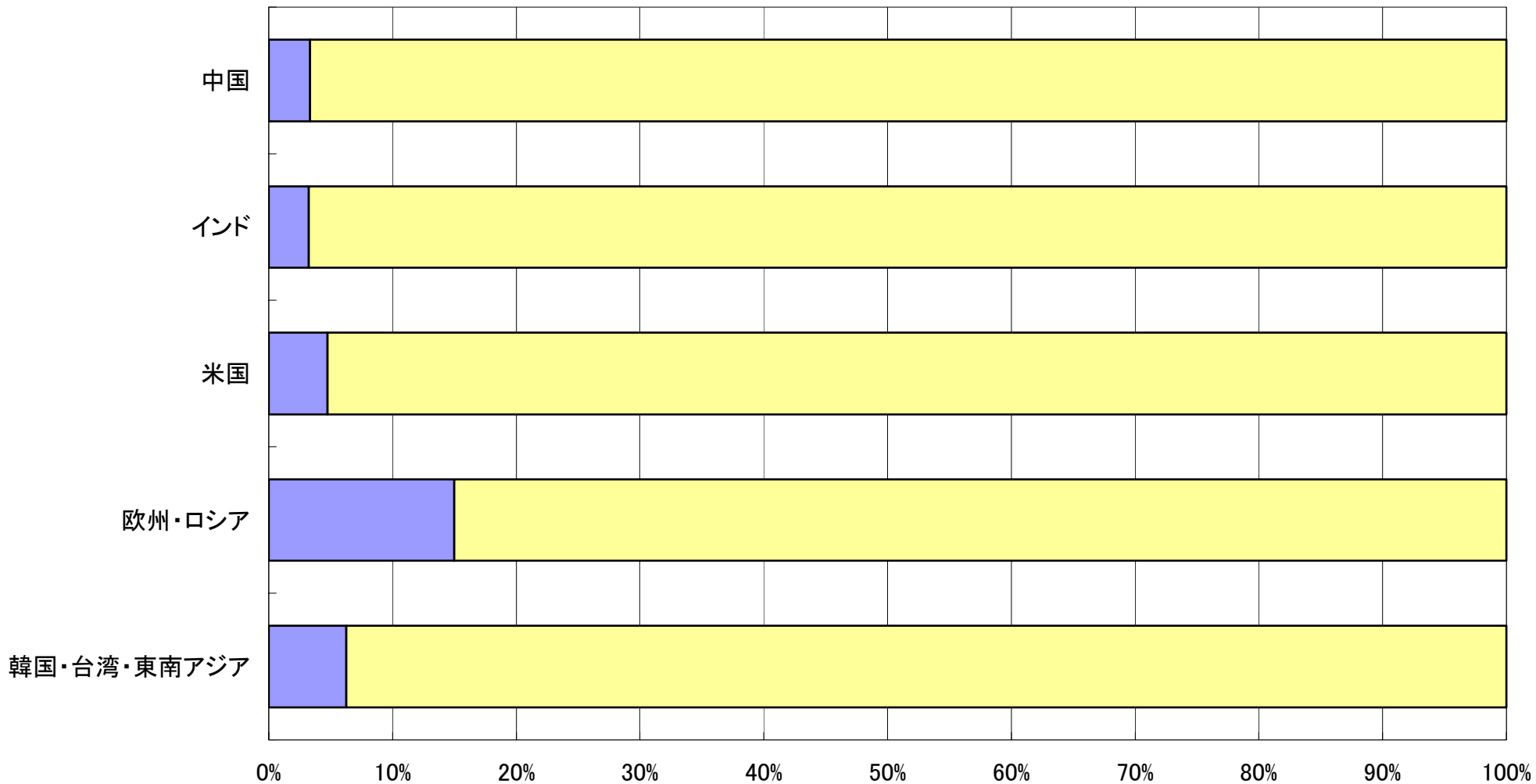


■ 購入・利用した ■ なし

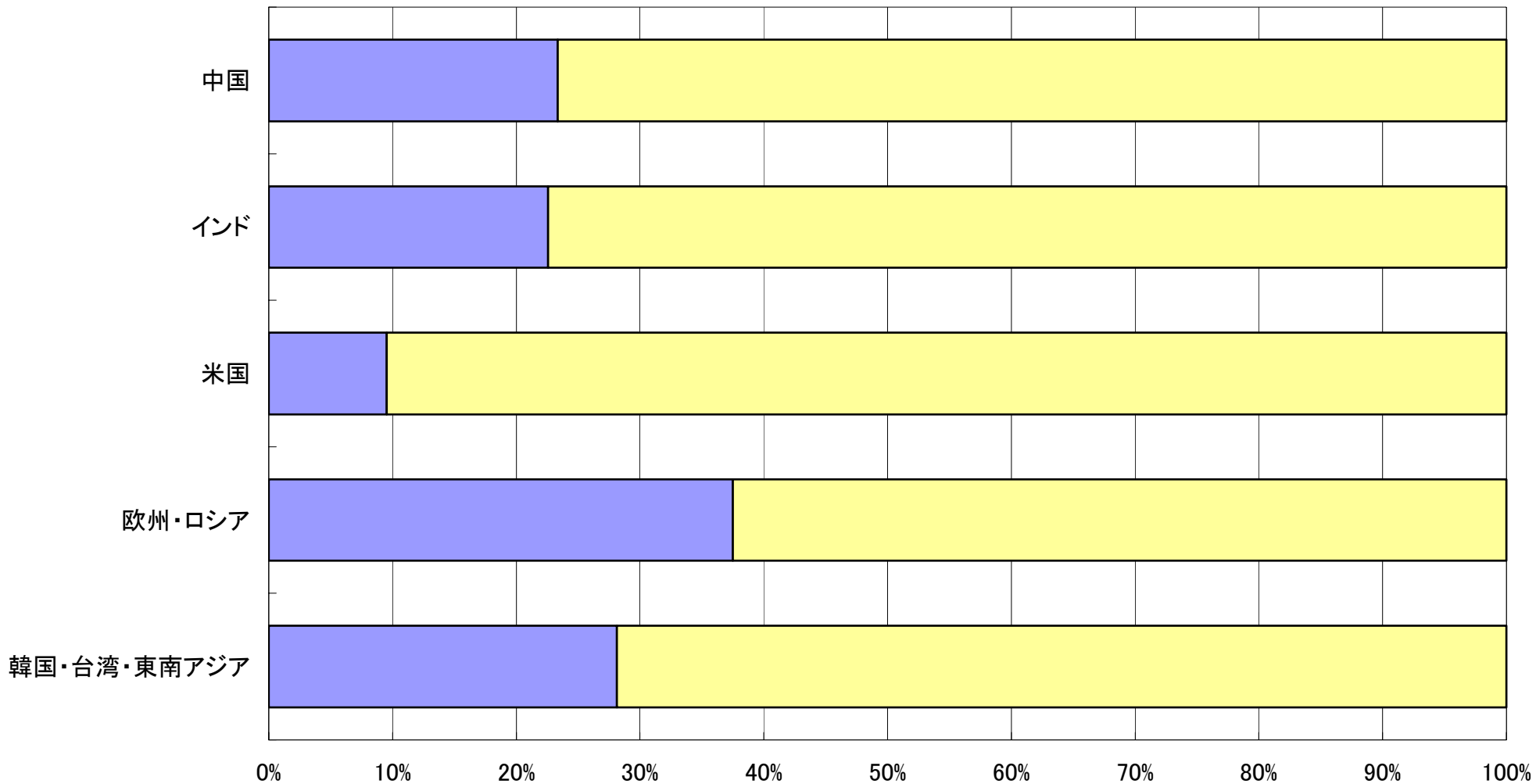




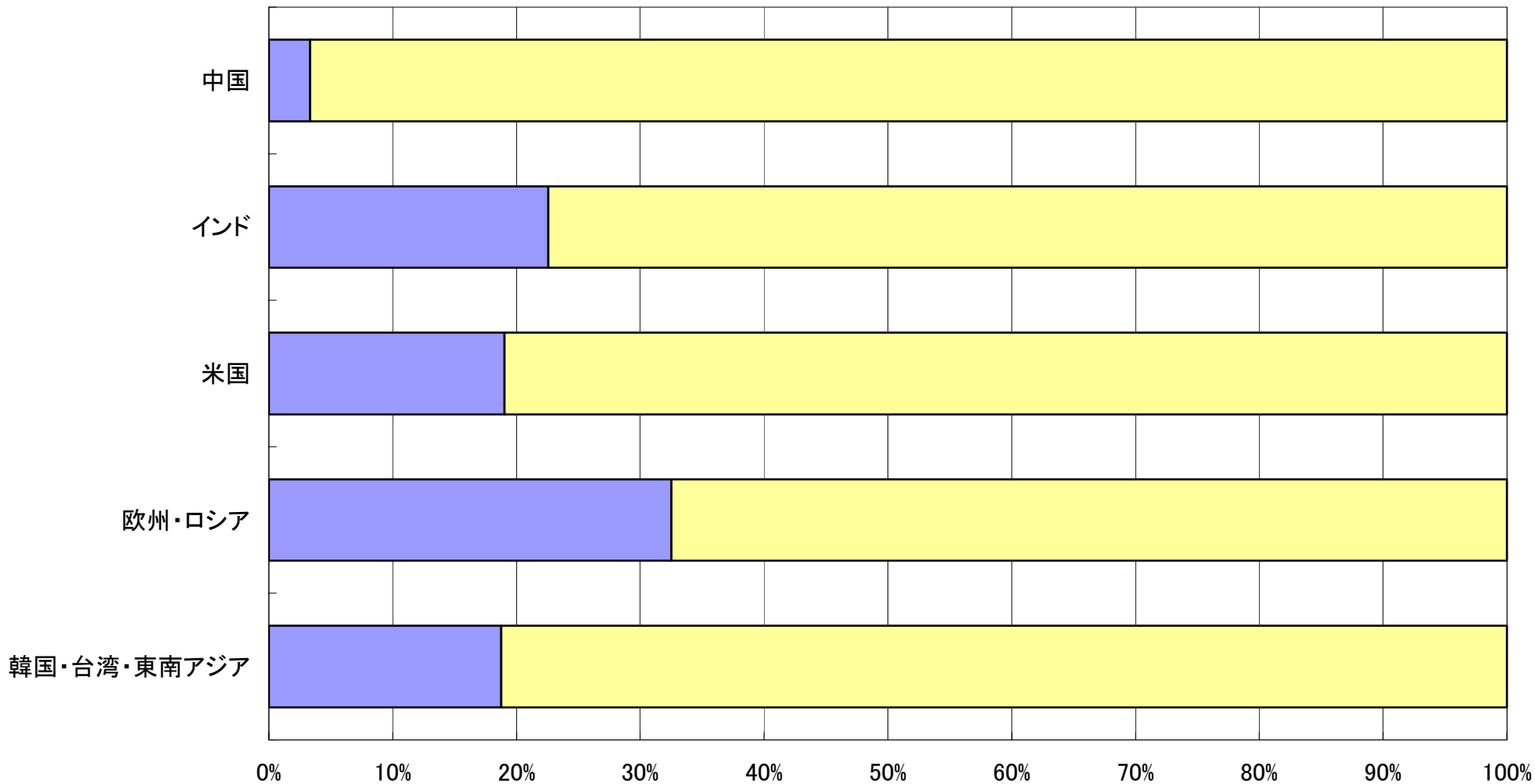
■ 購入・利用した ■ なし



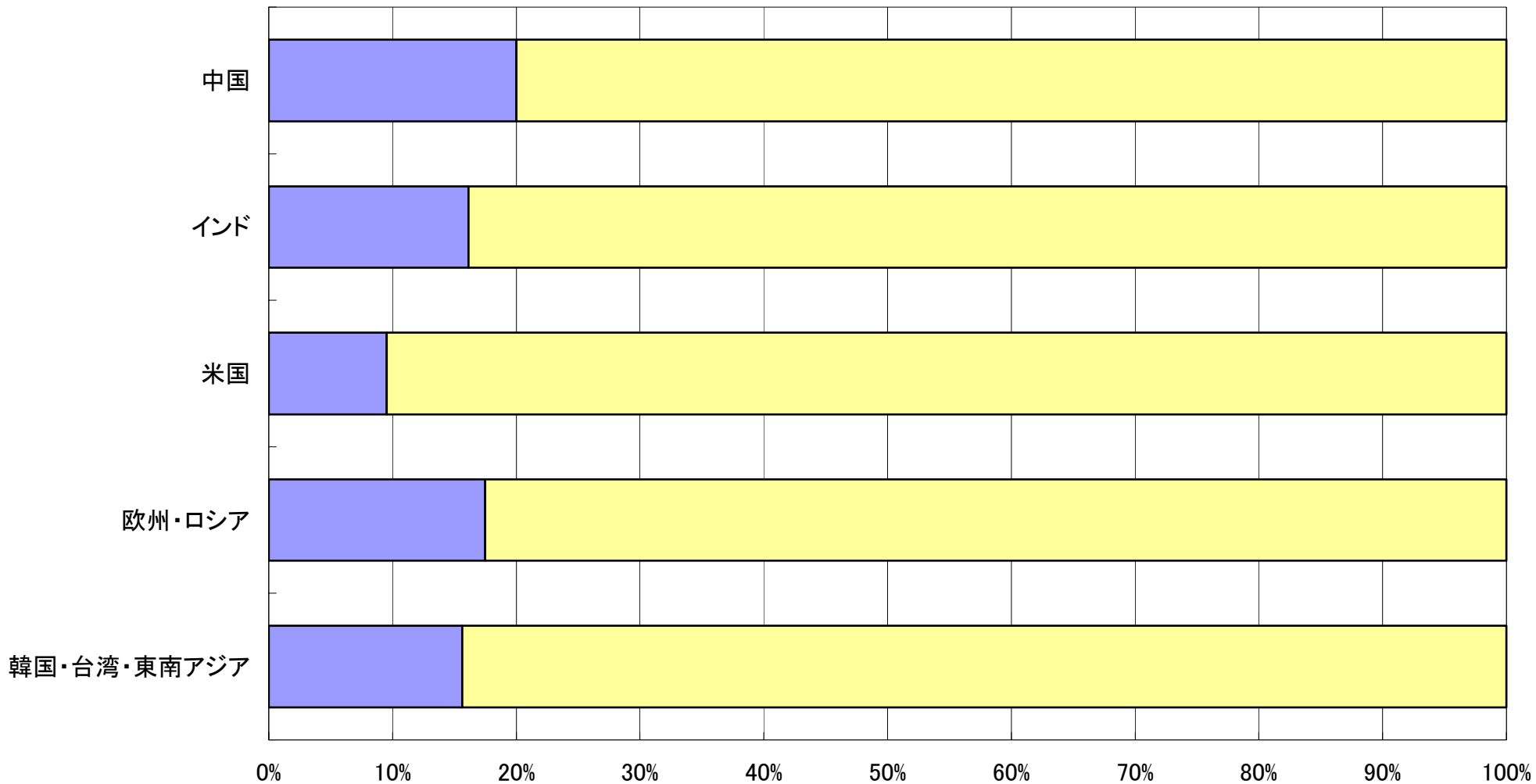
■ 購入・利用した ■ なし

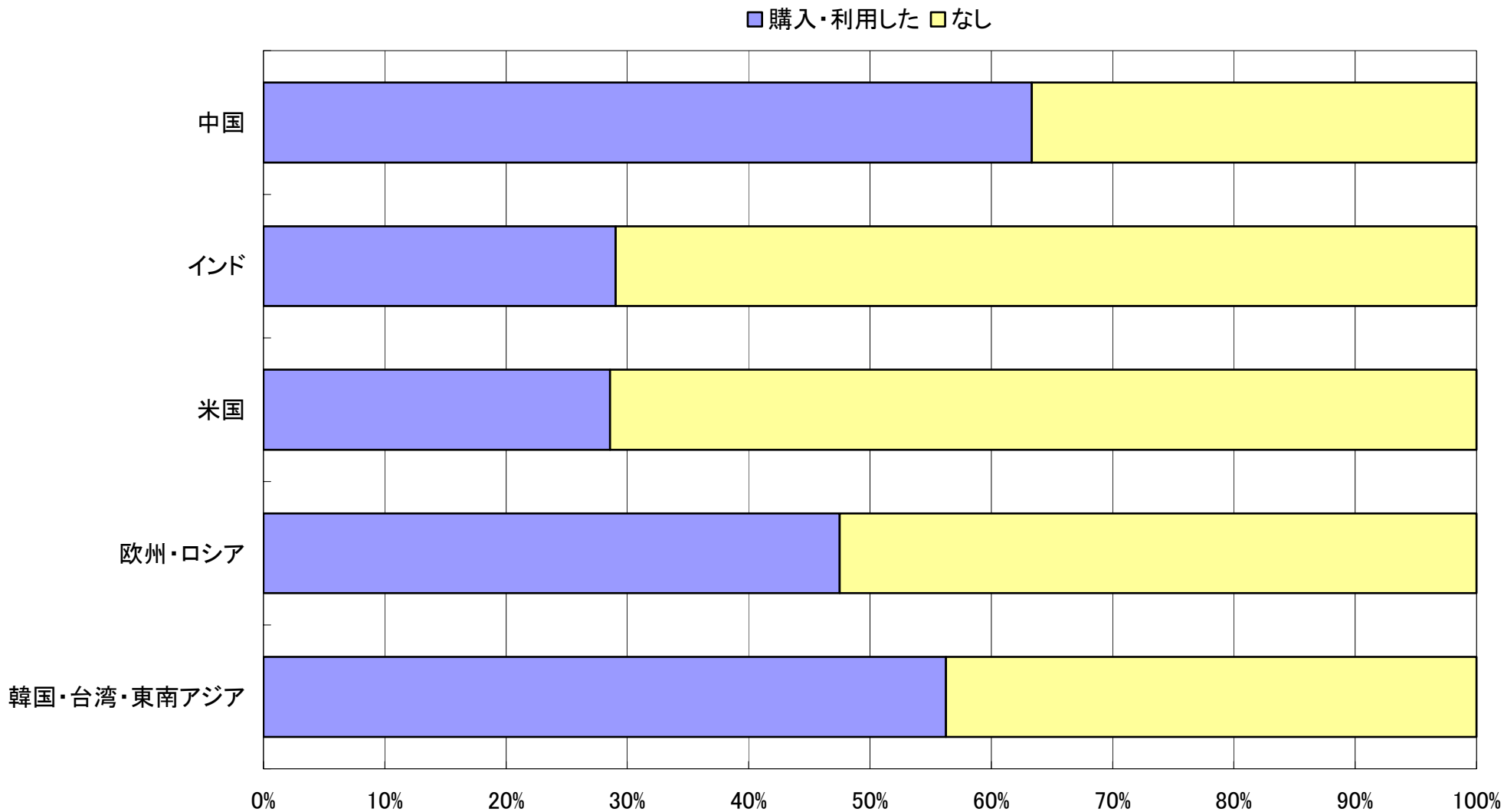


■ 購入・利用した ■ なし

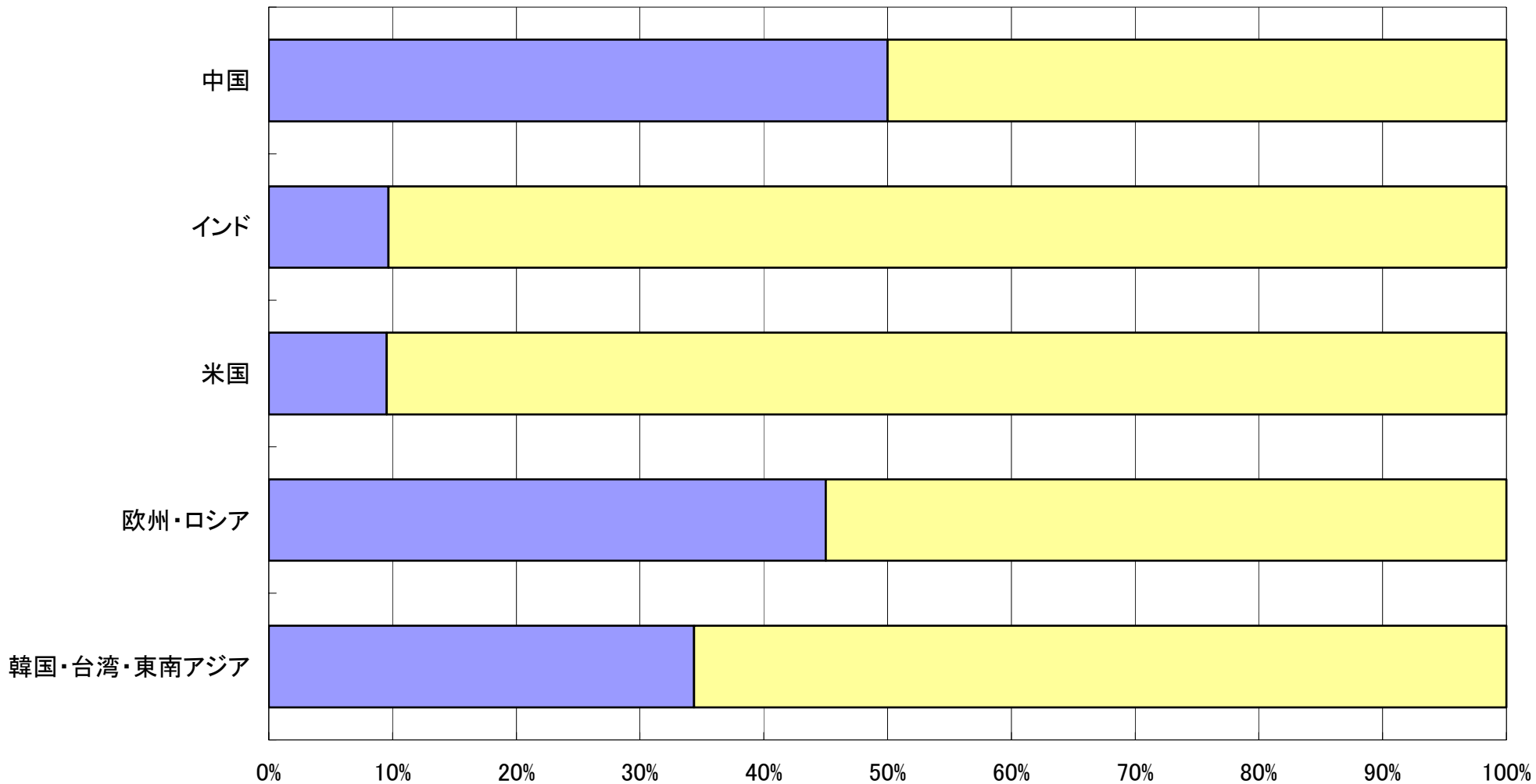


■ 購入・利用した ■ なし

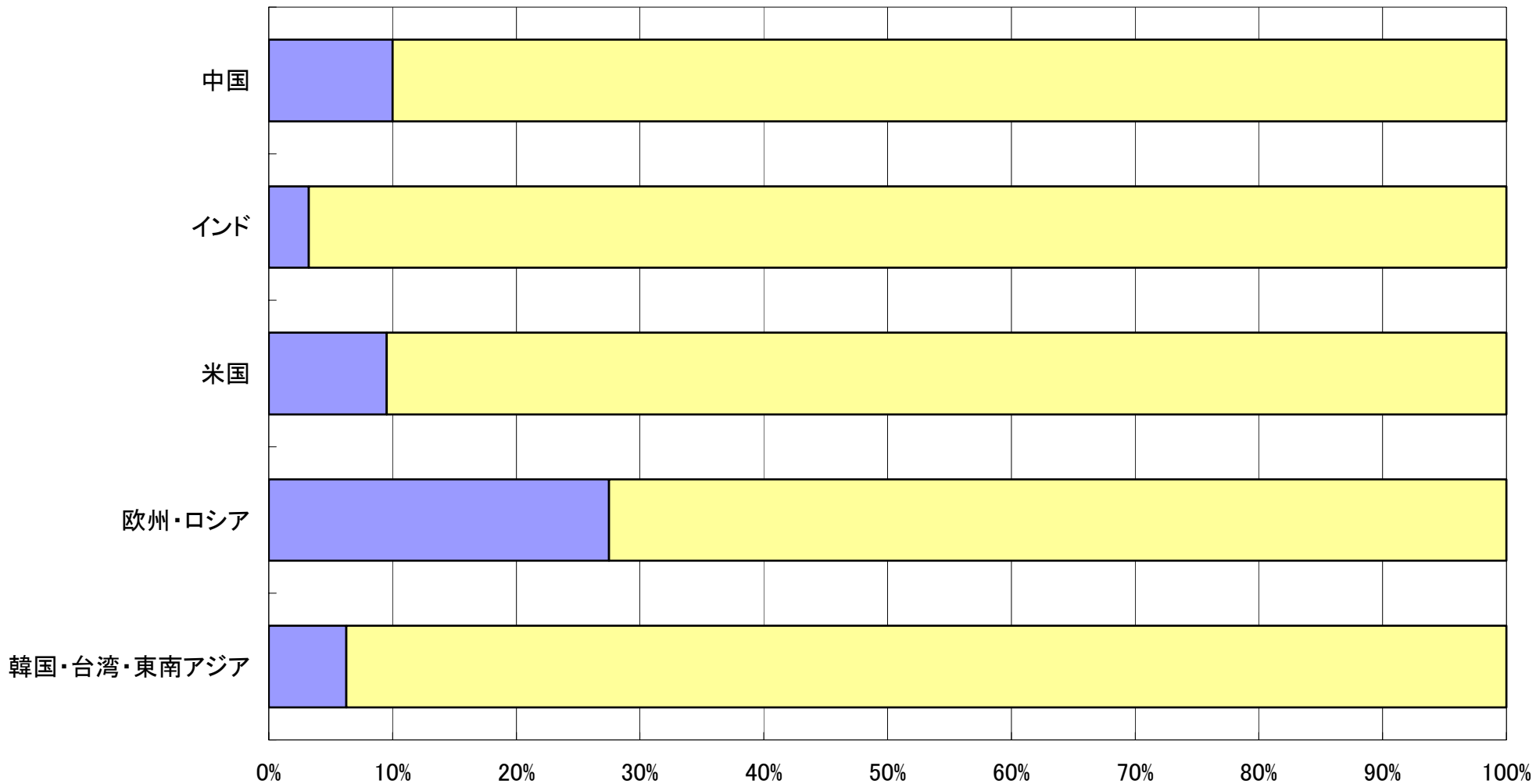




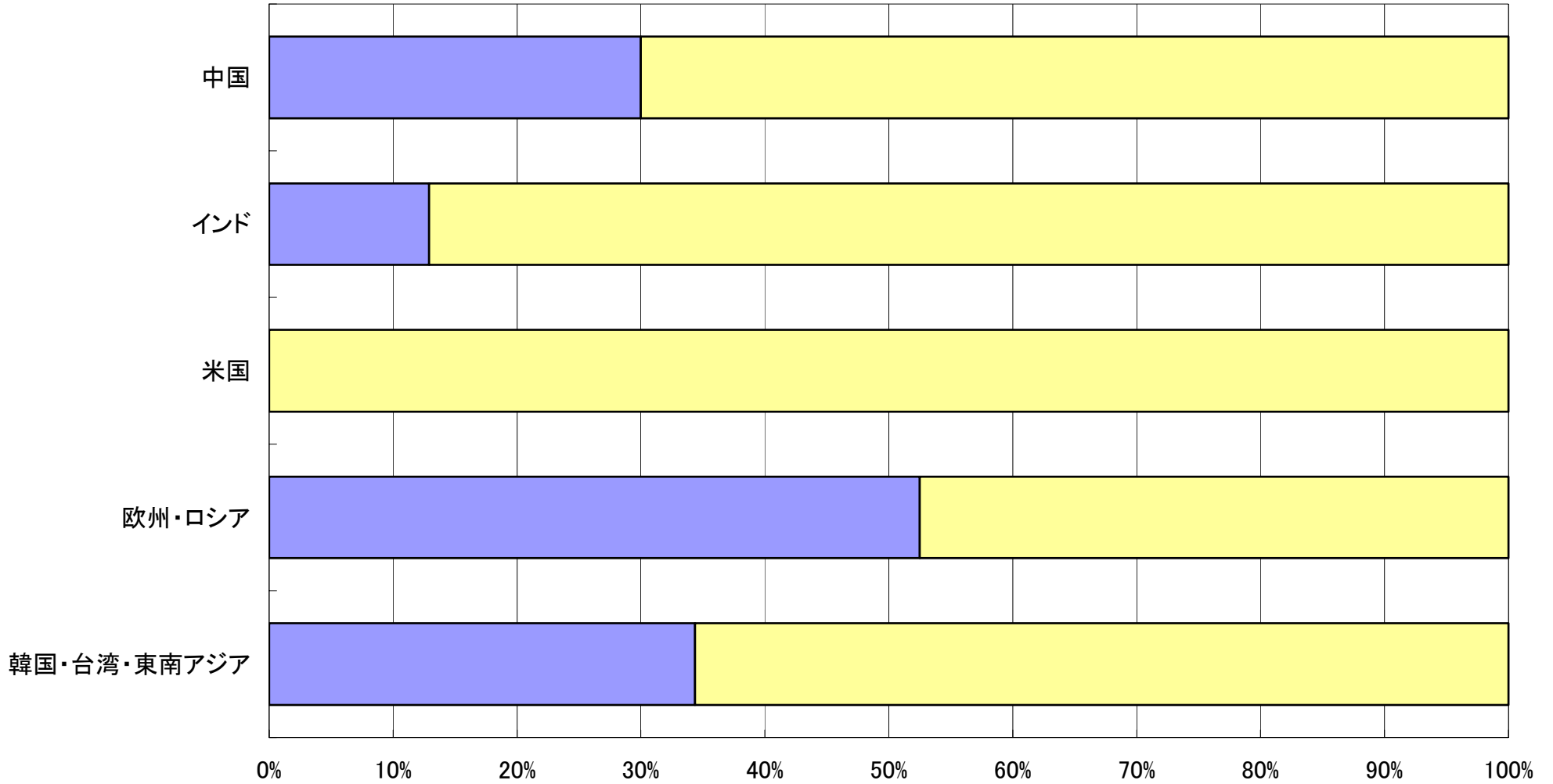
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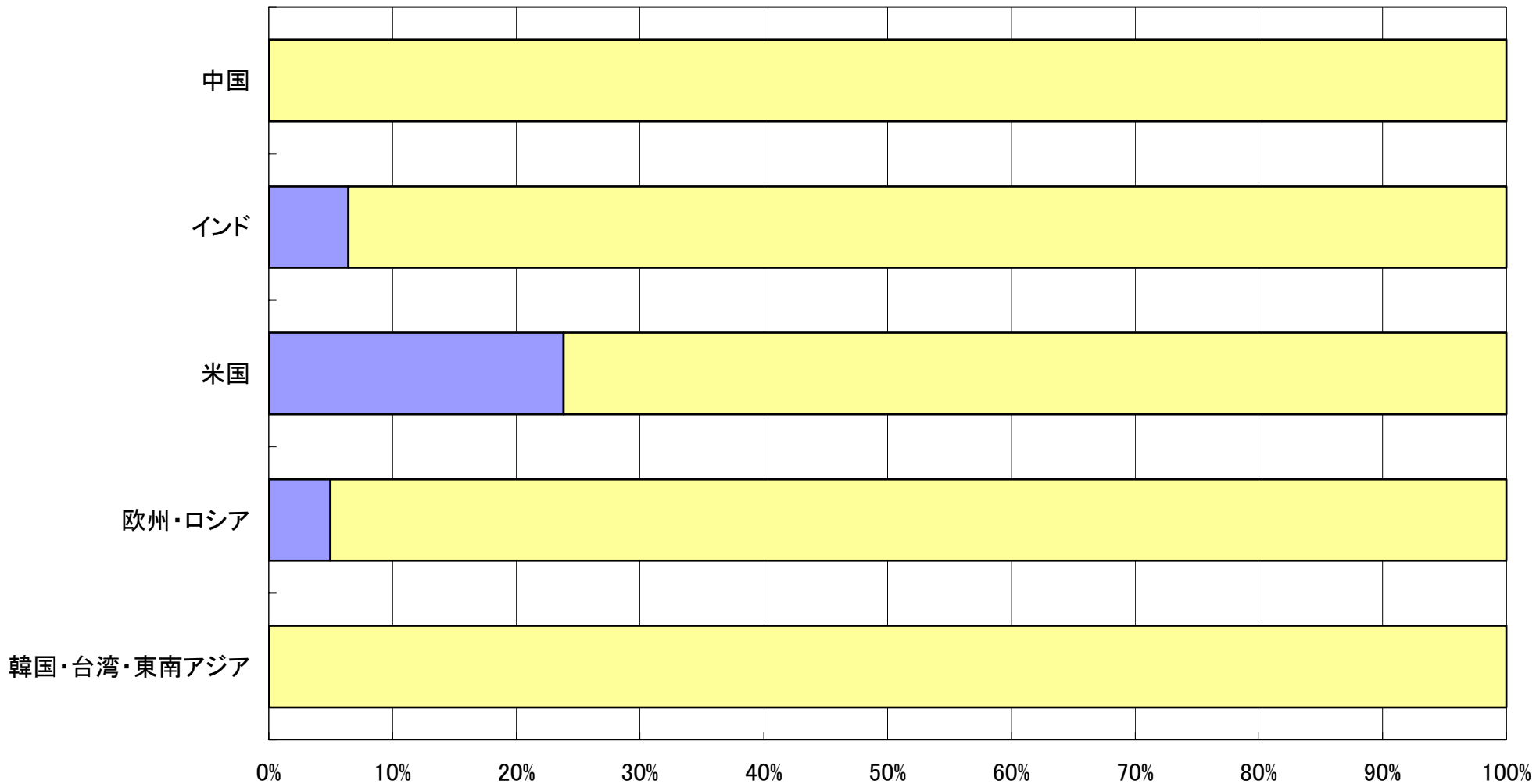
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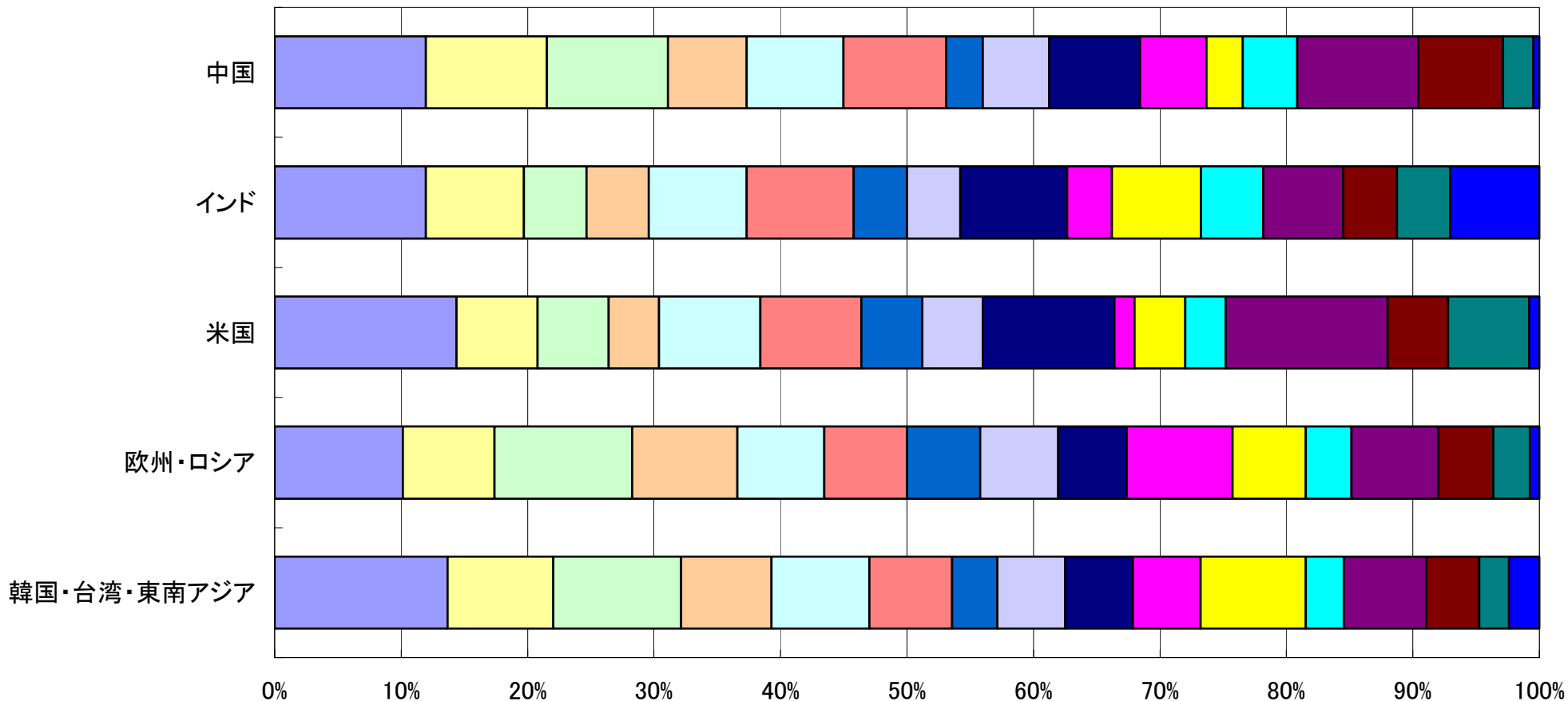
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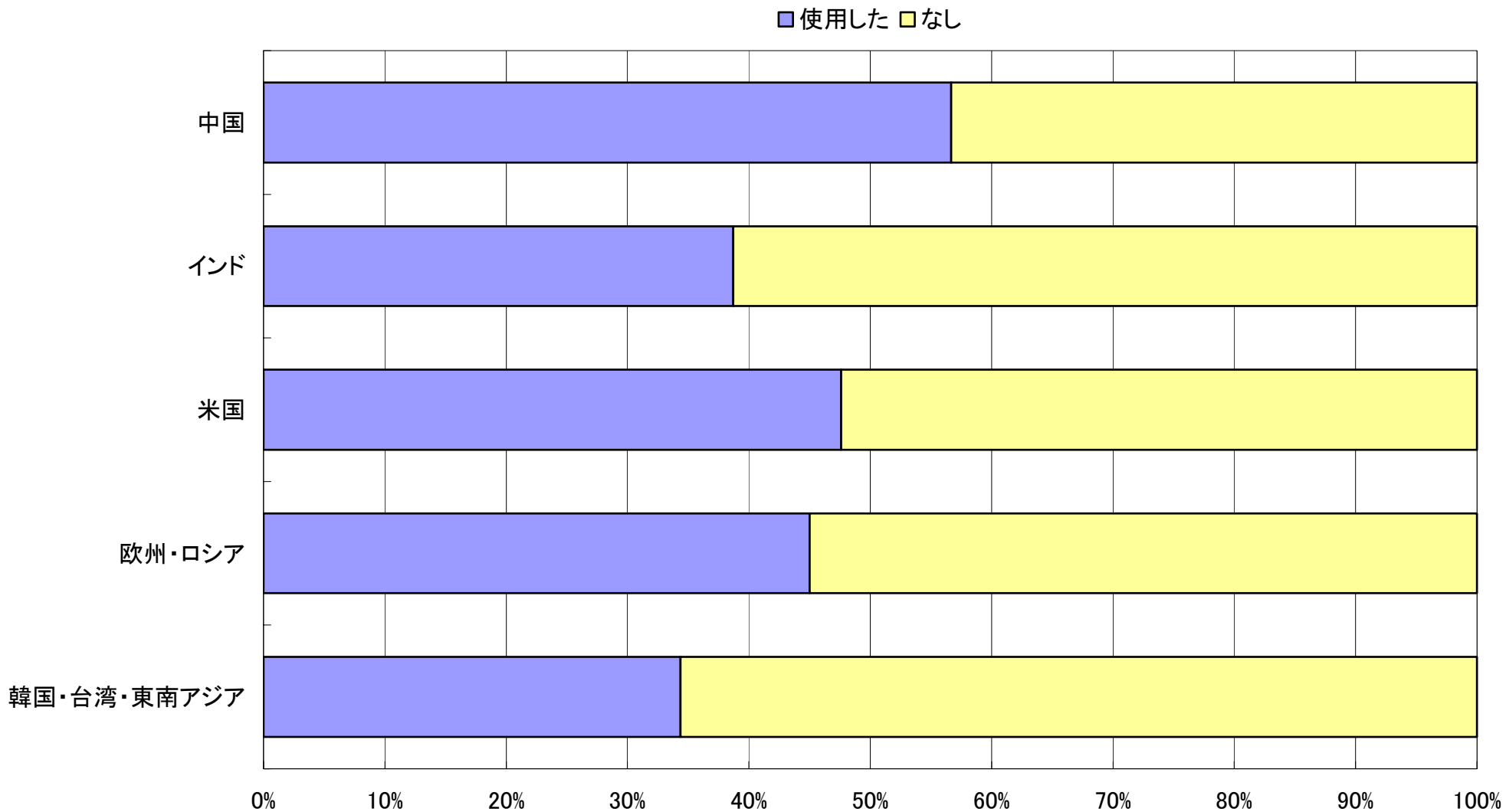


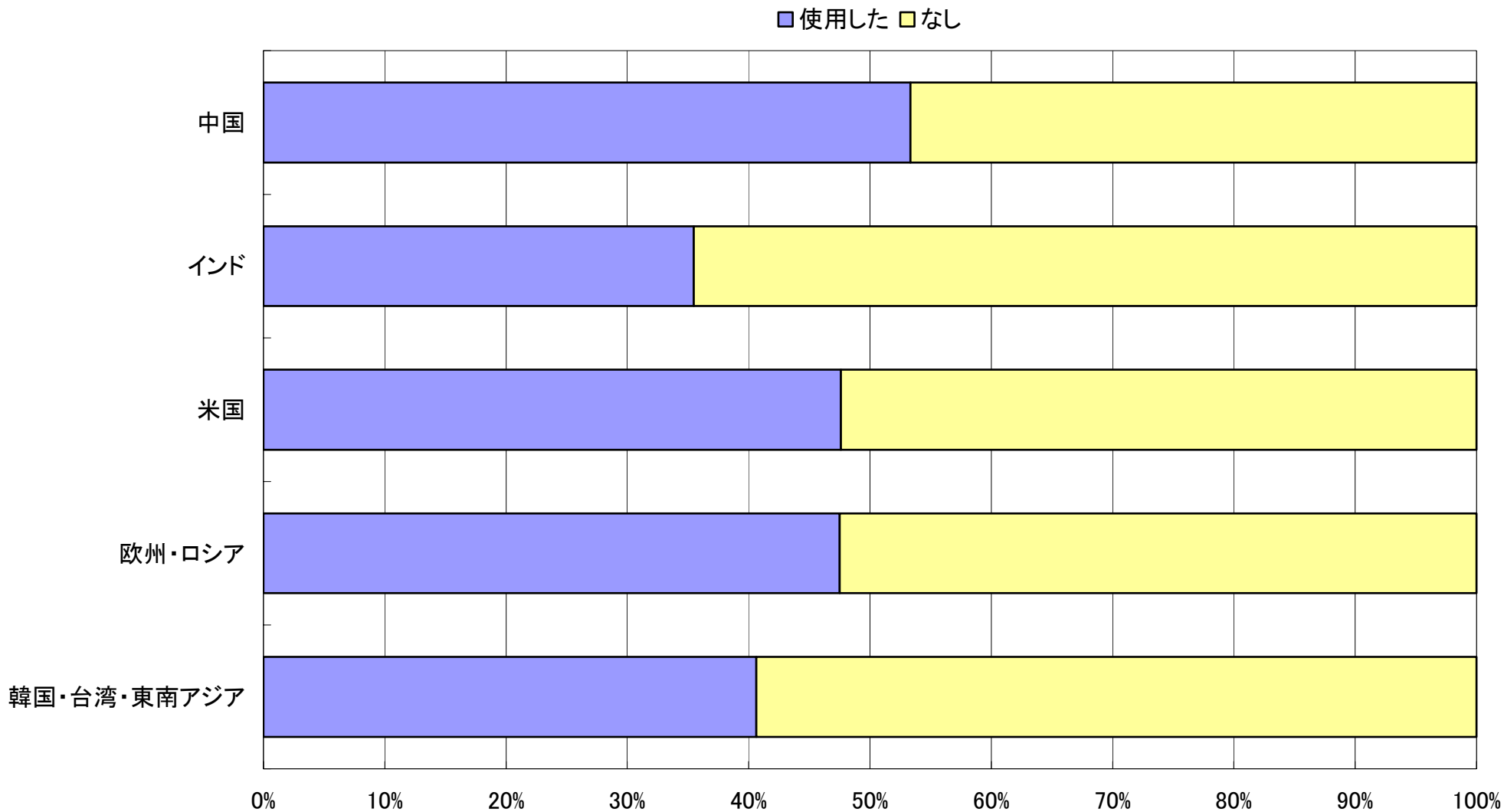
■ 購入・利用した □ なし

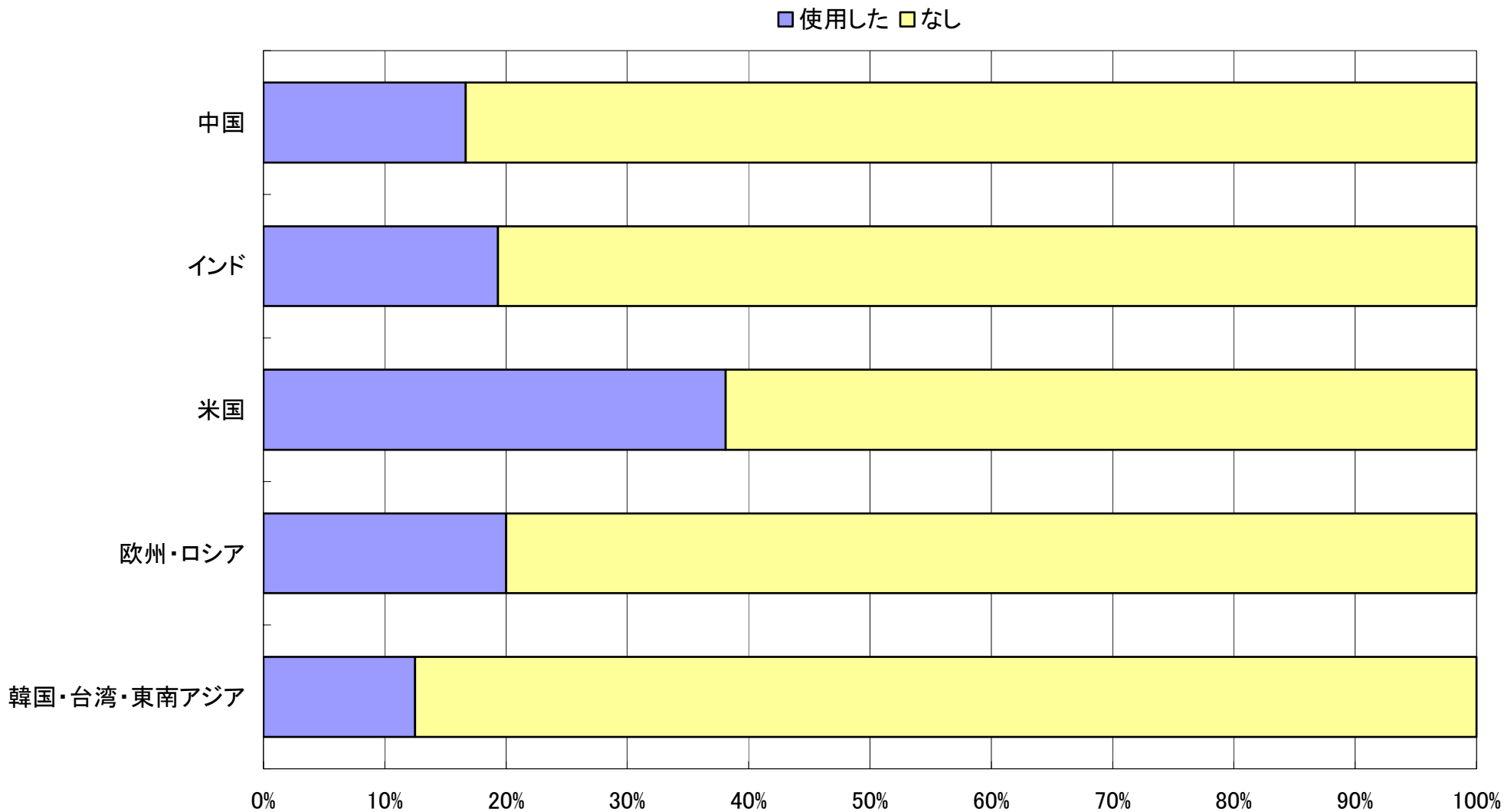


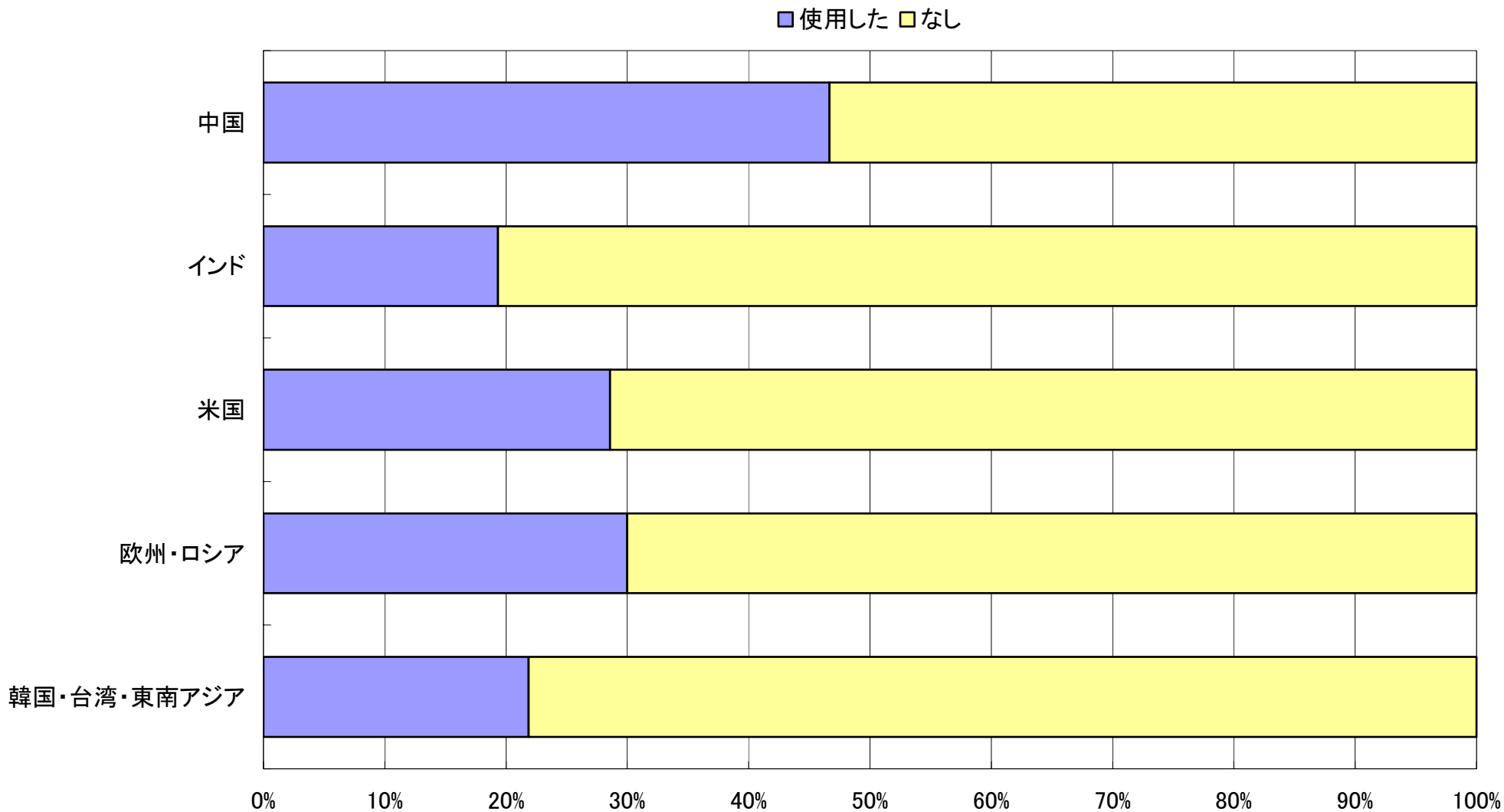
- コンパイラ/デバッガ
- テストツール
- 統合開発環境
- プロジェクト管理ツール
- ソースコード解析ツール
- 分析・設計ツール
- 構成管理ツール
- アナライザ・測定機
- インサーキットエミュレータ
- ドキュメント管理ツール
- 検証ツール
- 品質管理ツール
- 評価ボード
- 静的コードチェックツール
- 数値解析ツール
- 使用していない

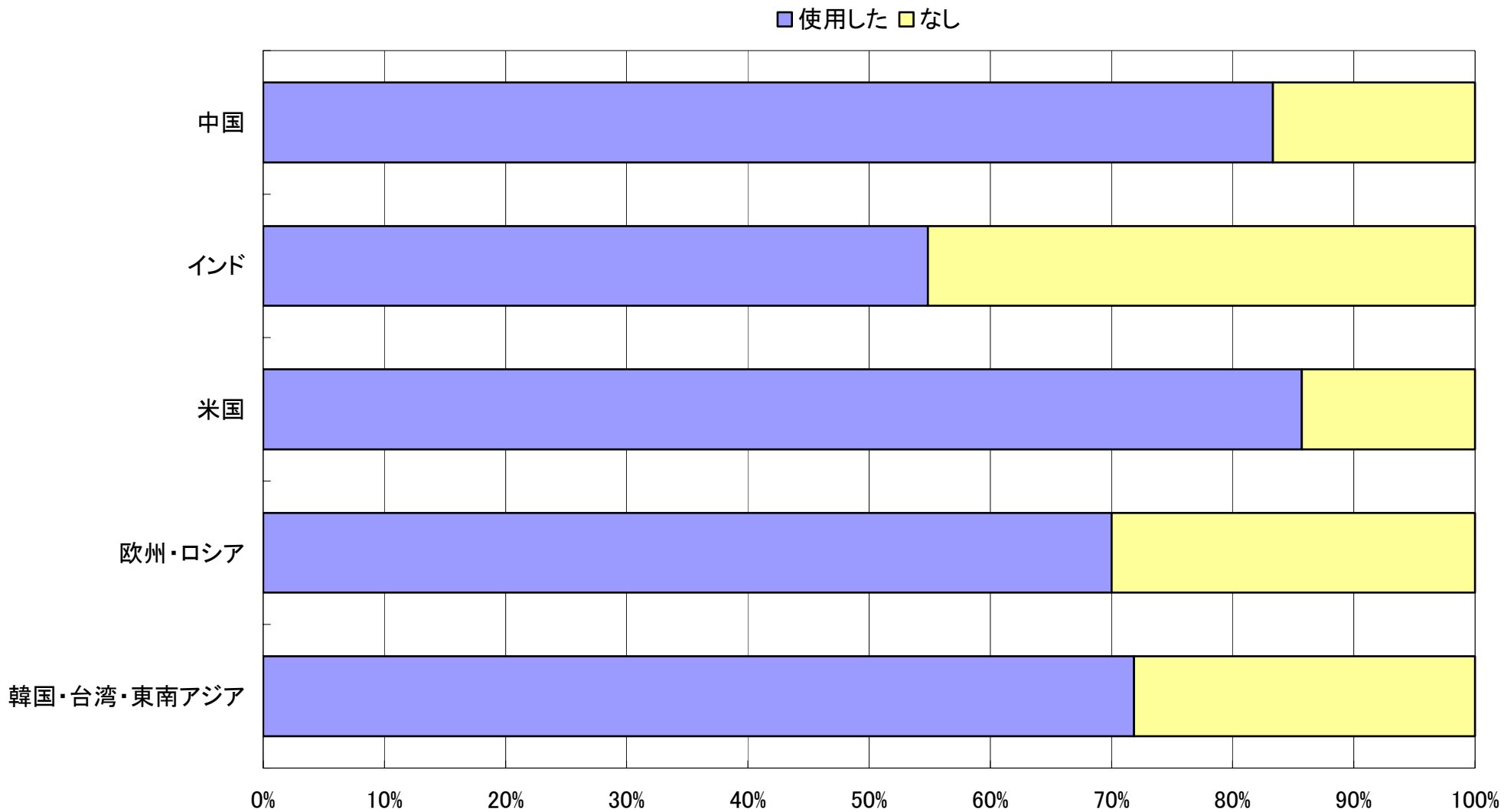


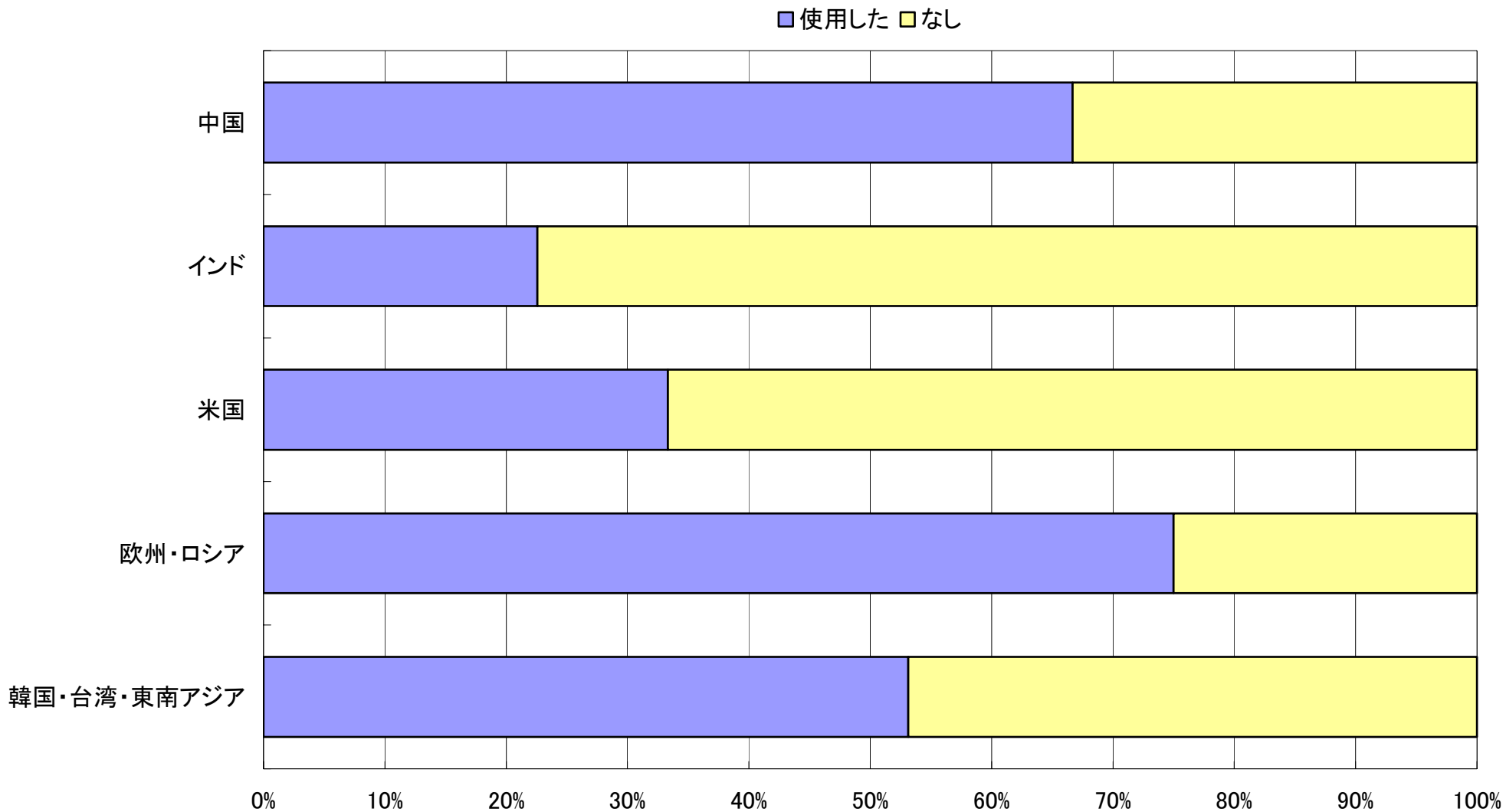


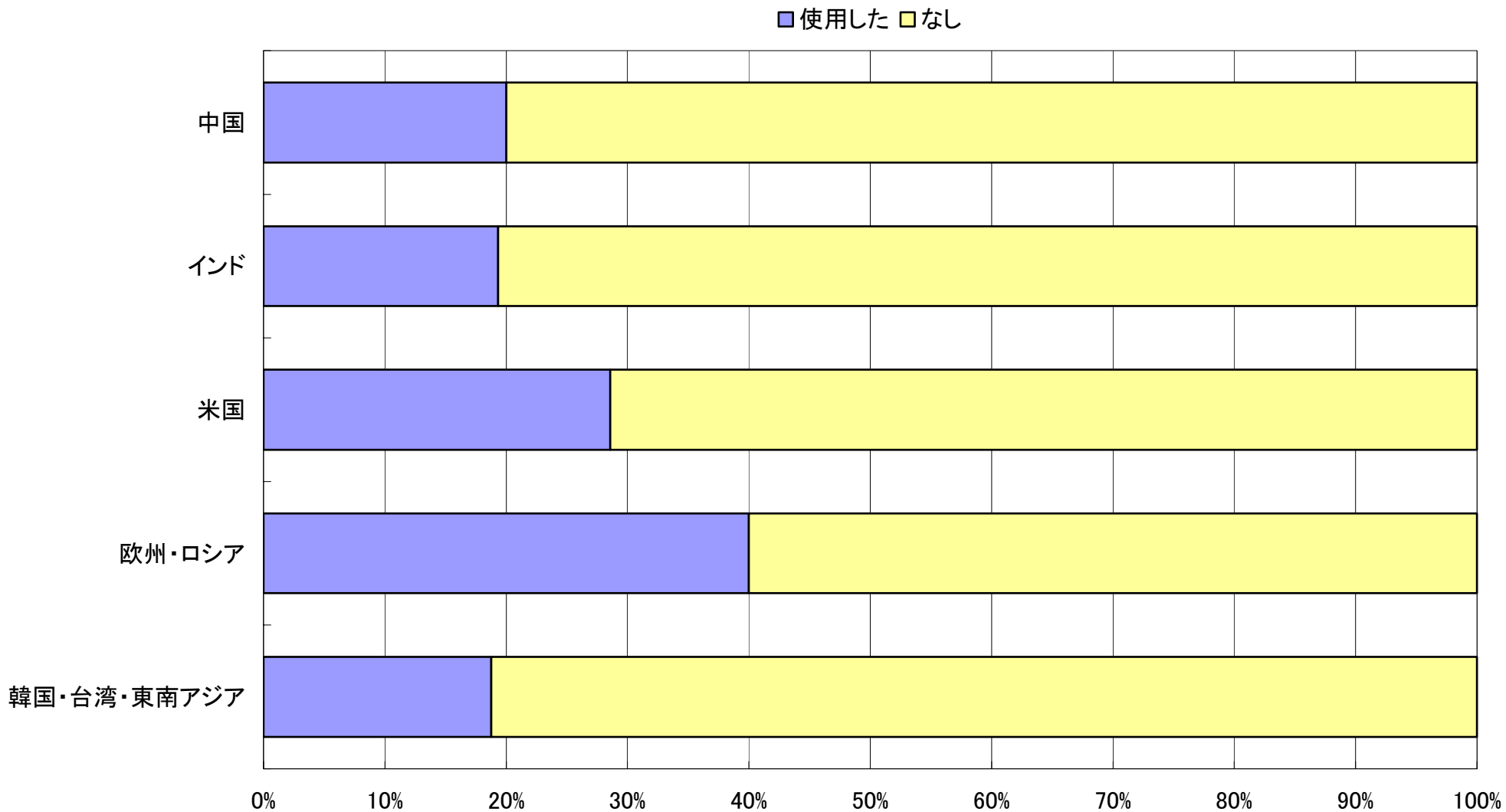


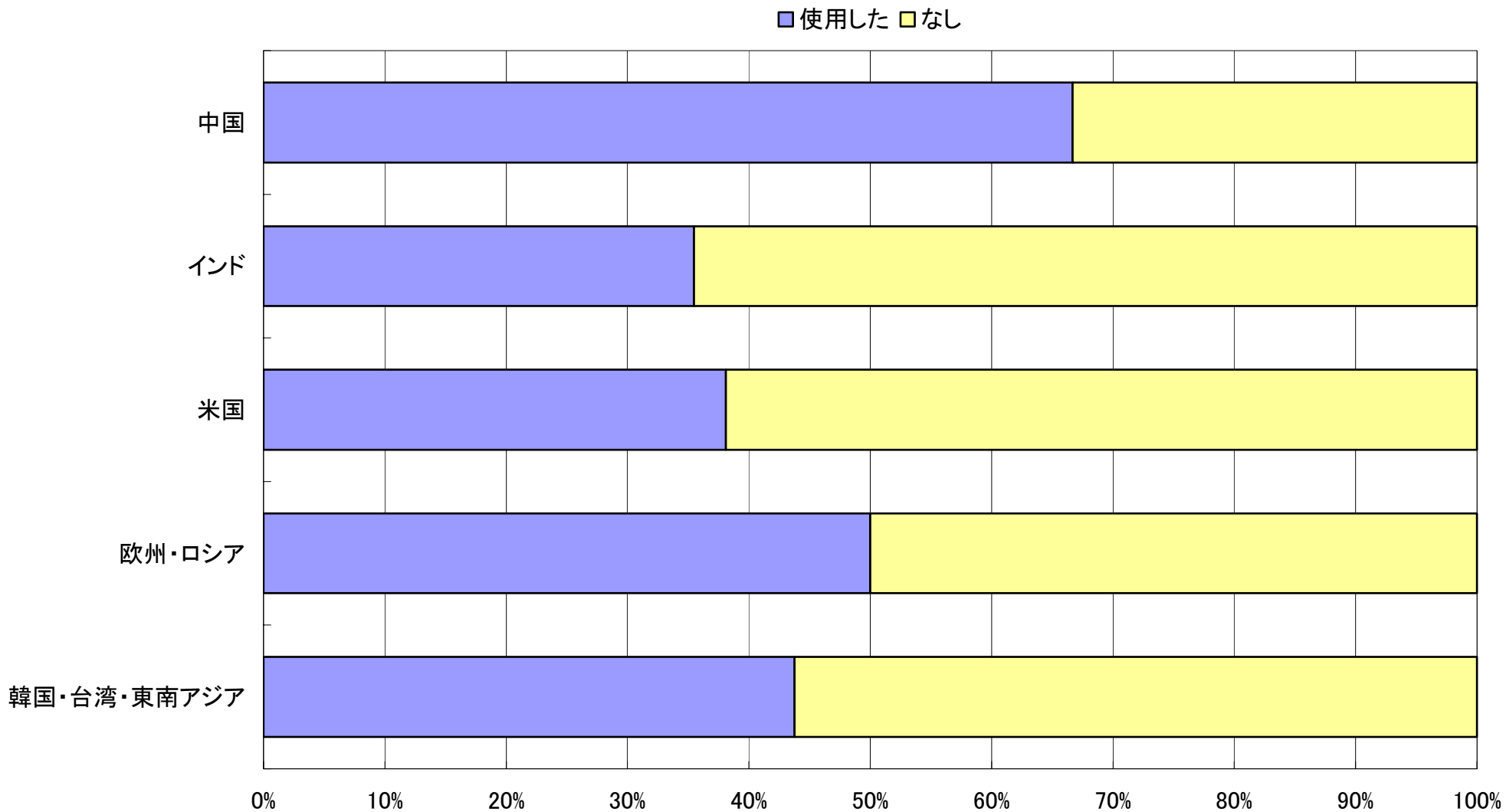


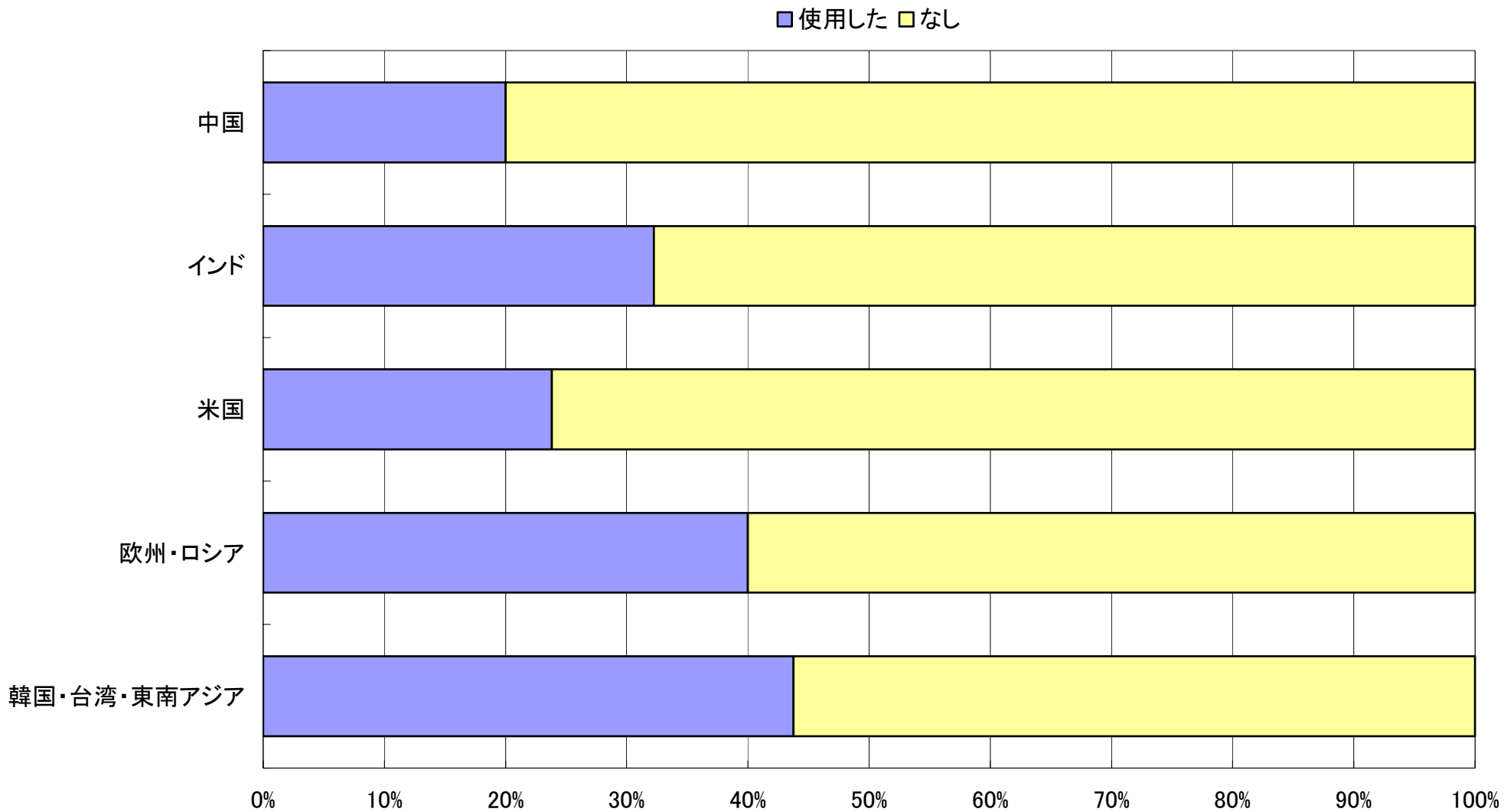


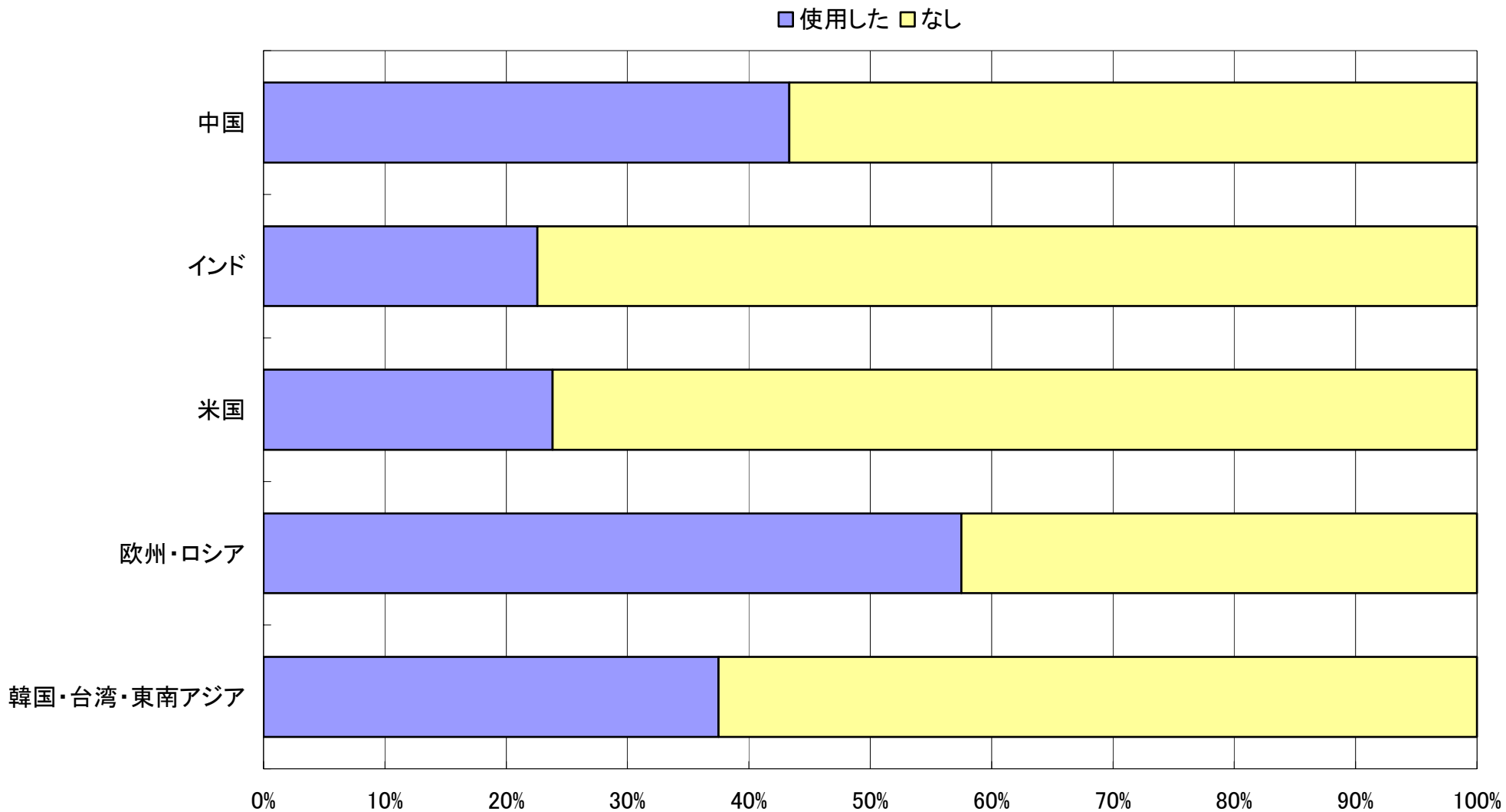


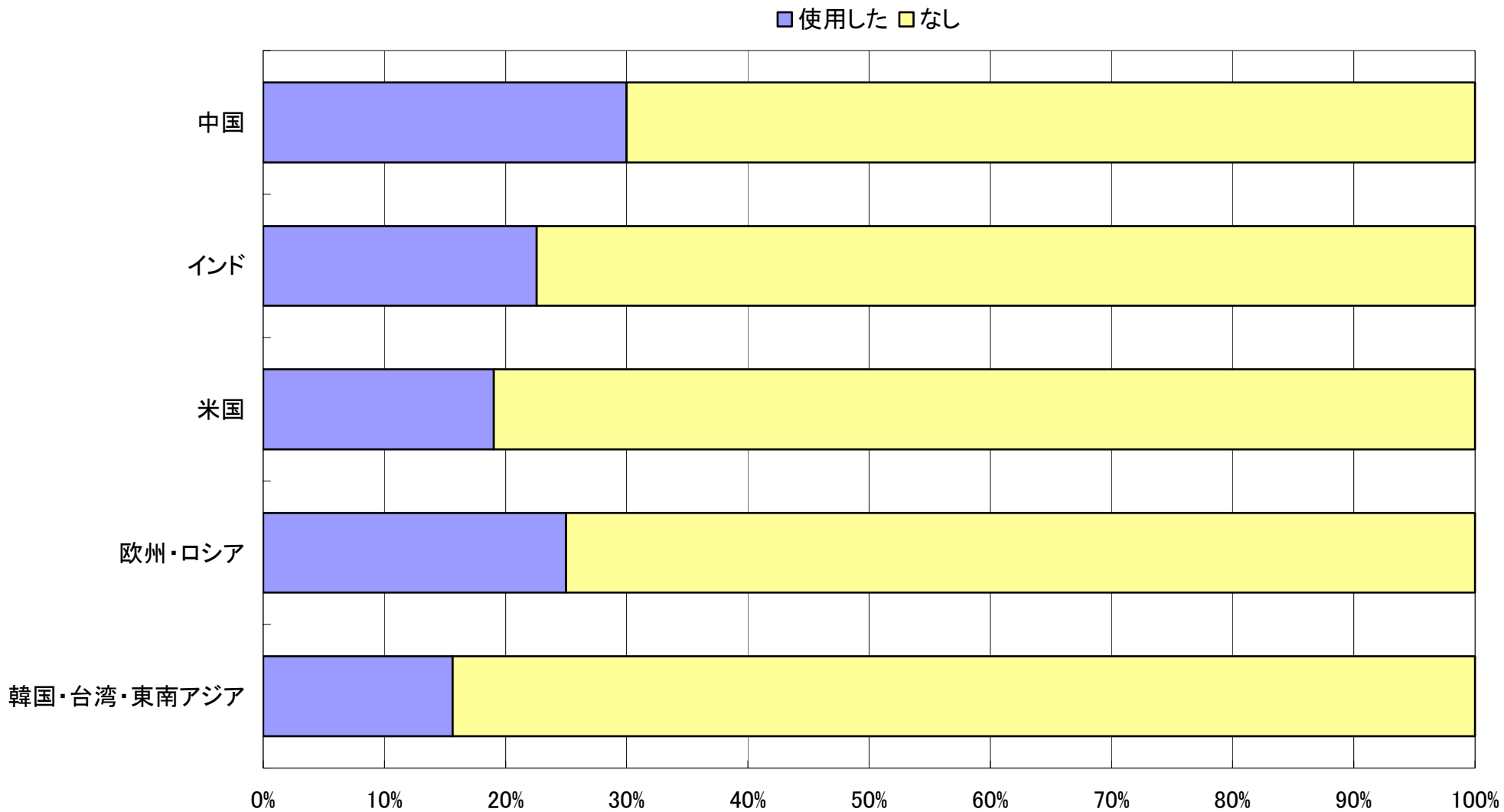


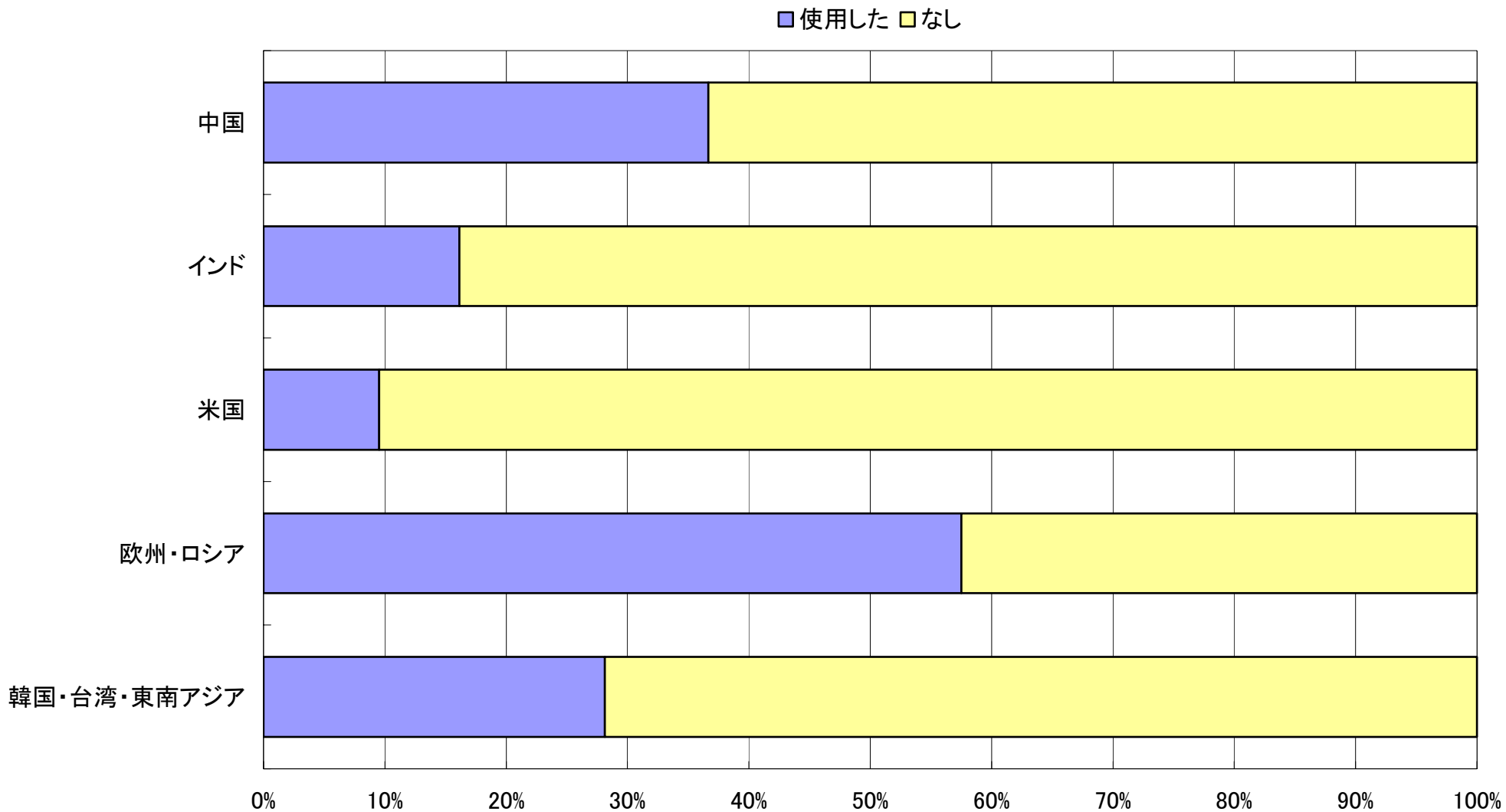


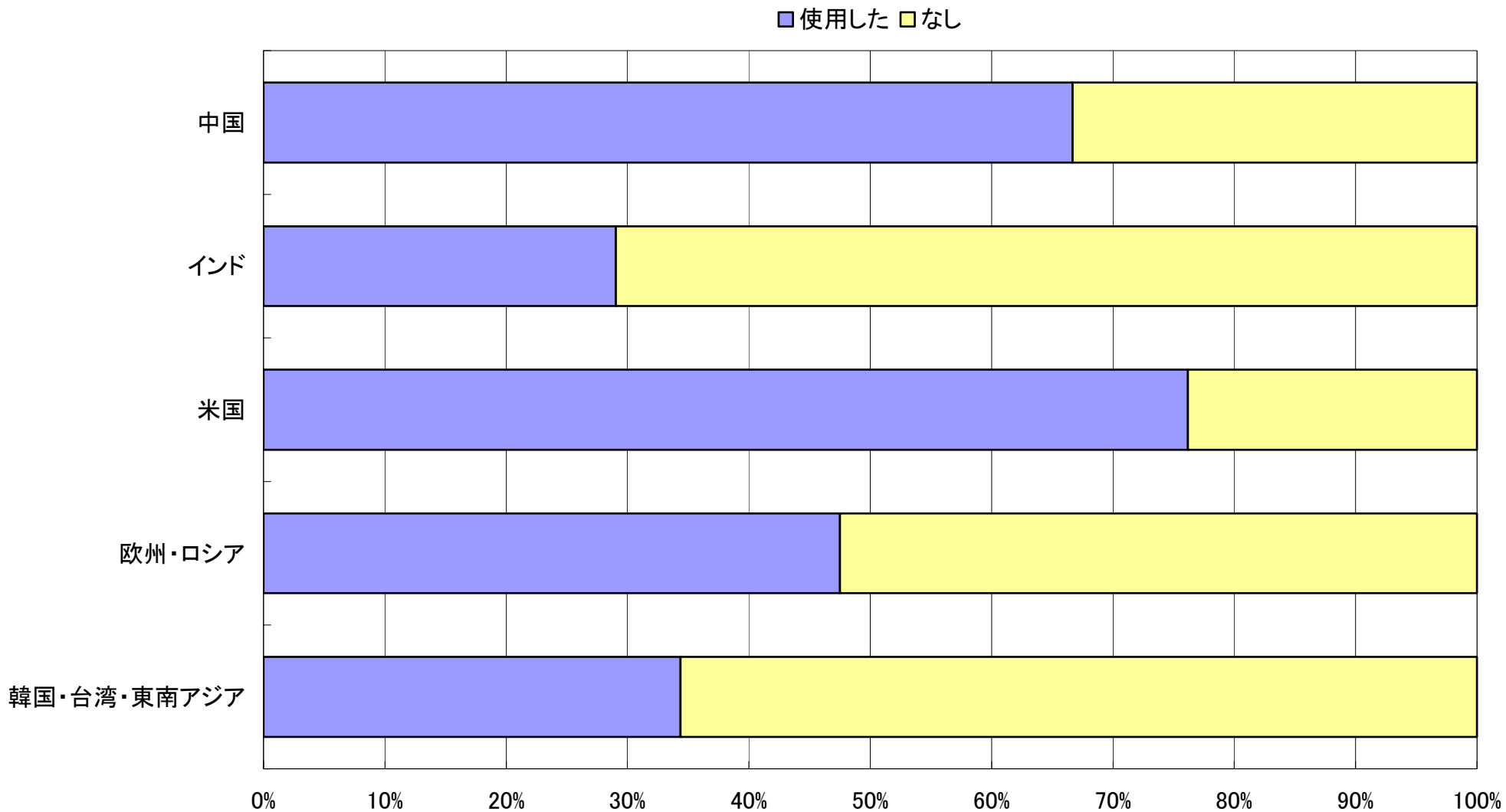


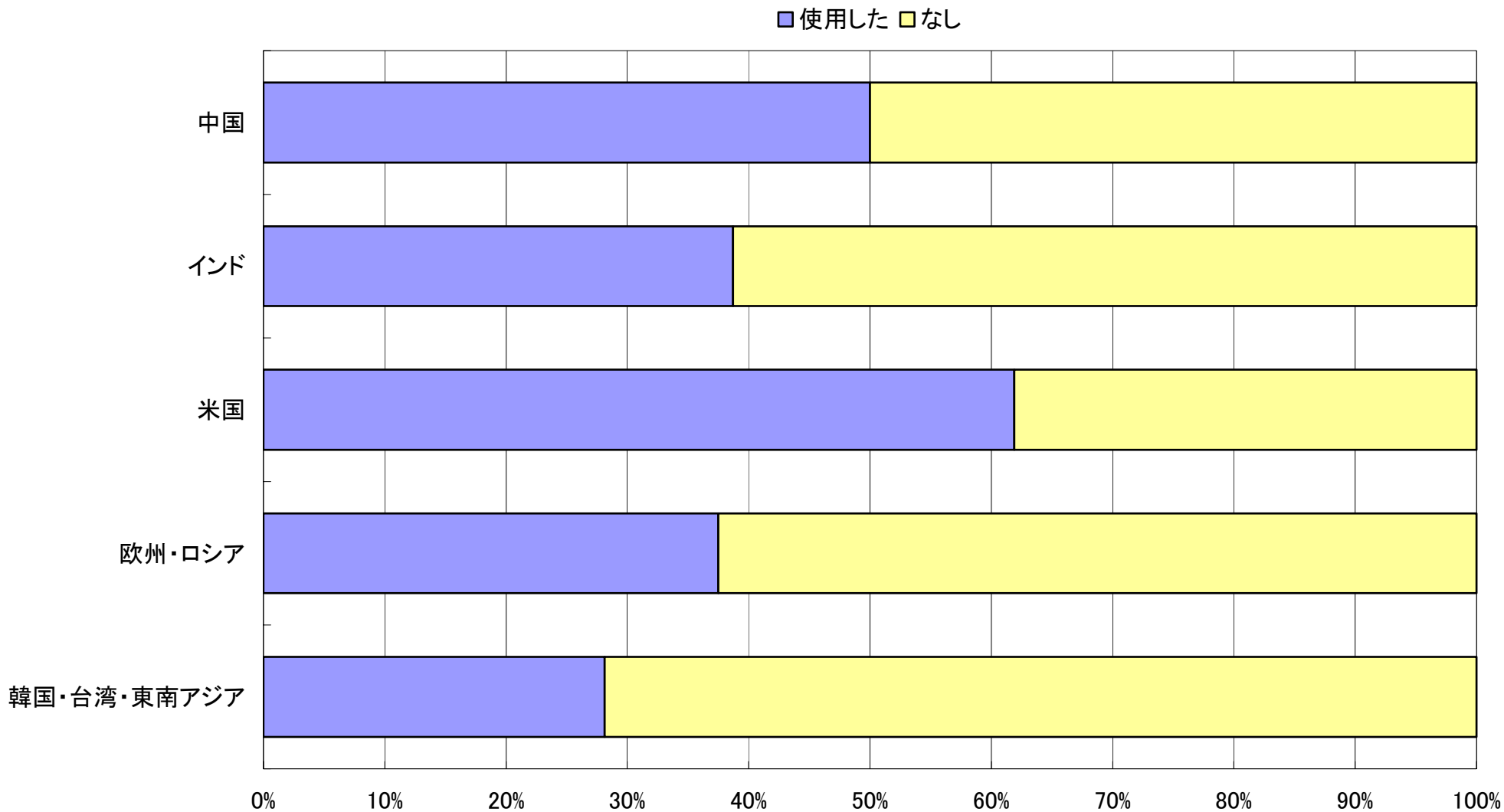


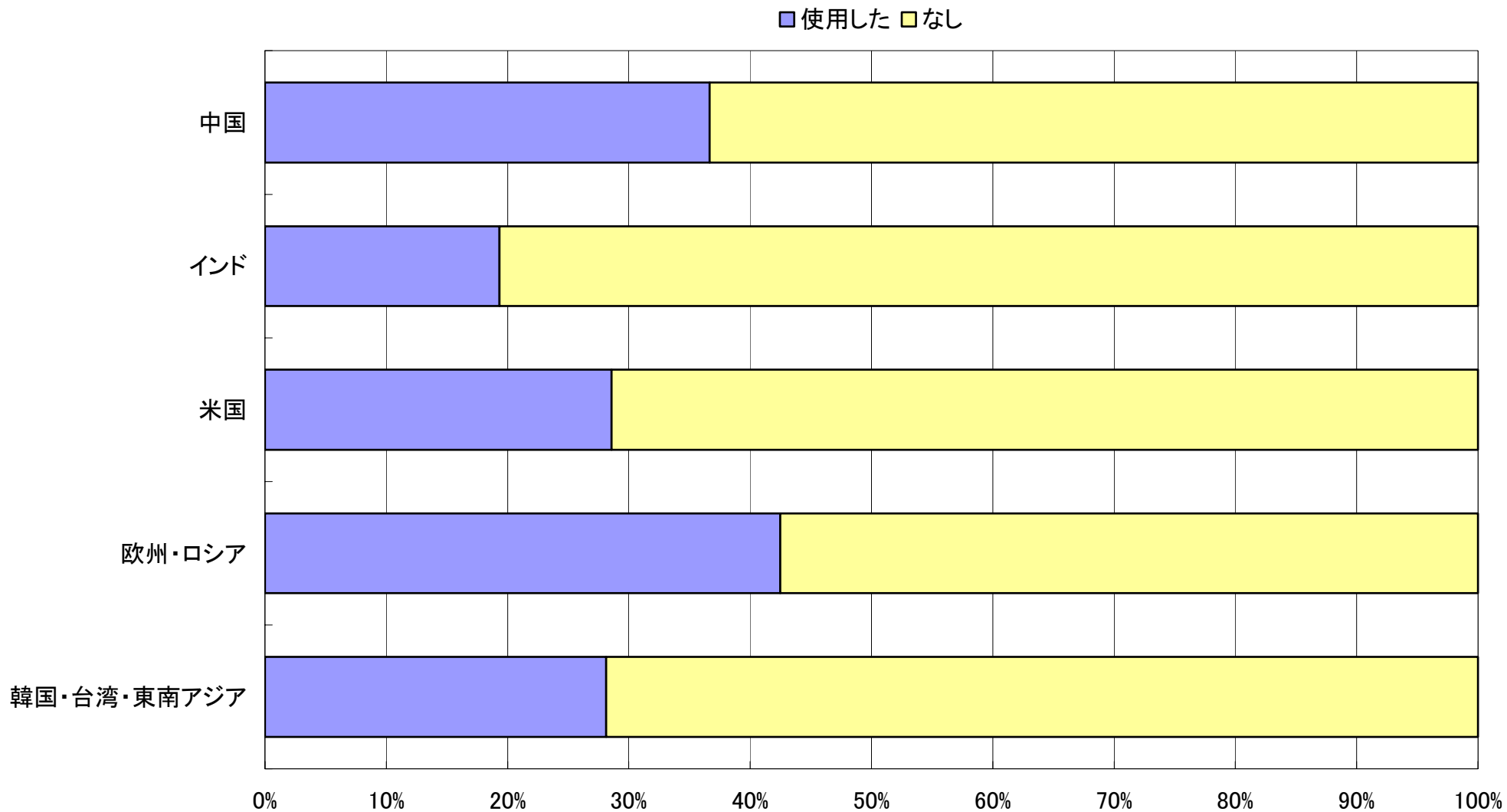


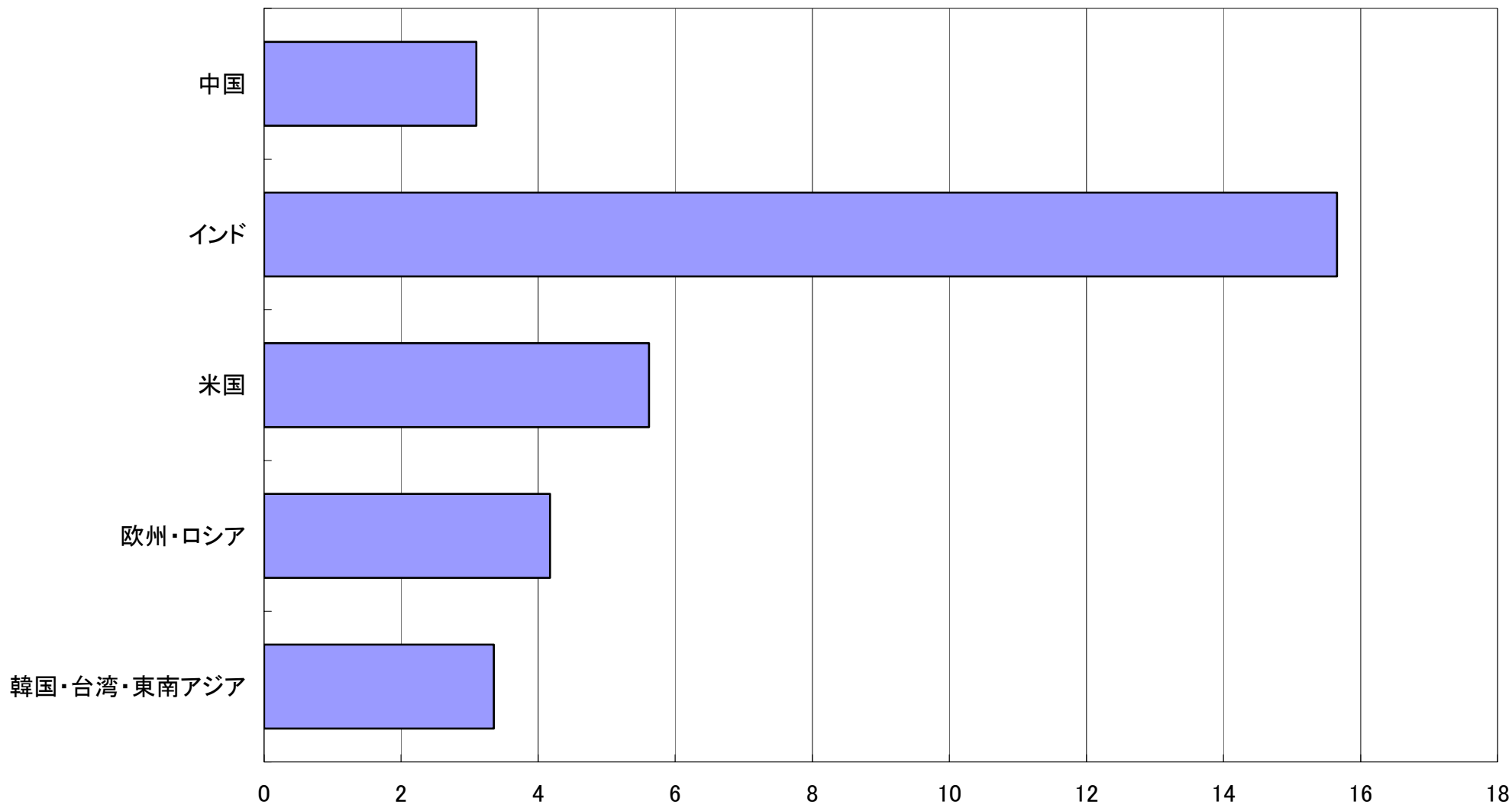




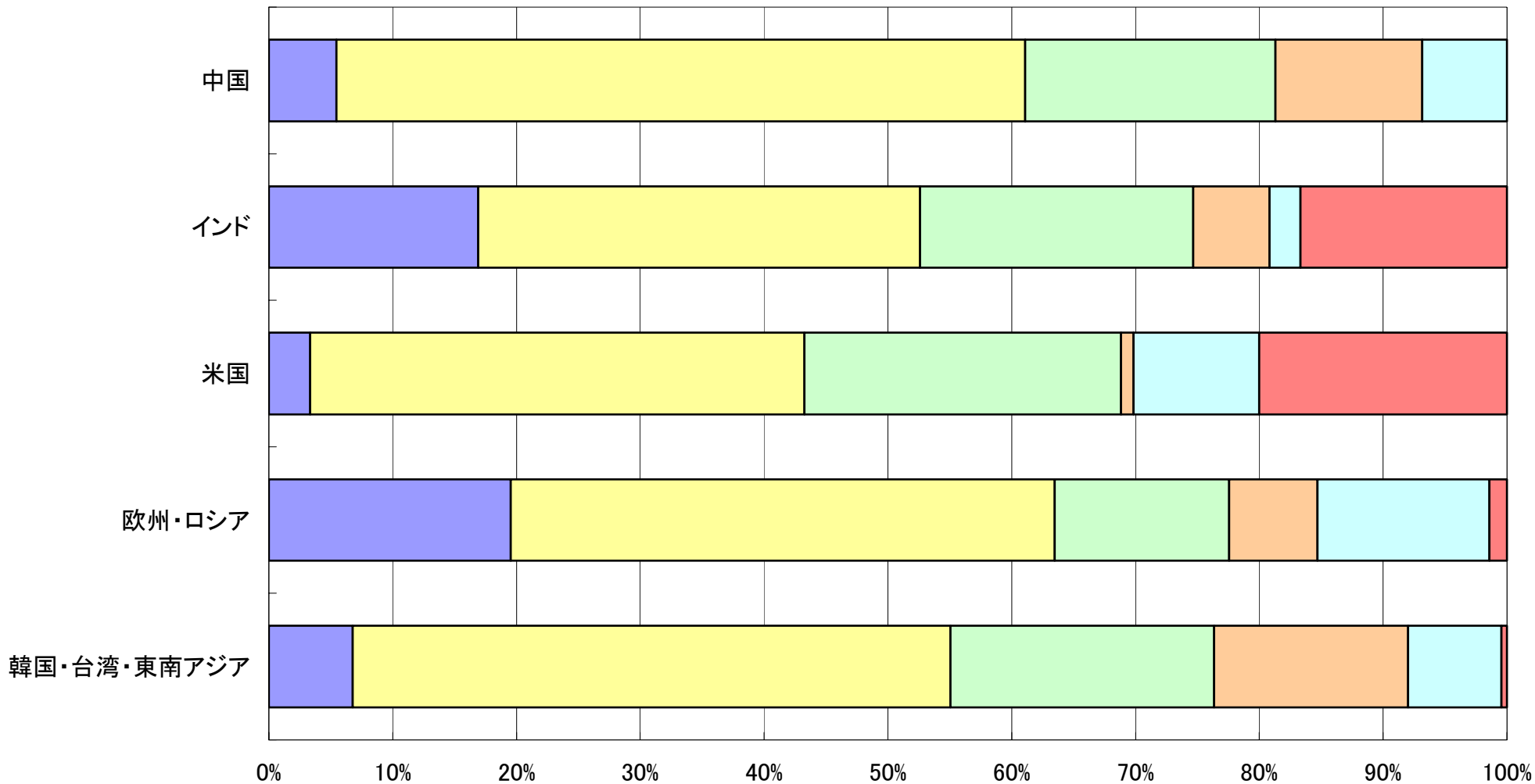




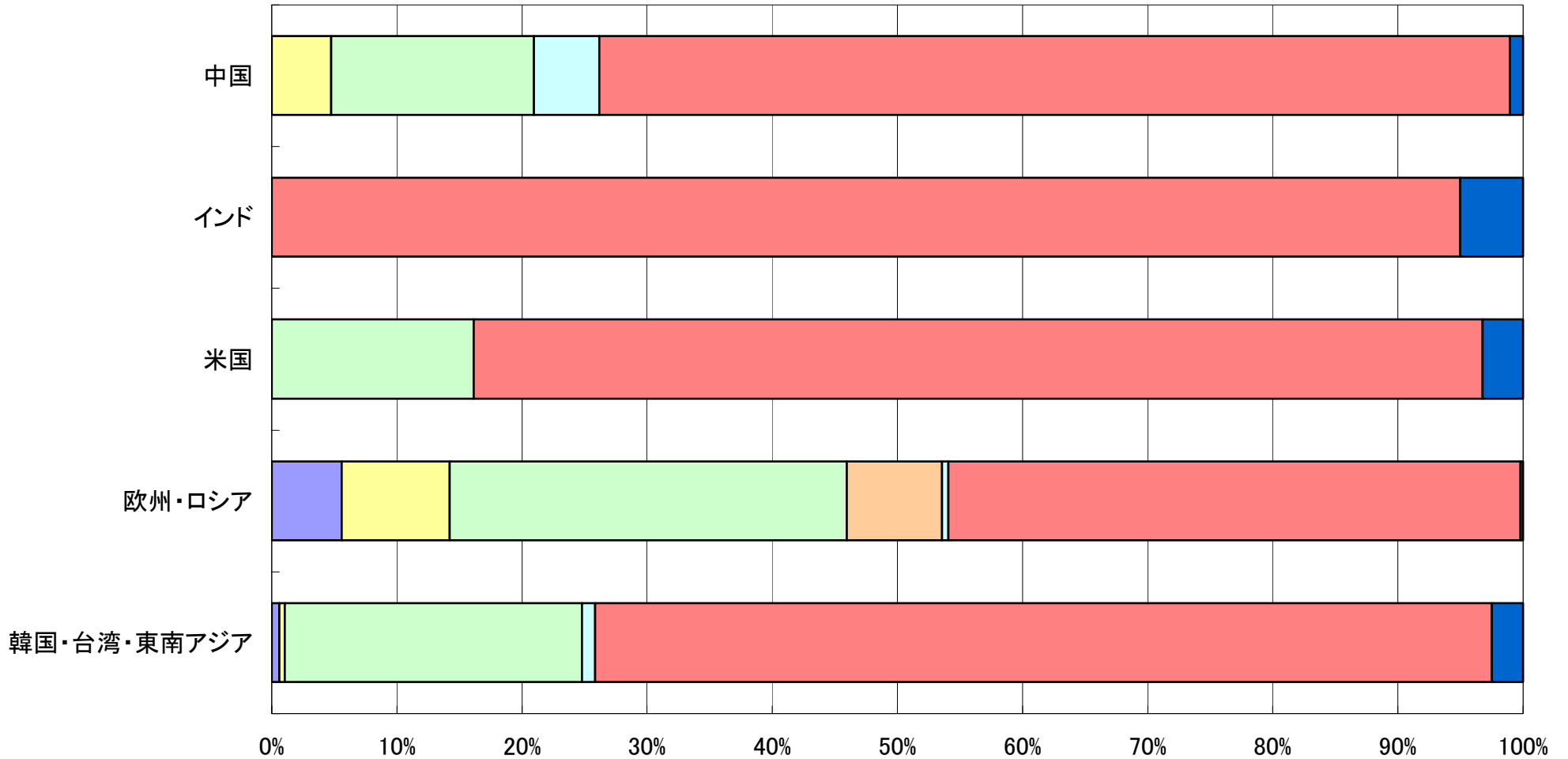


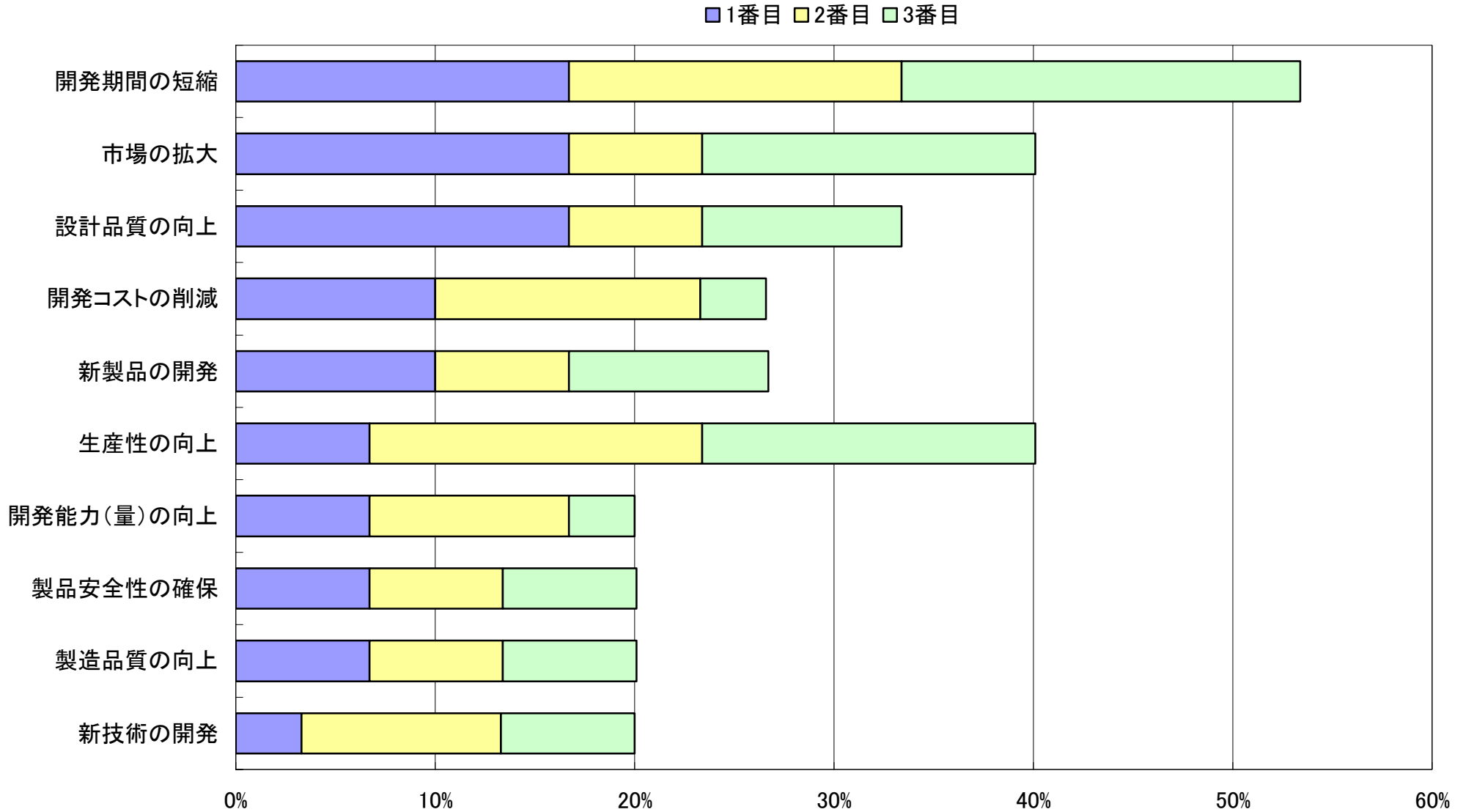


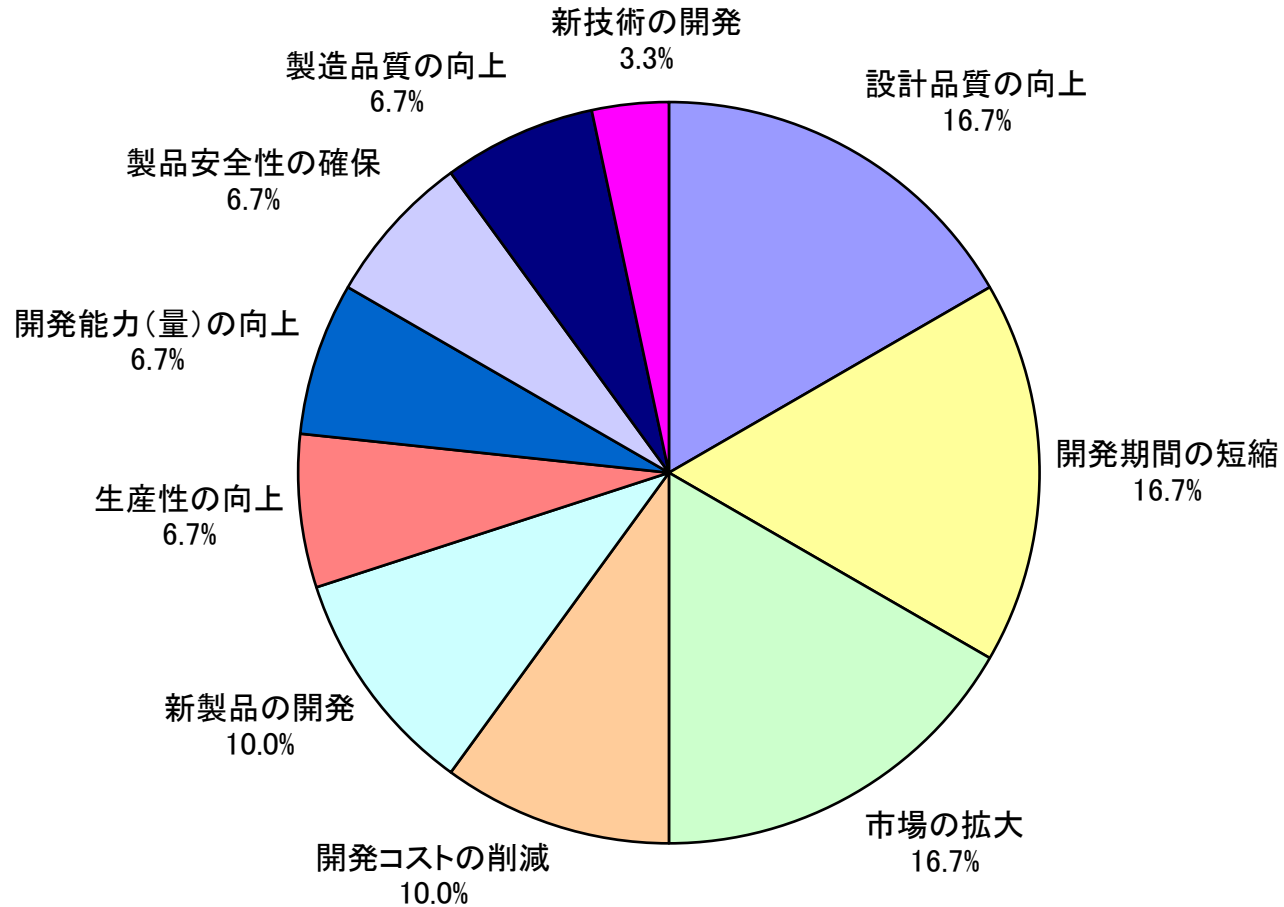
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 ■ ソフトウェアの不具合
 ■ ハードウェアの不具合
 ■ 製造上の不具合
 ■ 運用・保守の不具合
 ■ その他

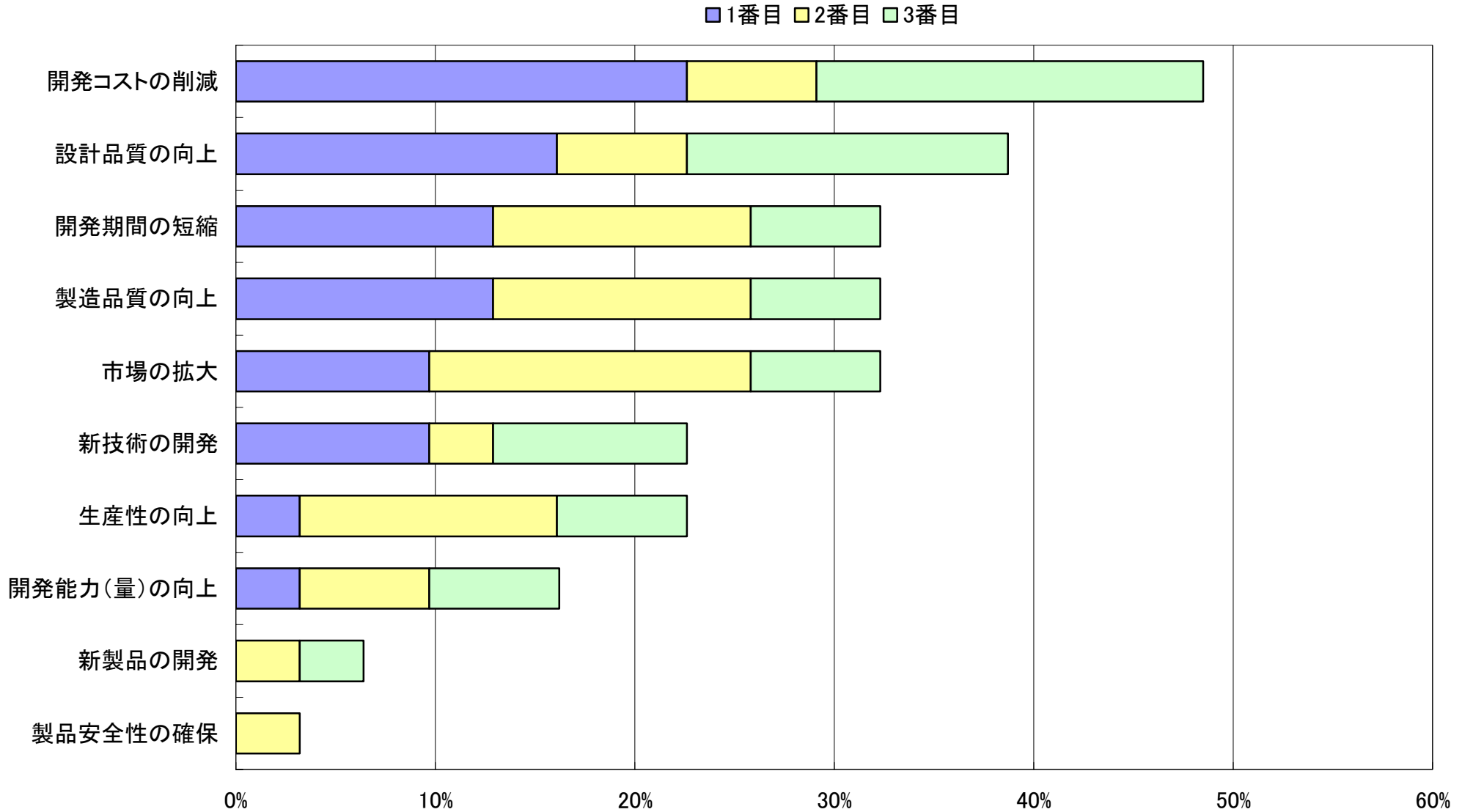


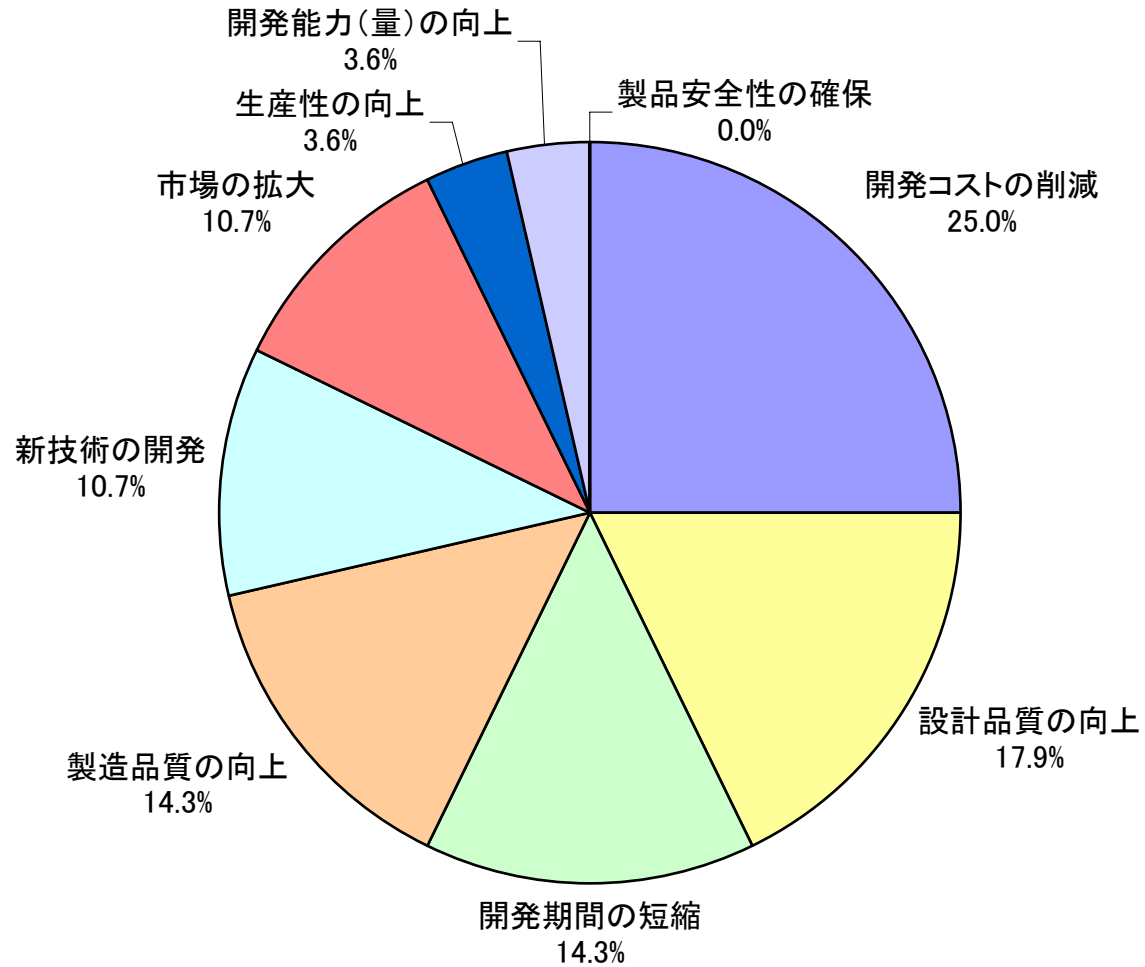
- 死亡を伴う不具合
- 重大な人身傷害を伴う不具合
- 軽微な人身傷害を伴う不具合
- 環境汚染を伴う不具合
- 大規模な経済損失を伴う不具合
- 軽微な経済損失を伴う不具合
- その他

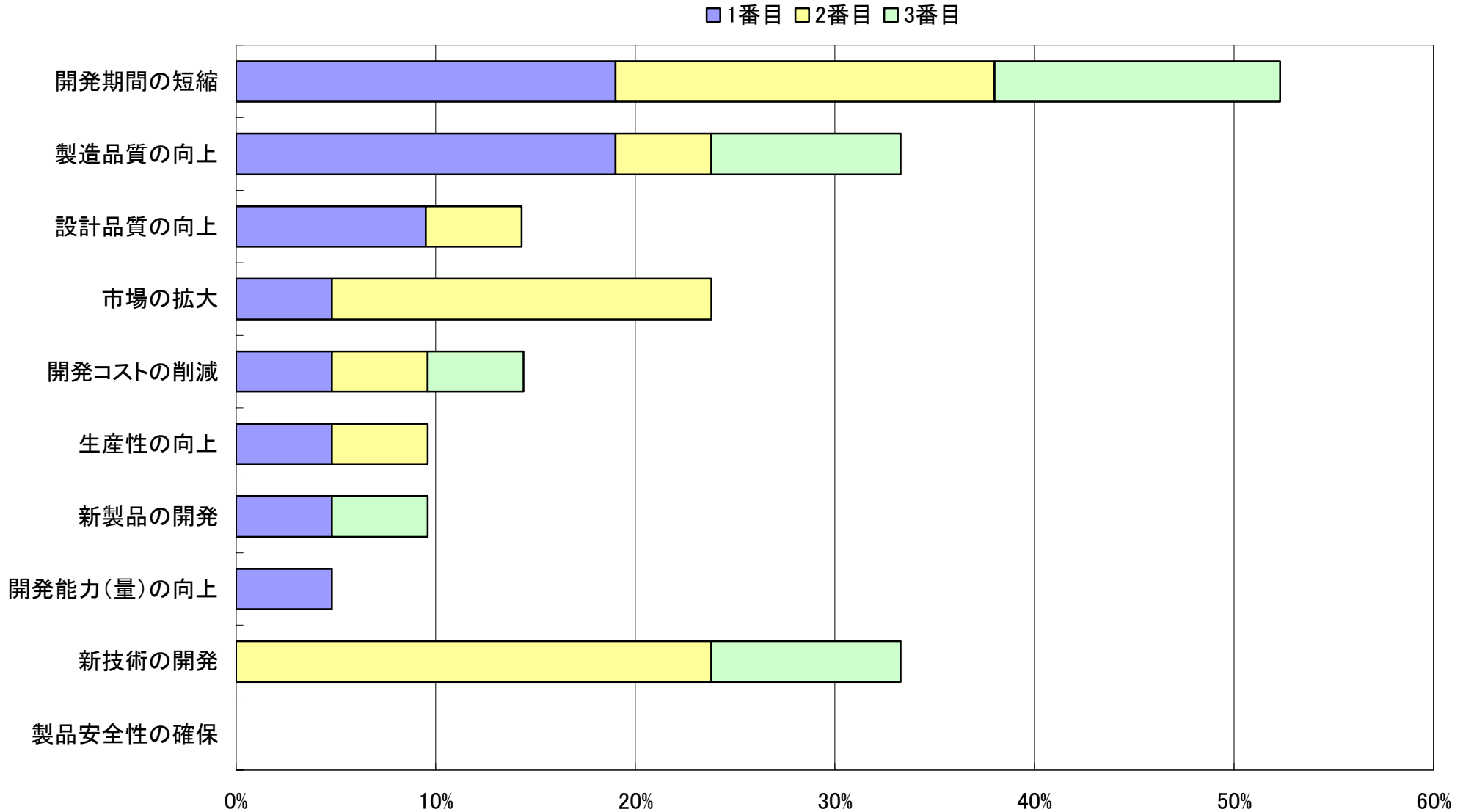


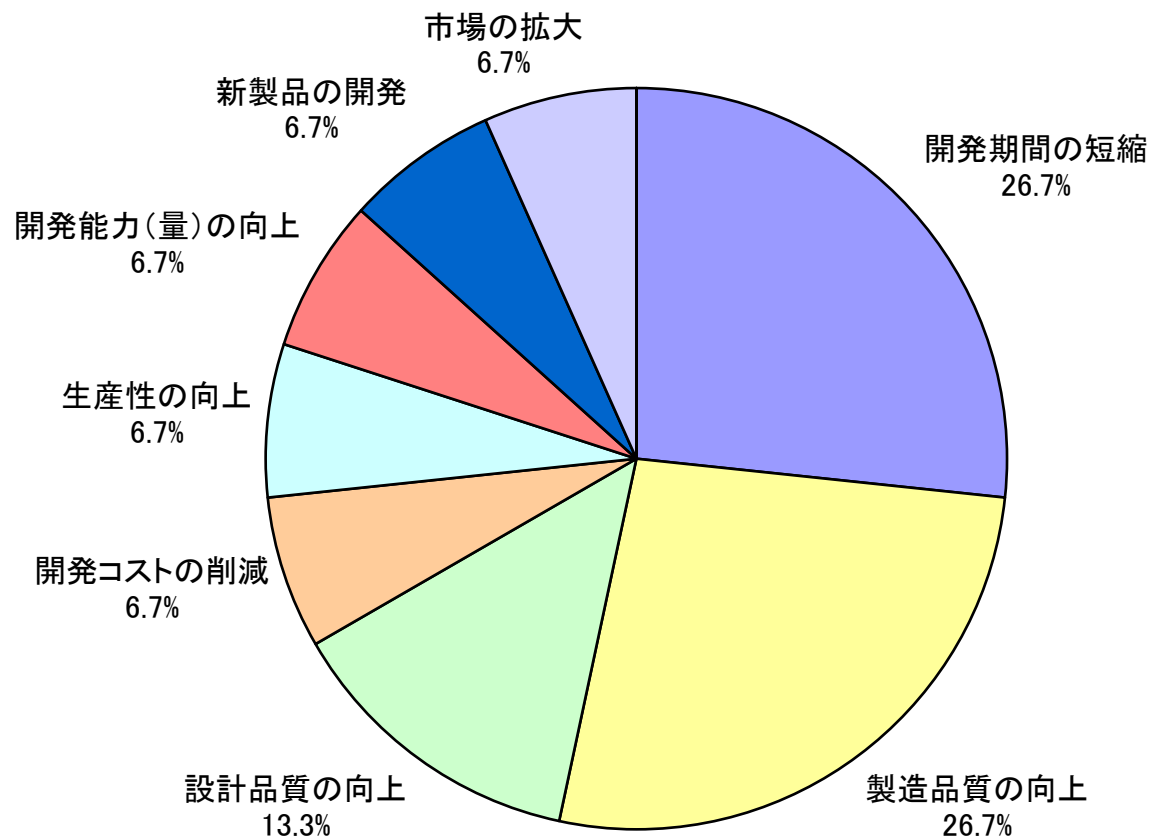


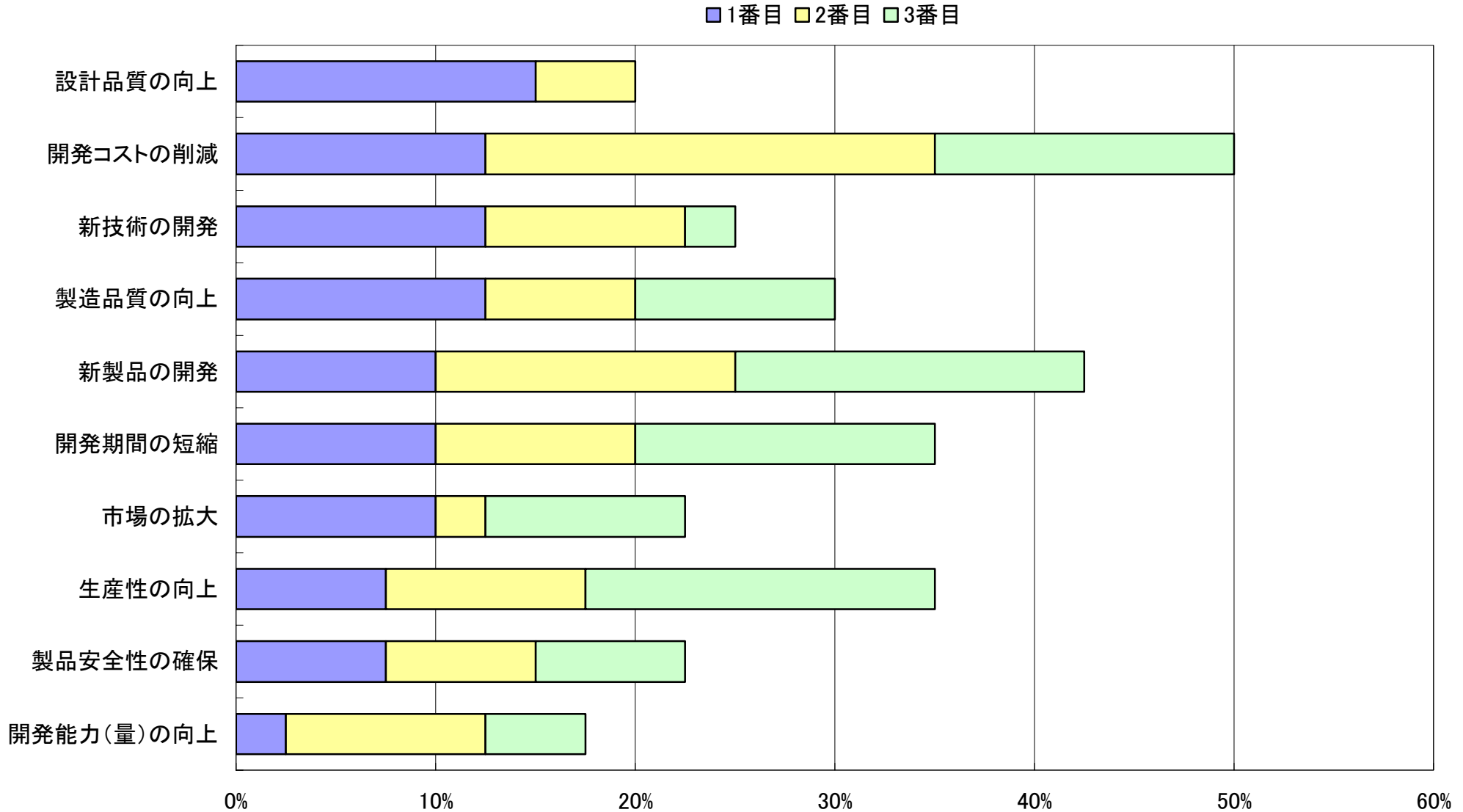


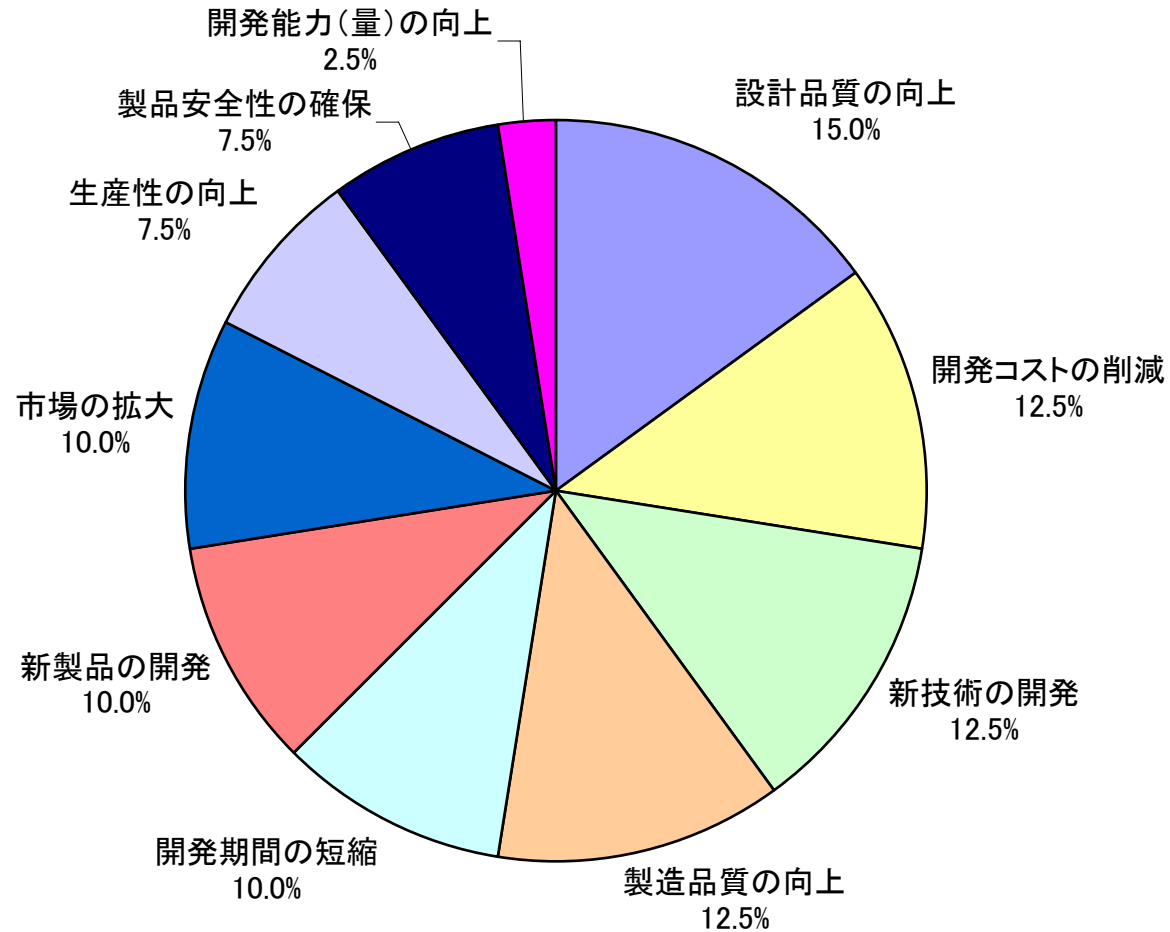


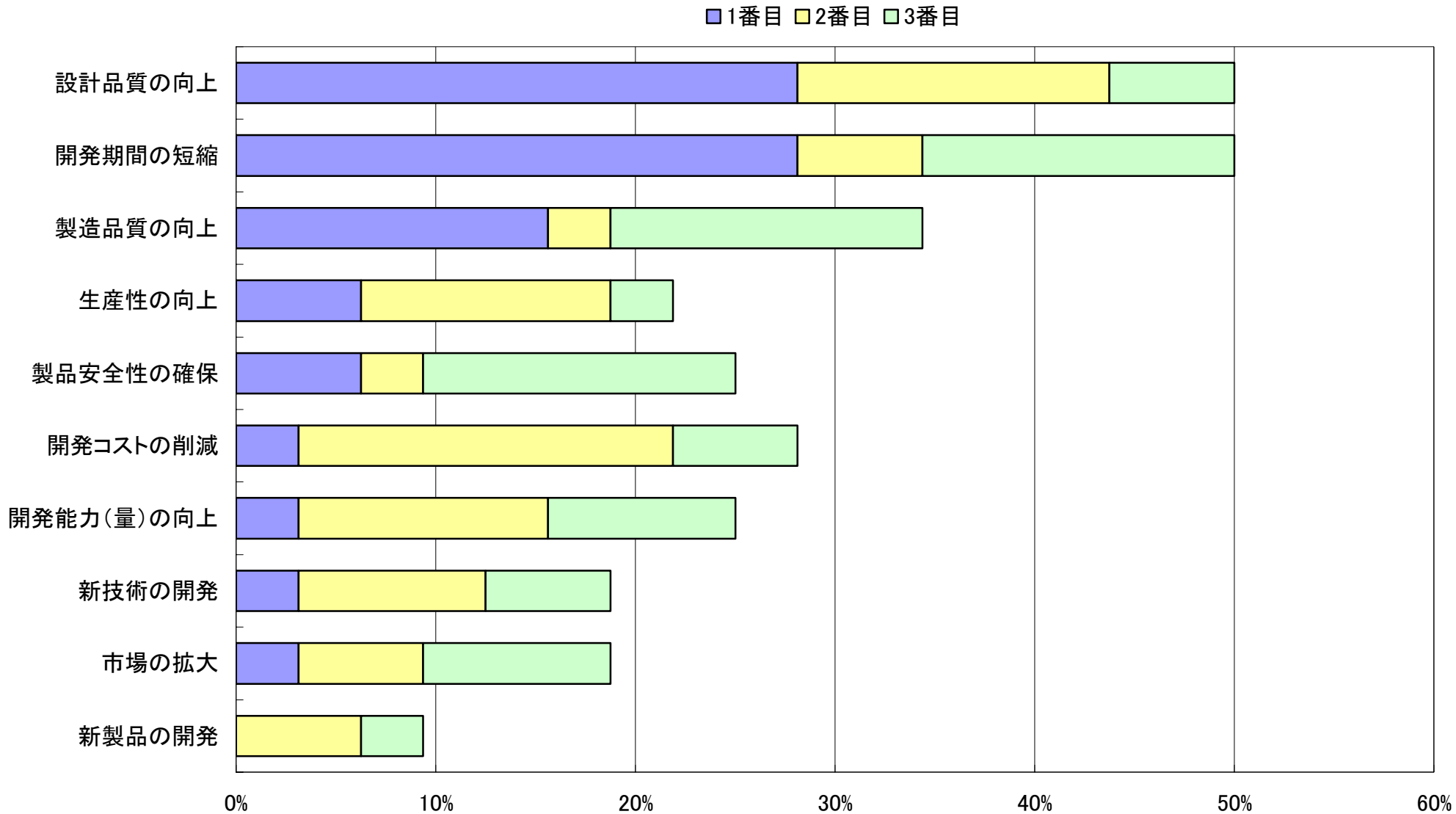


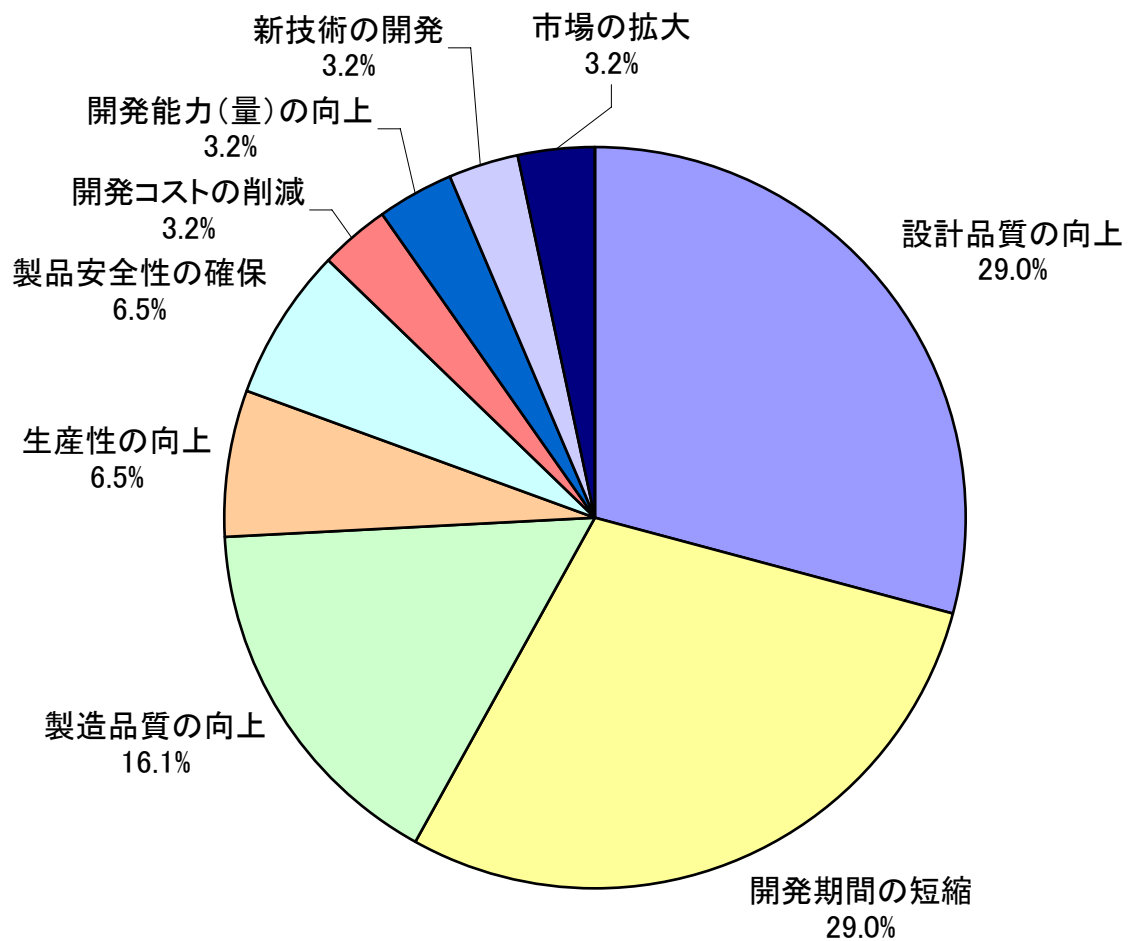


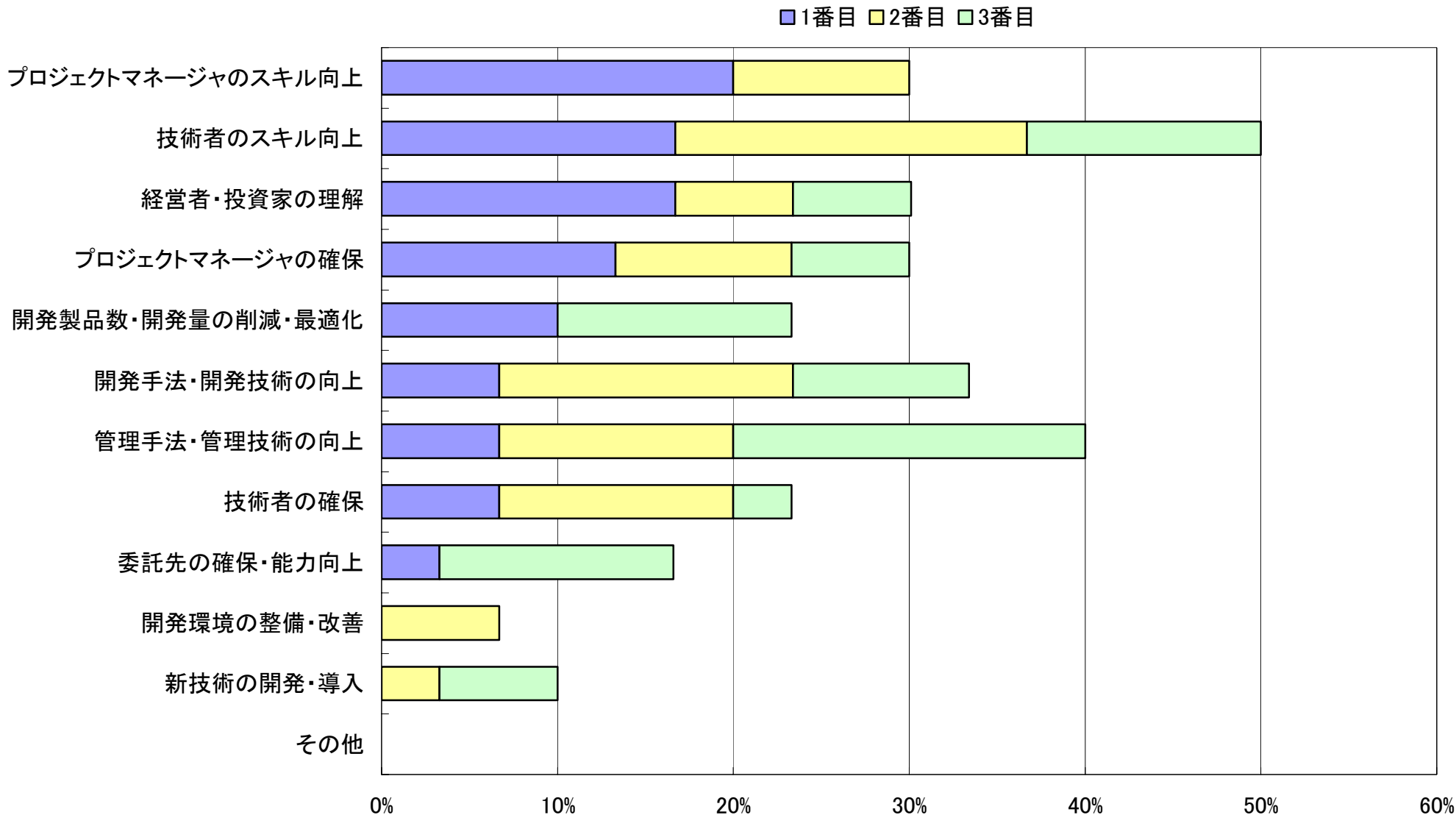


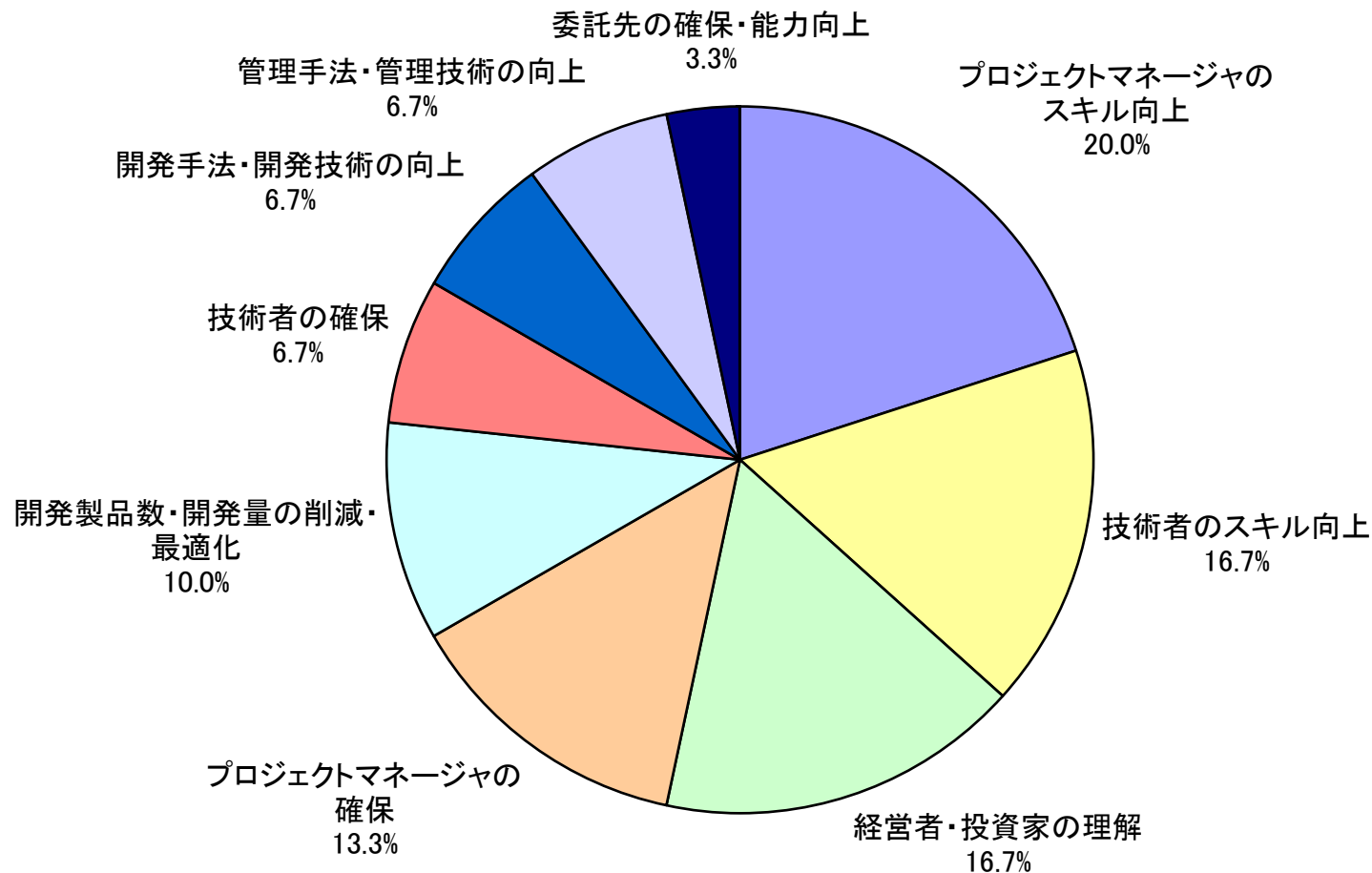


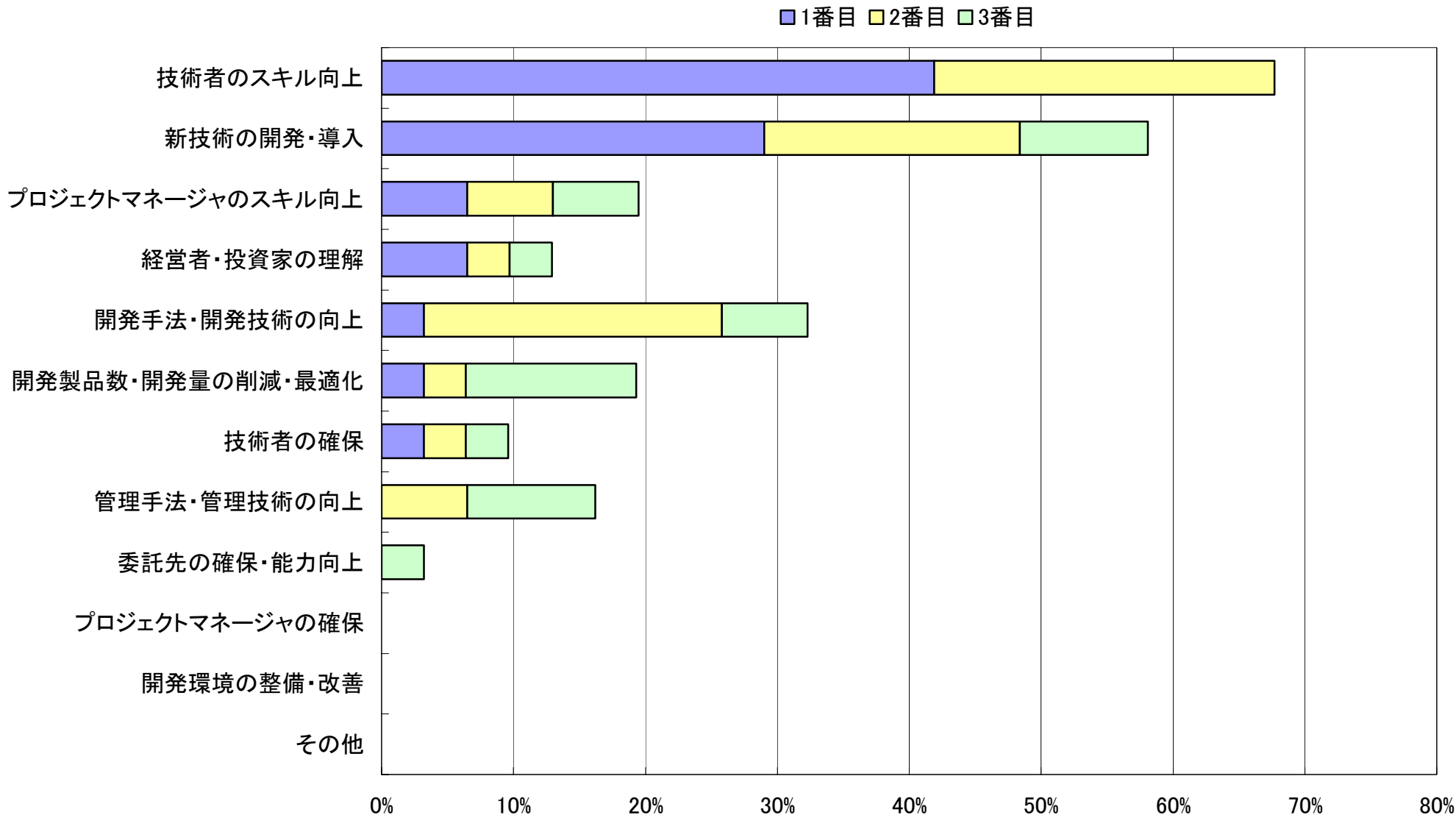


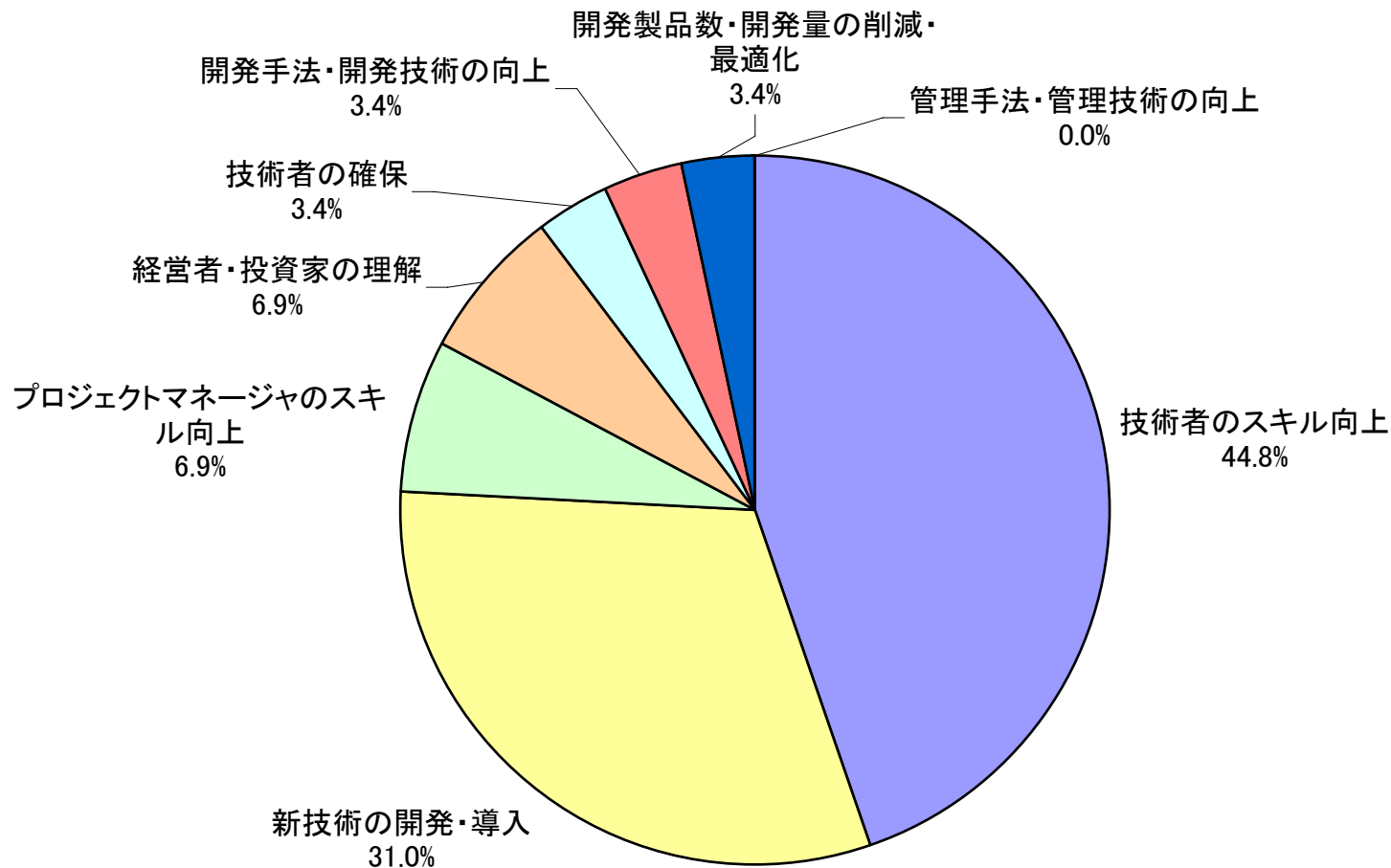


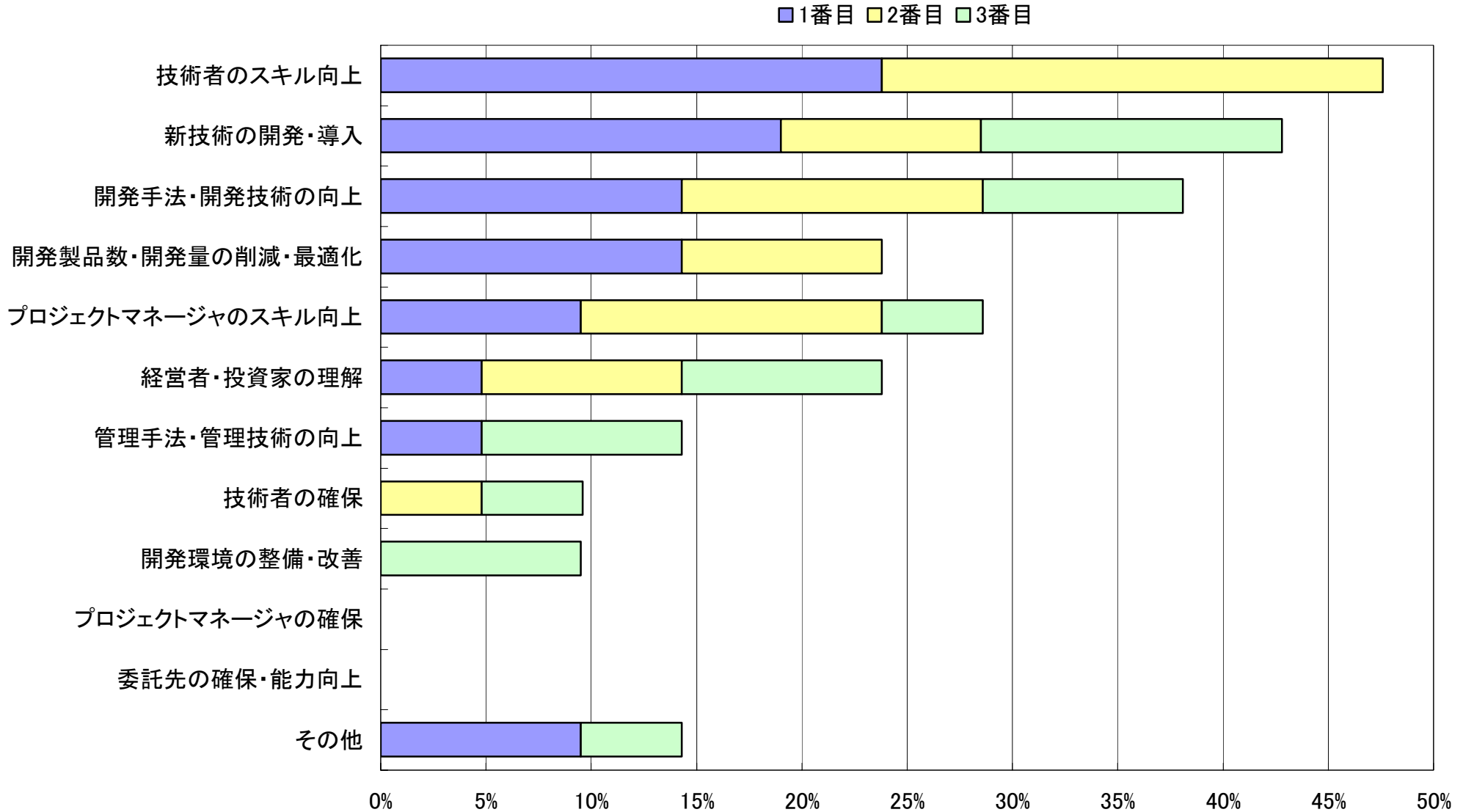


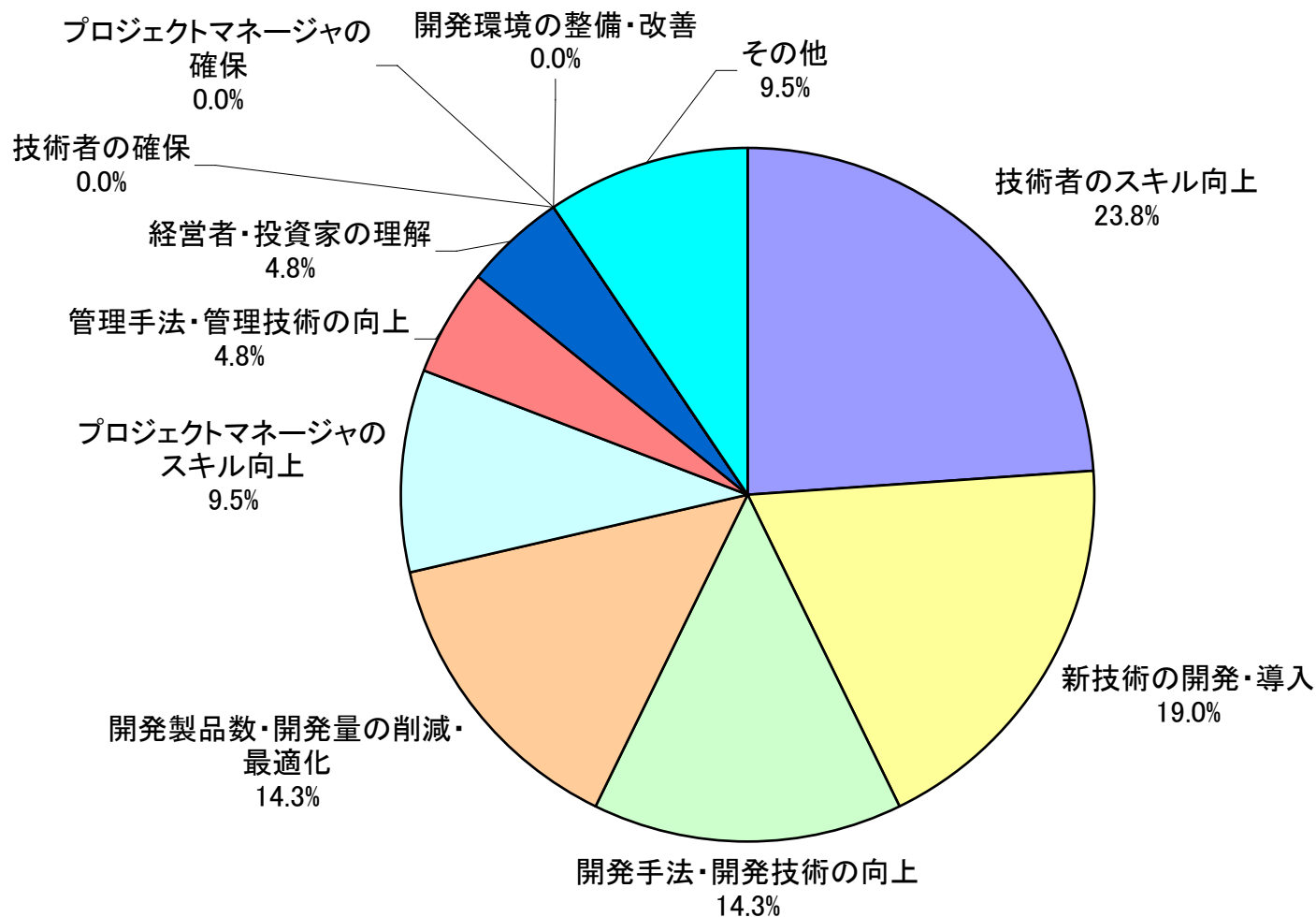


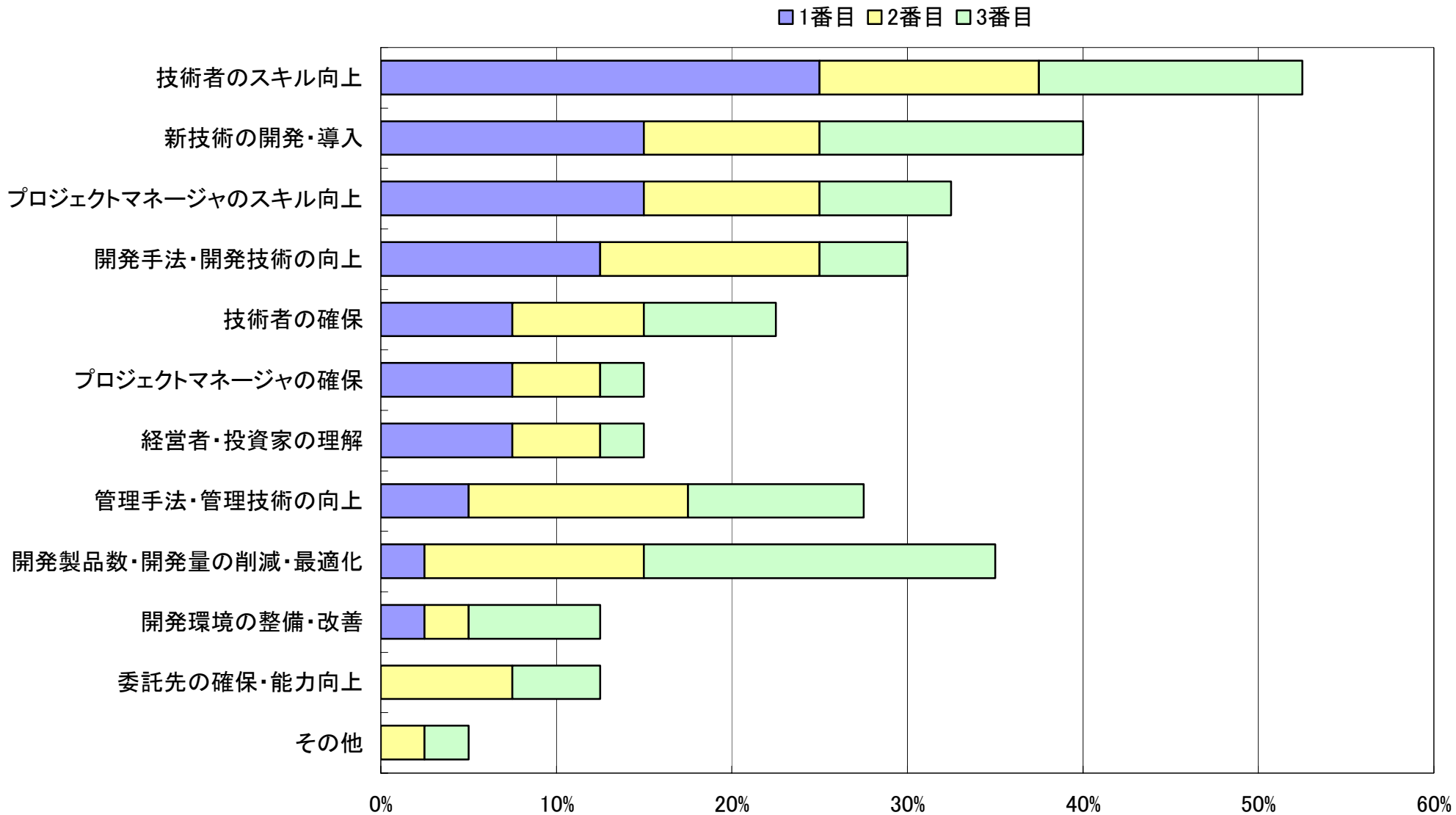


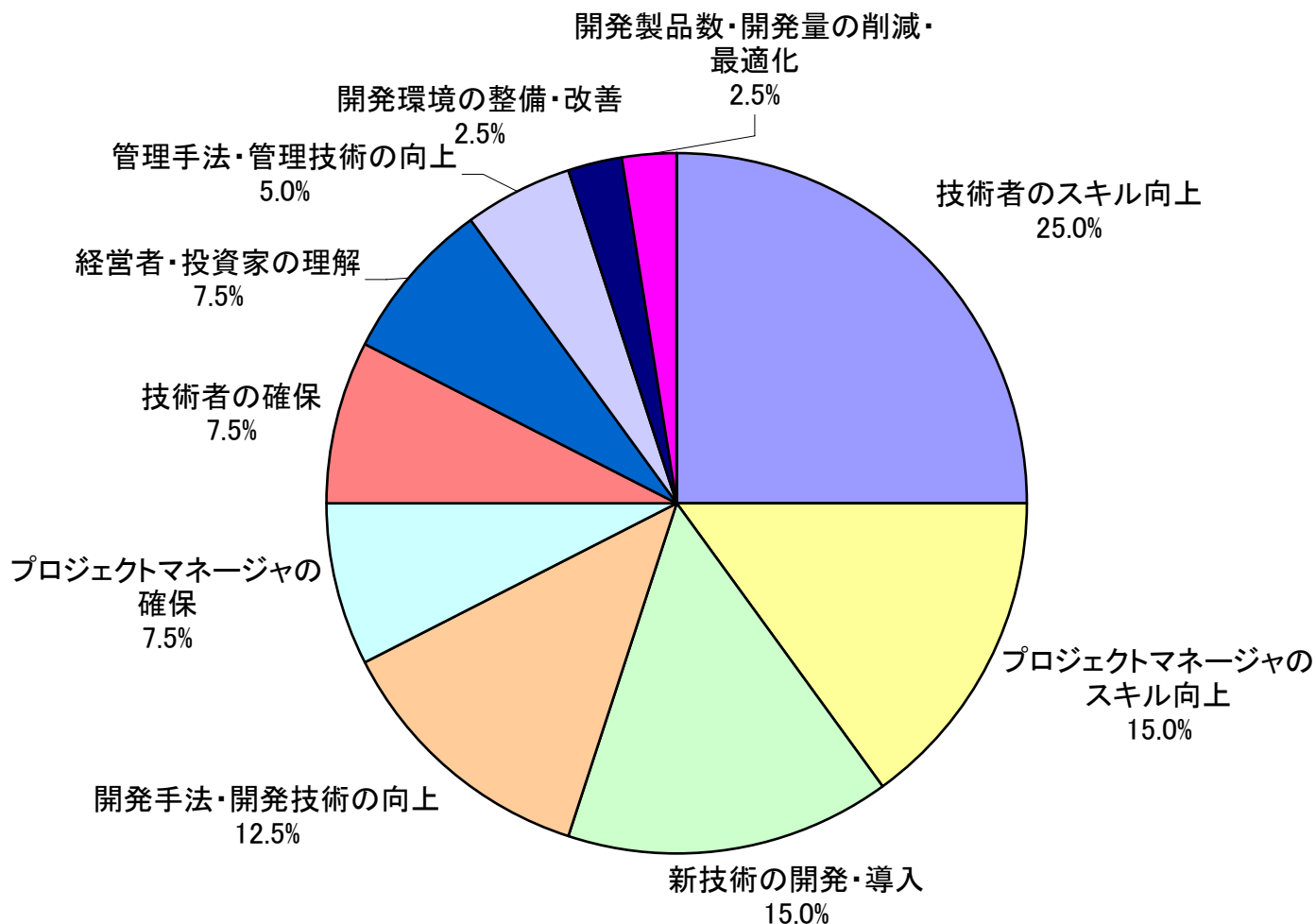


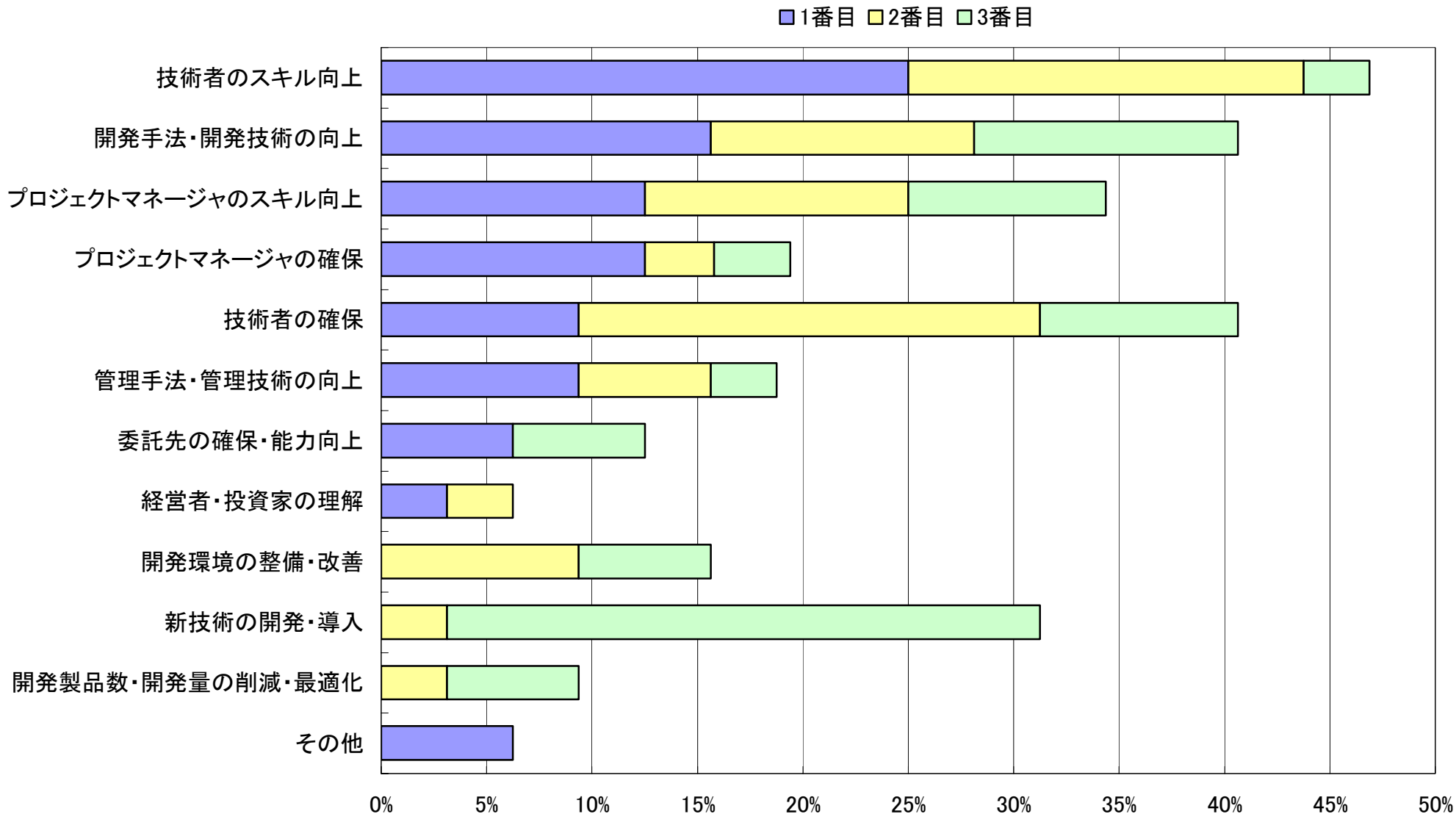






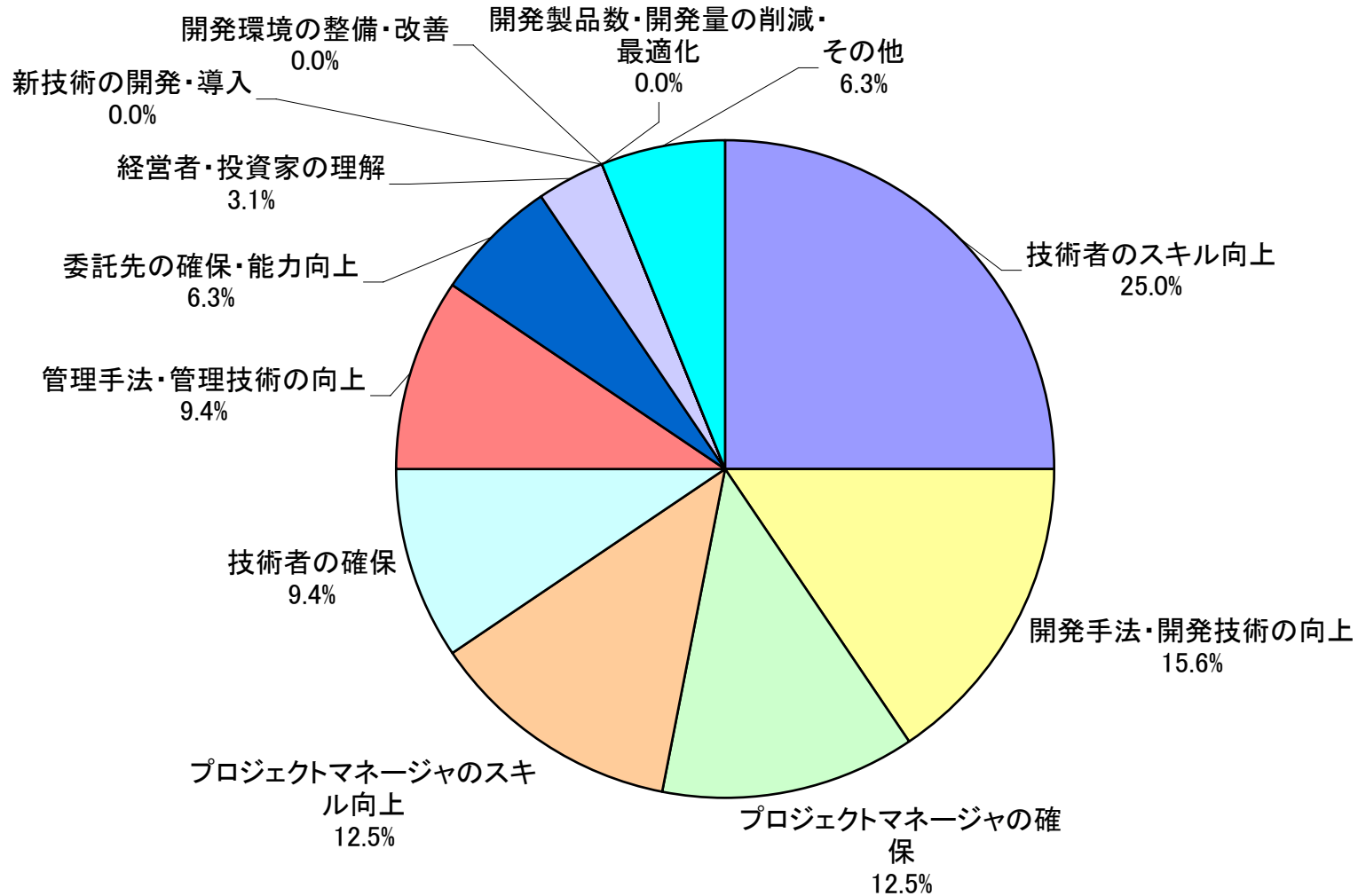




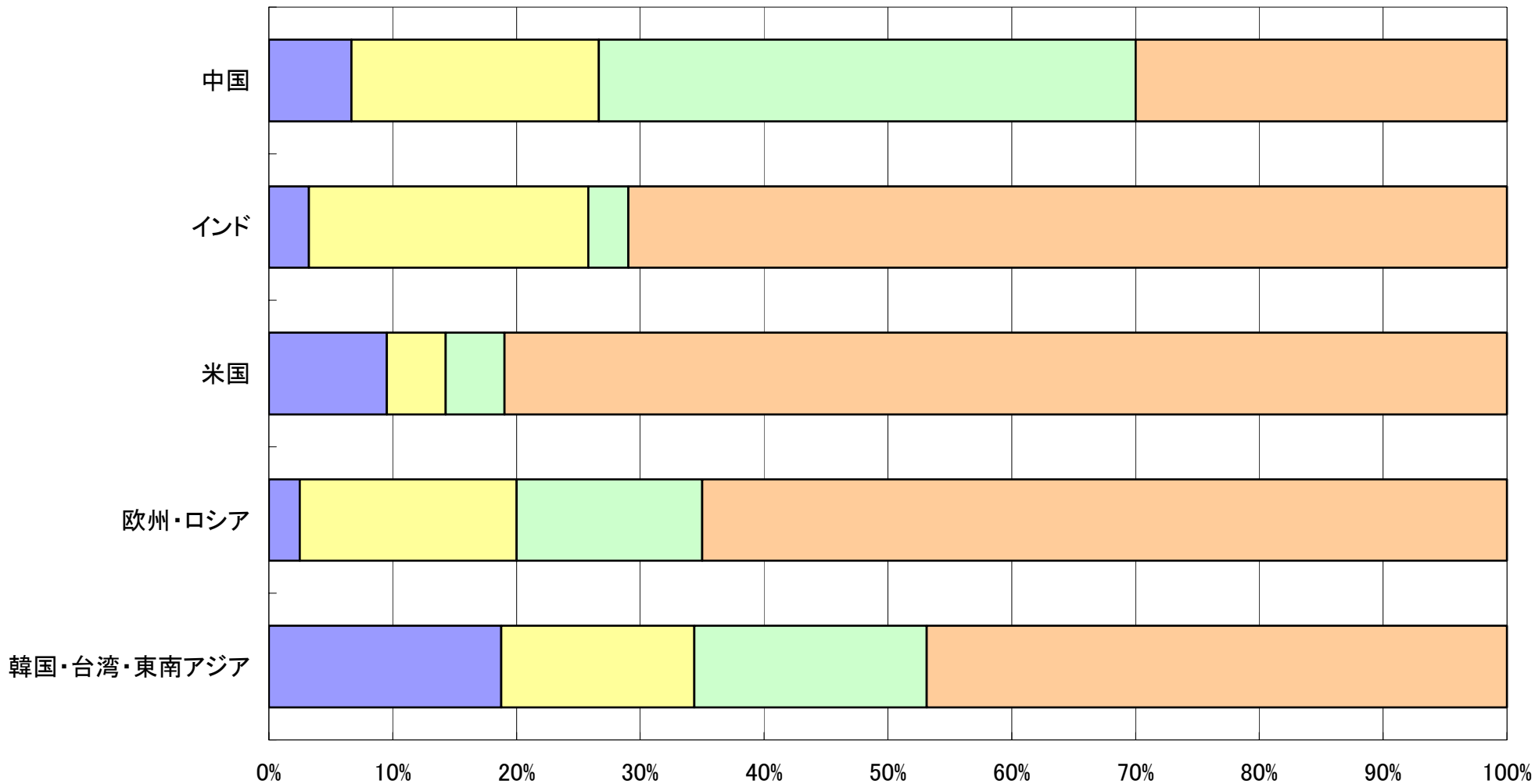


Q23-5a 組込みソフトウェア開発の課題を解決するための有効な手段：
 韓国・台湾・東南アジア：1番目

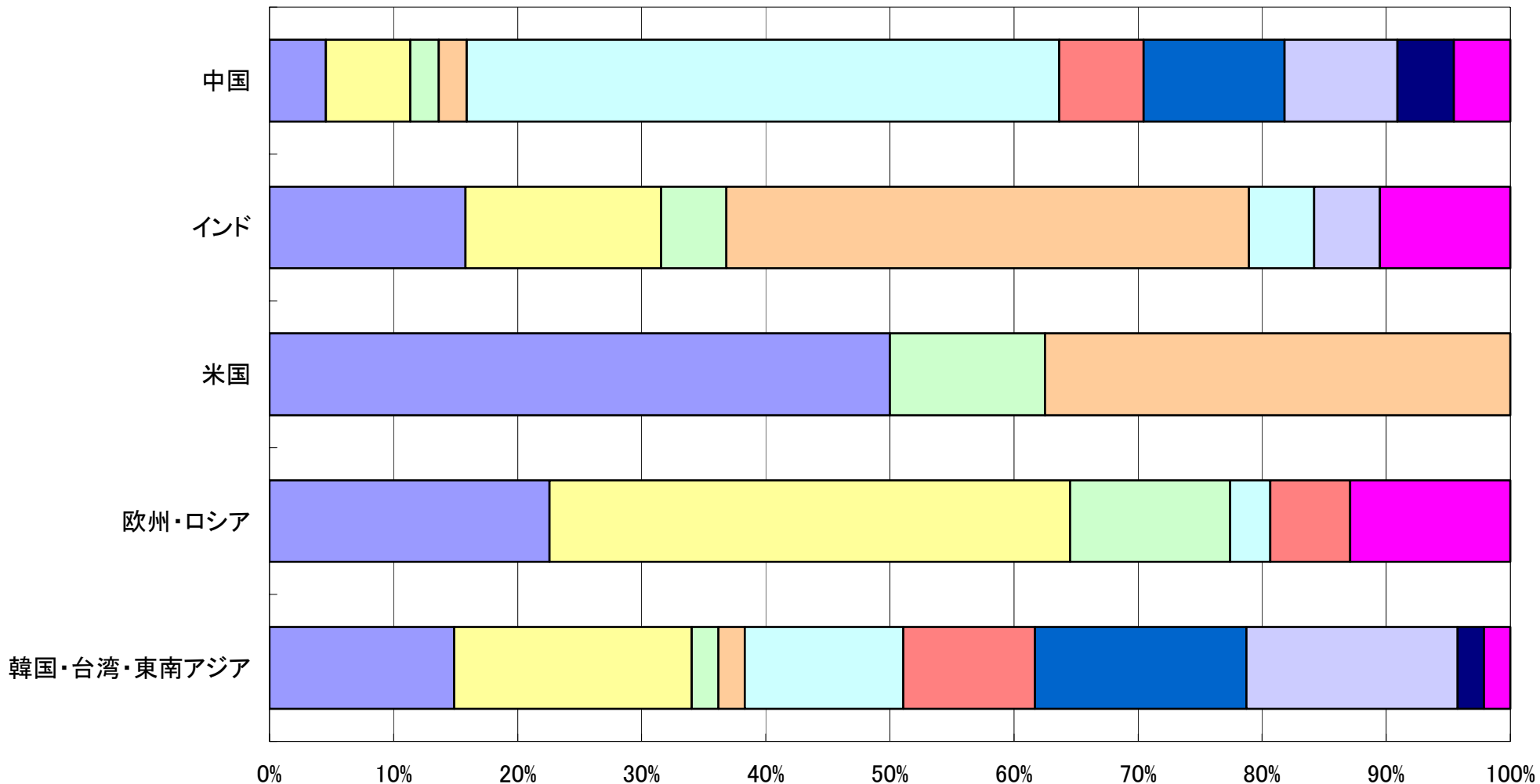
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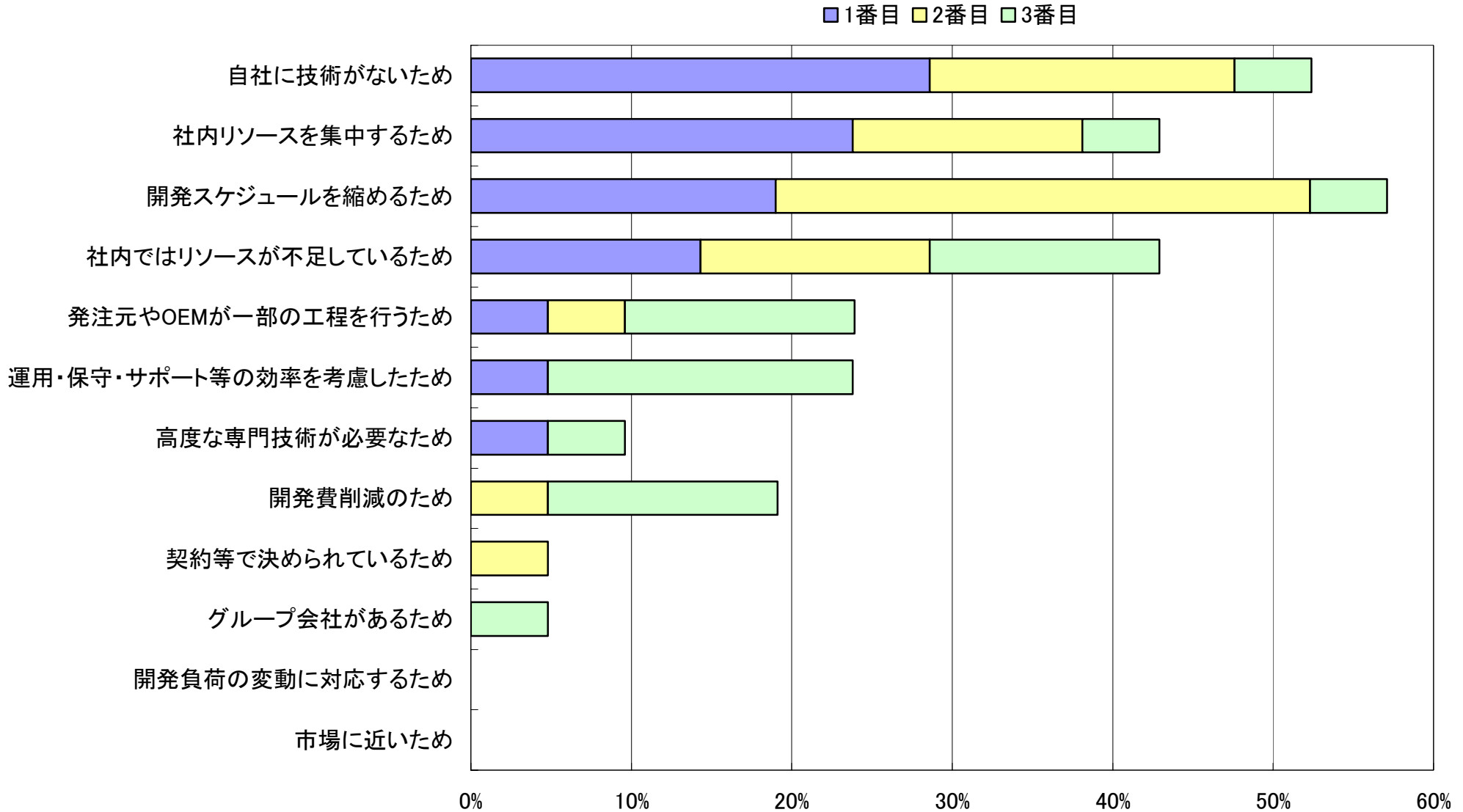


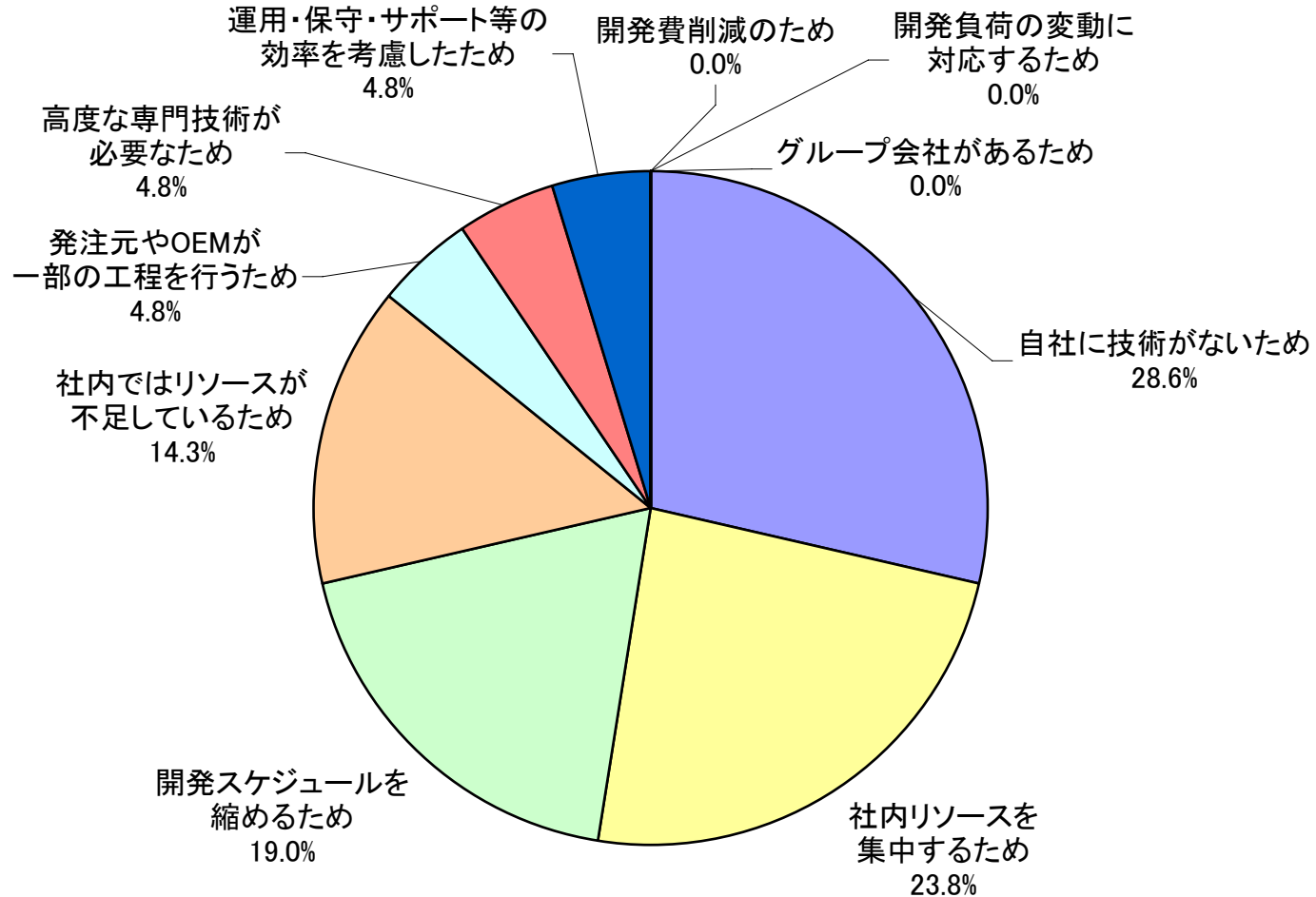
■ 外部委託している ■ 外部受託している □ 外部委託、外部受託の両方をしている ■ 外部委託、外部受託の両方をしていない

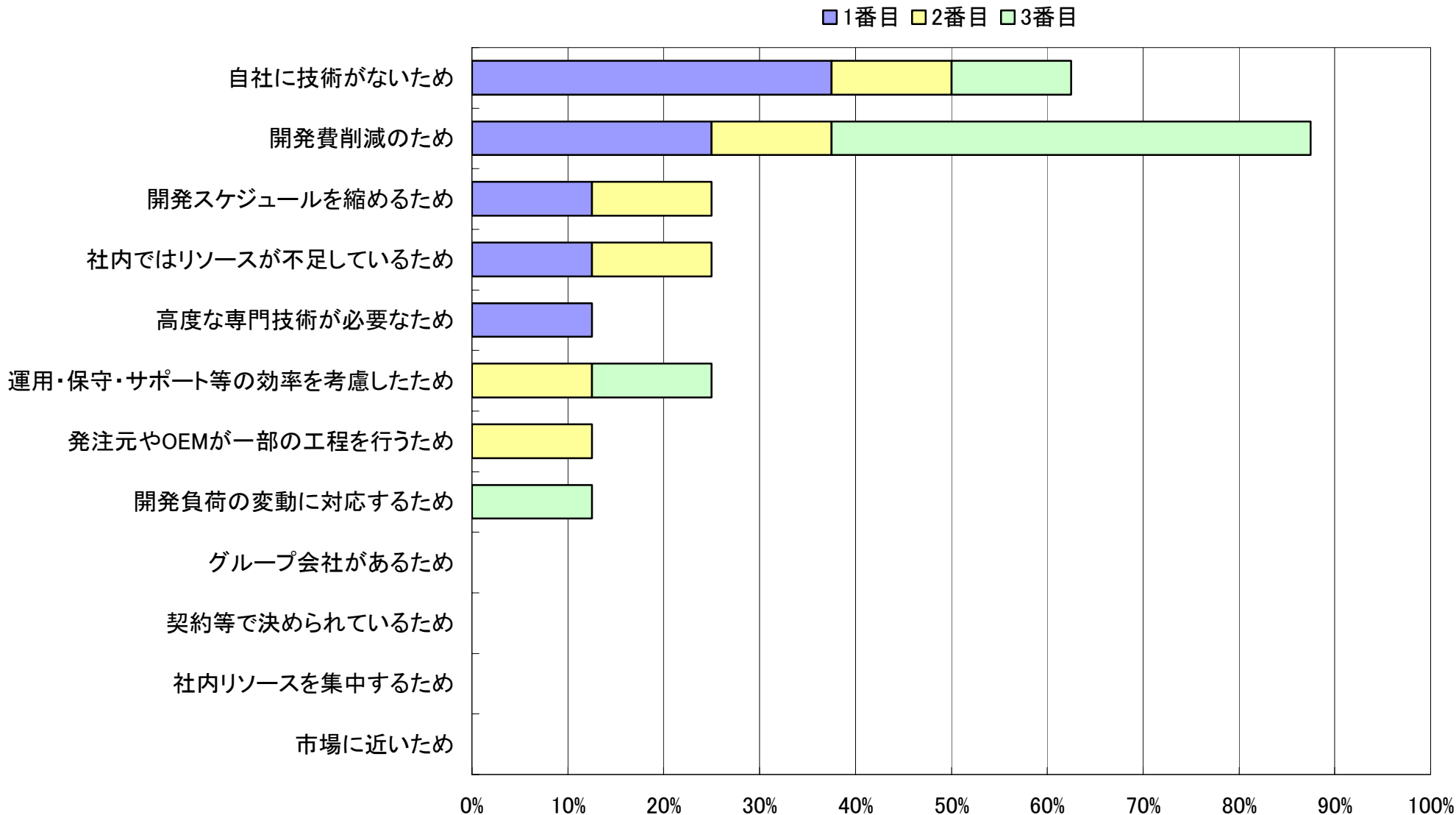


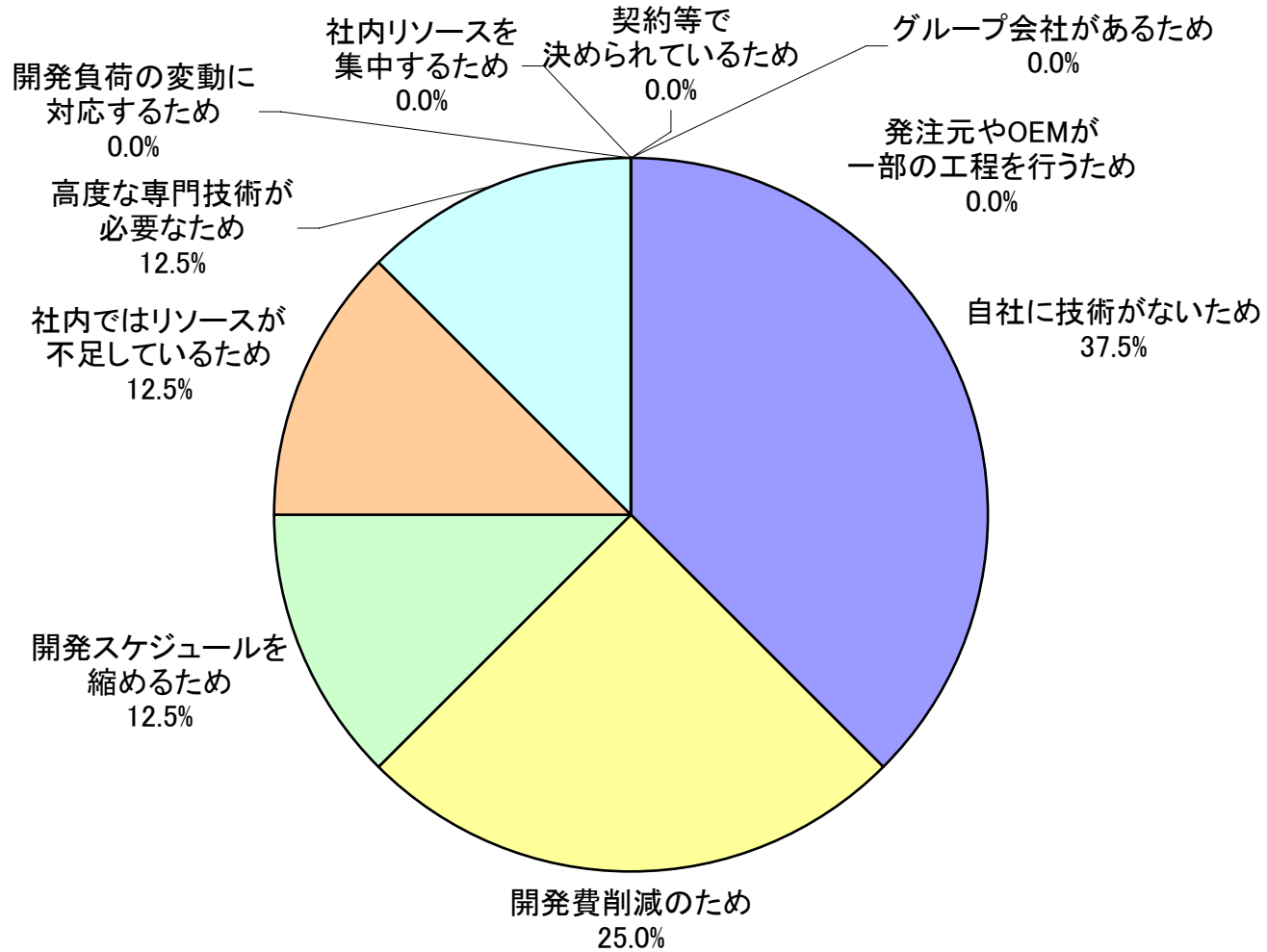
■ 米国
 ■ 西欧
 ■ 東欧・ロシア
 ■ インド
 ■ 中国
 ■ 韓国
 ■ 台湾
 ■ 東南アジア
 ■ 日本
 ■ その他

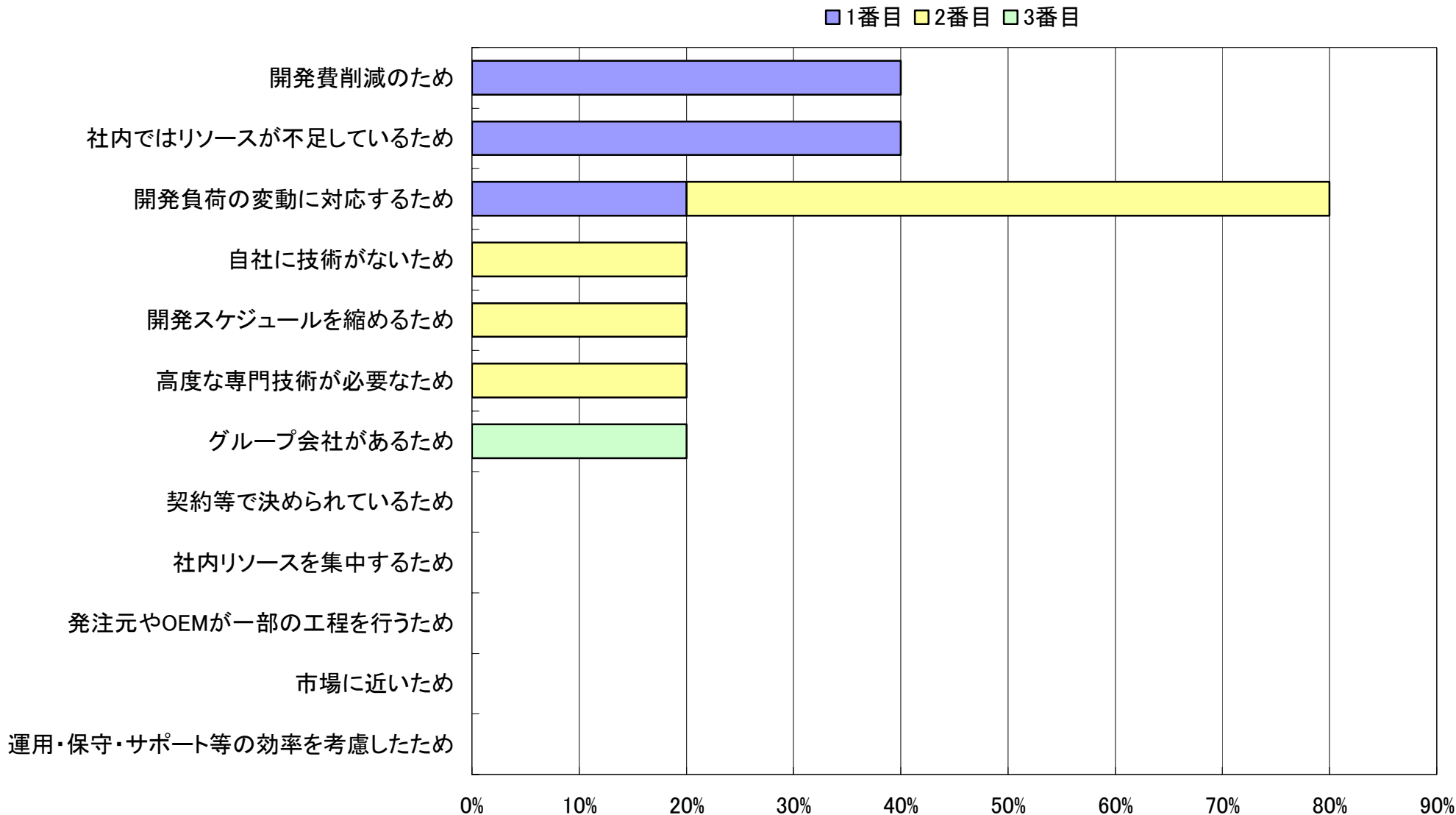


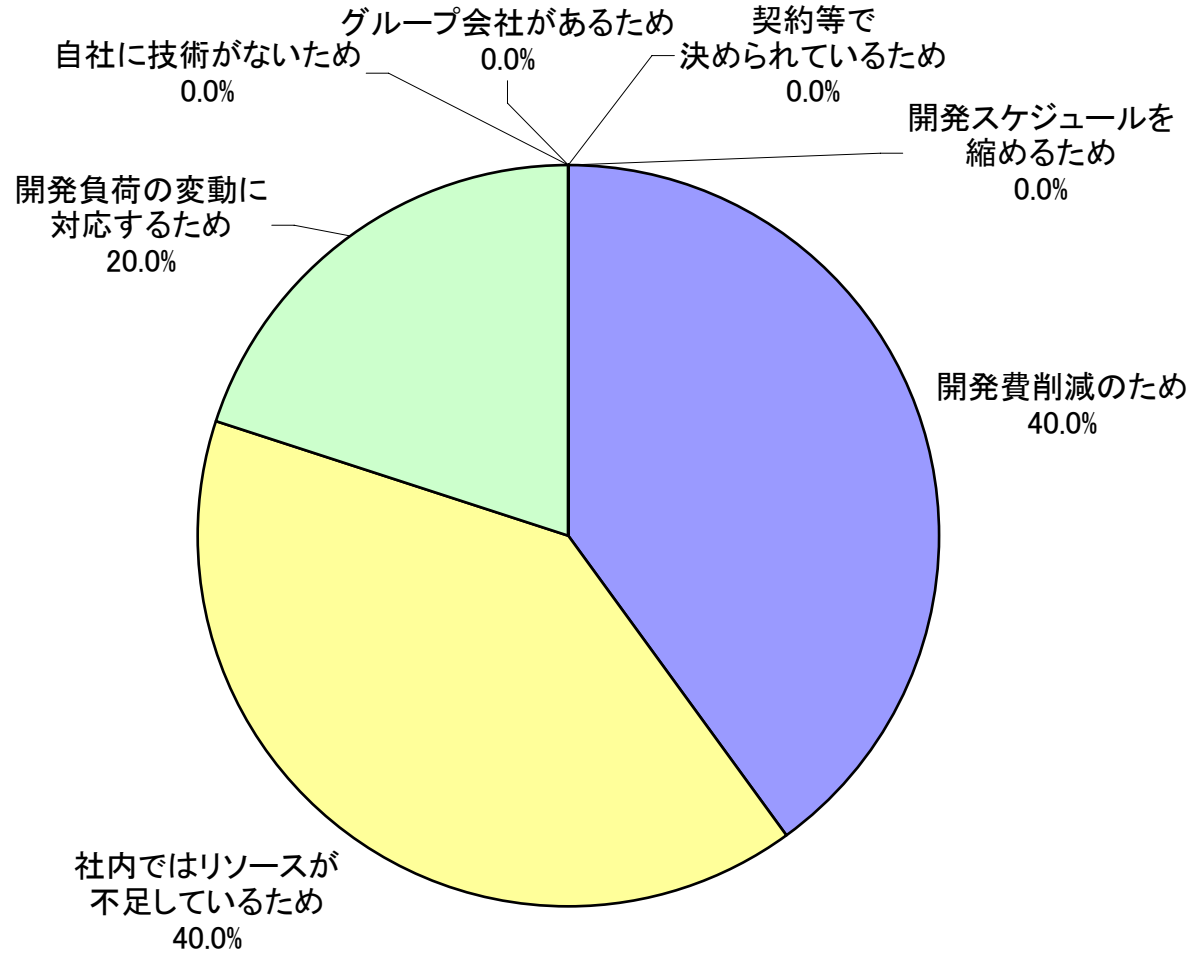


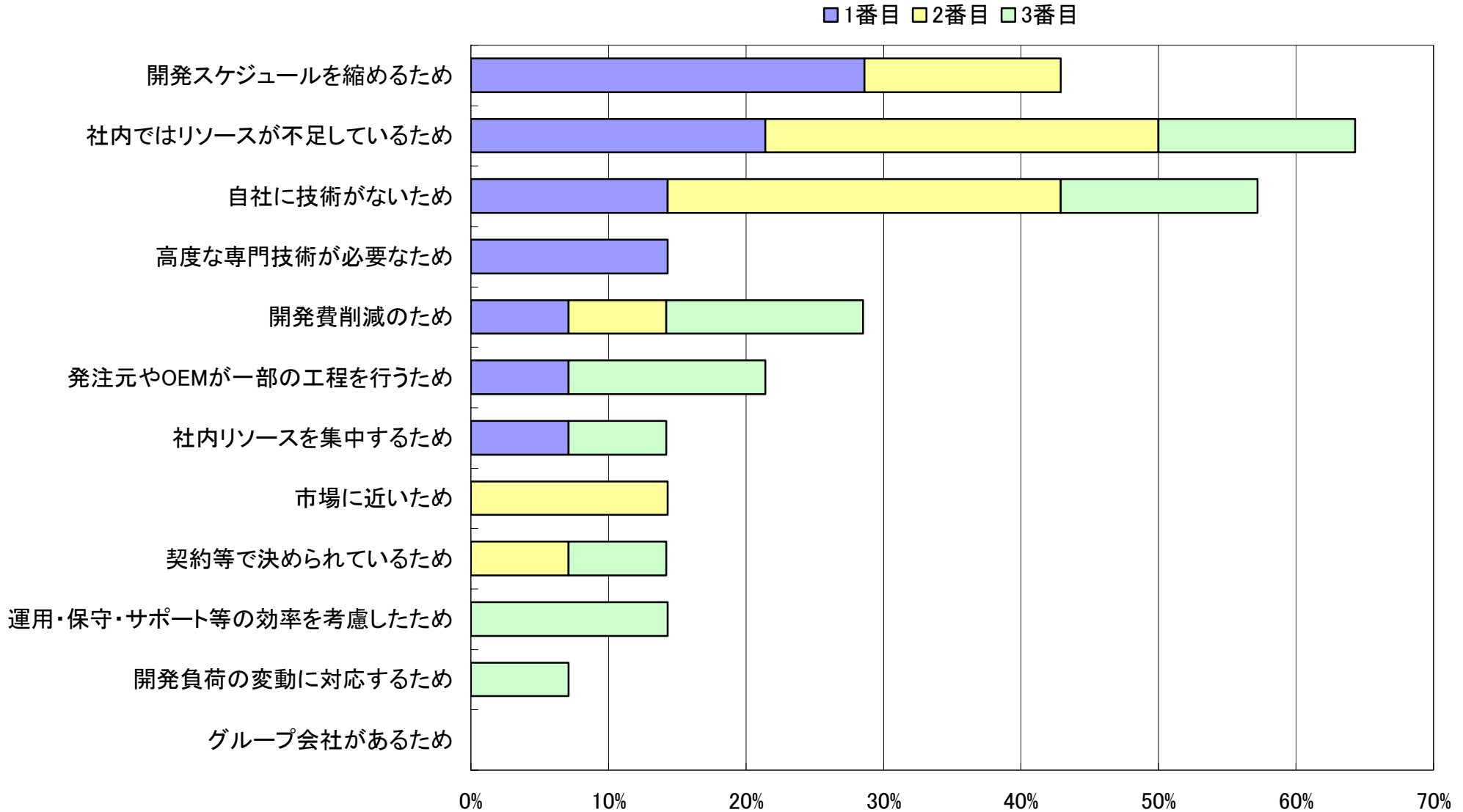


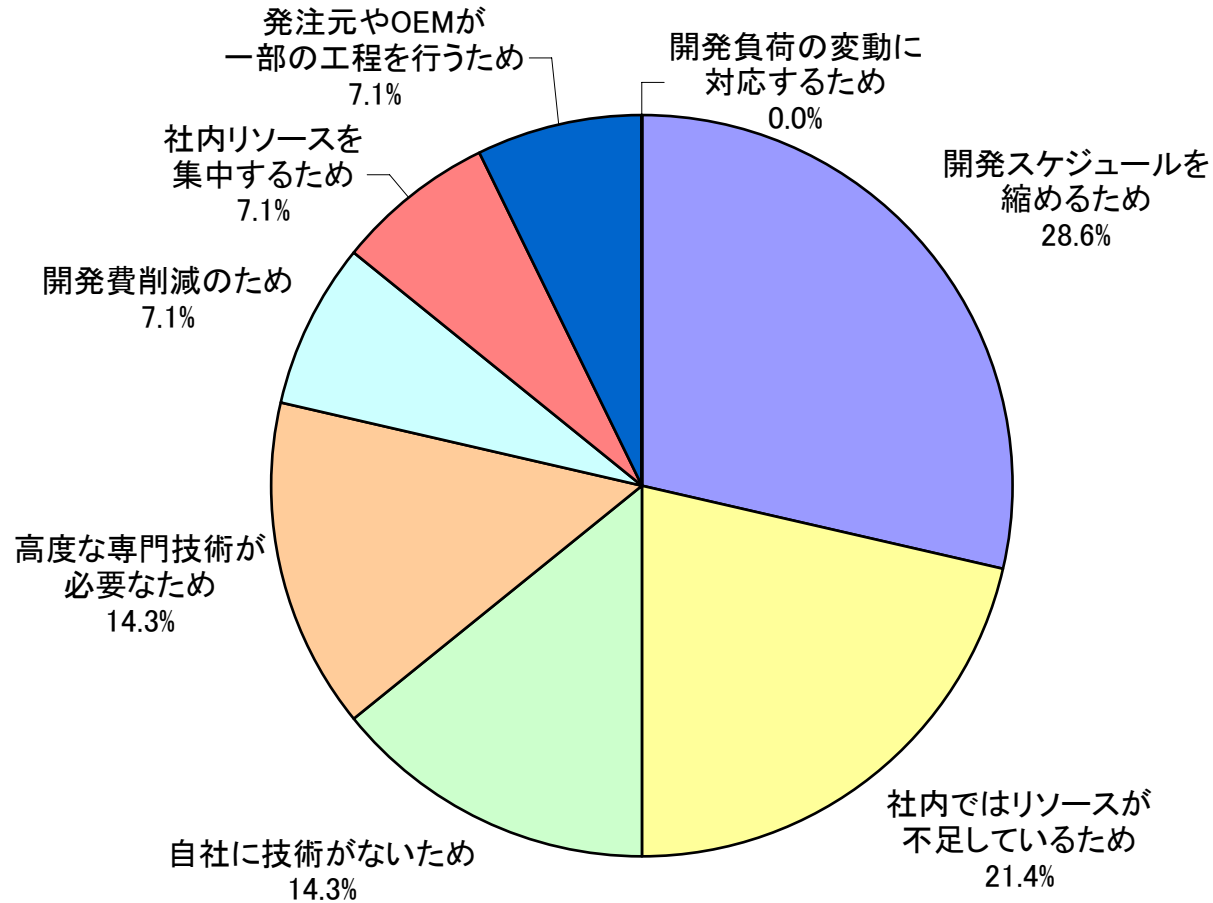


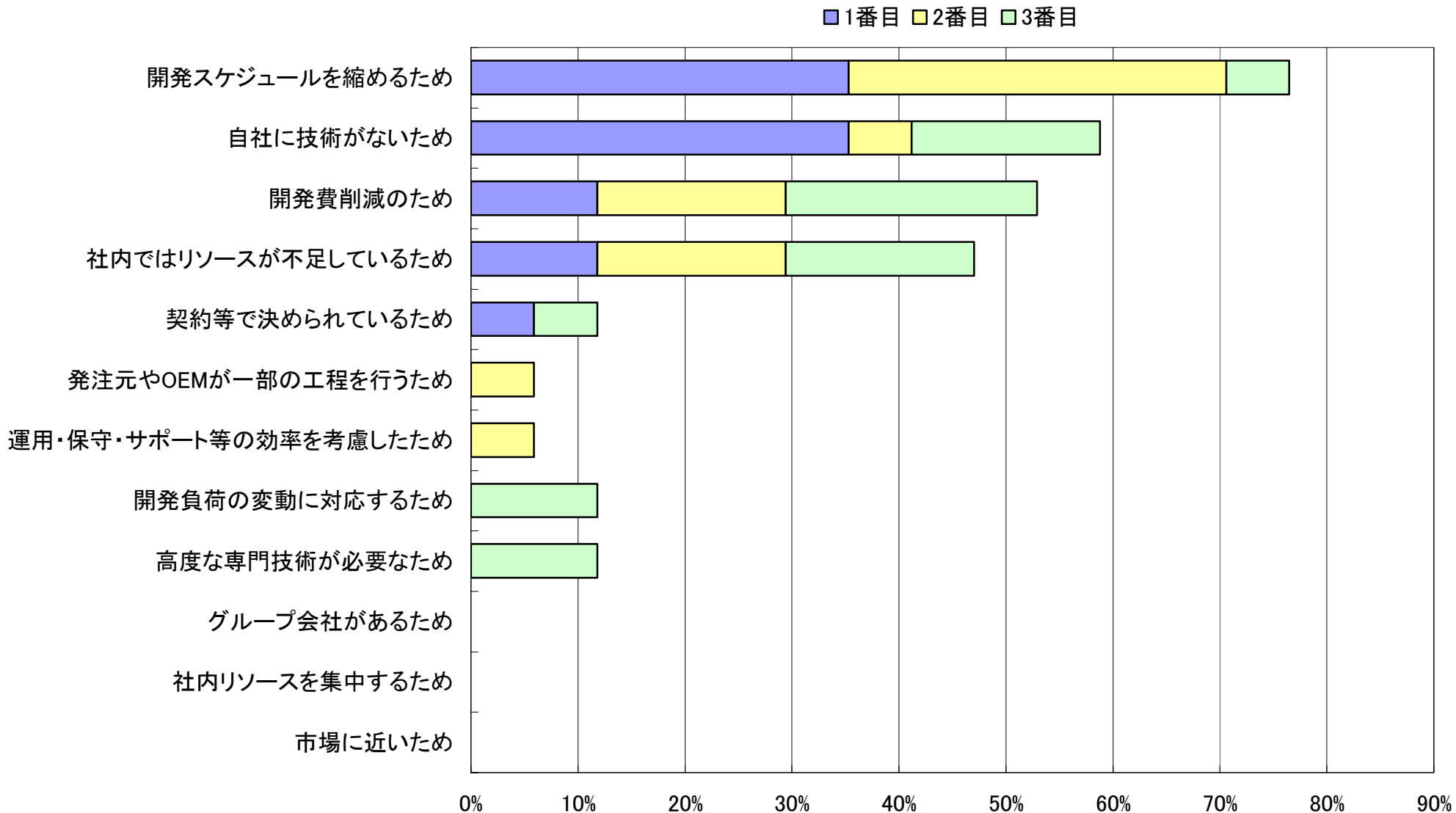


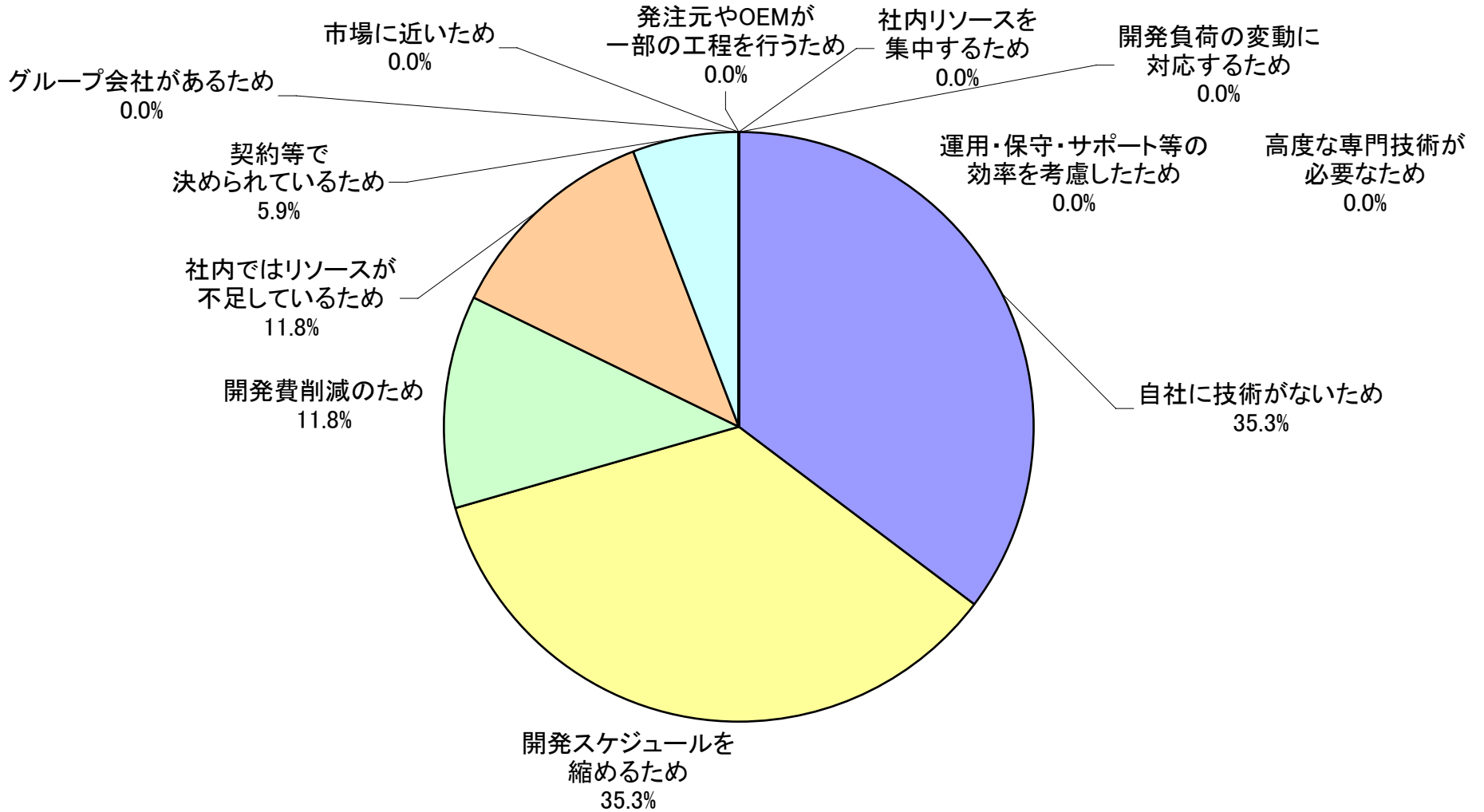


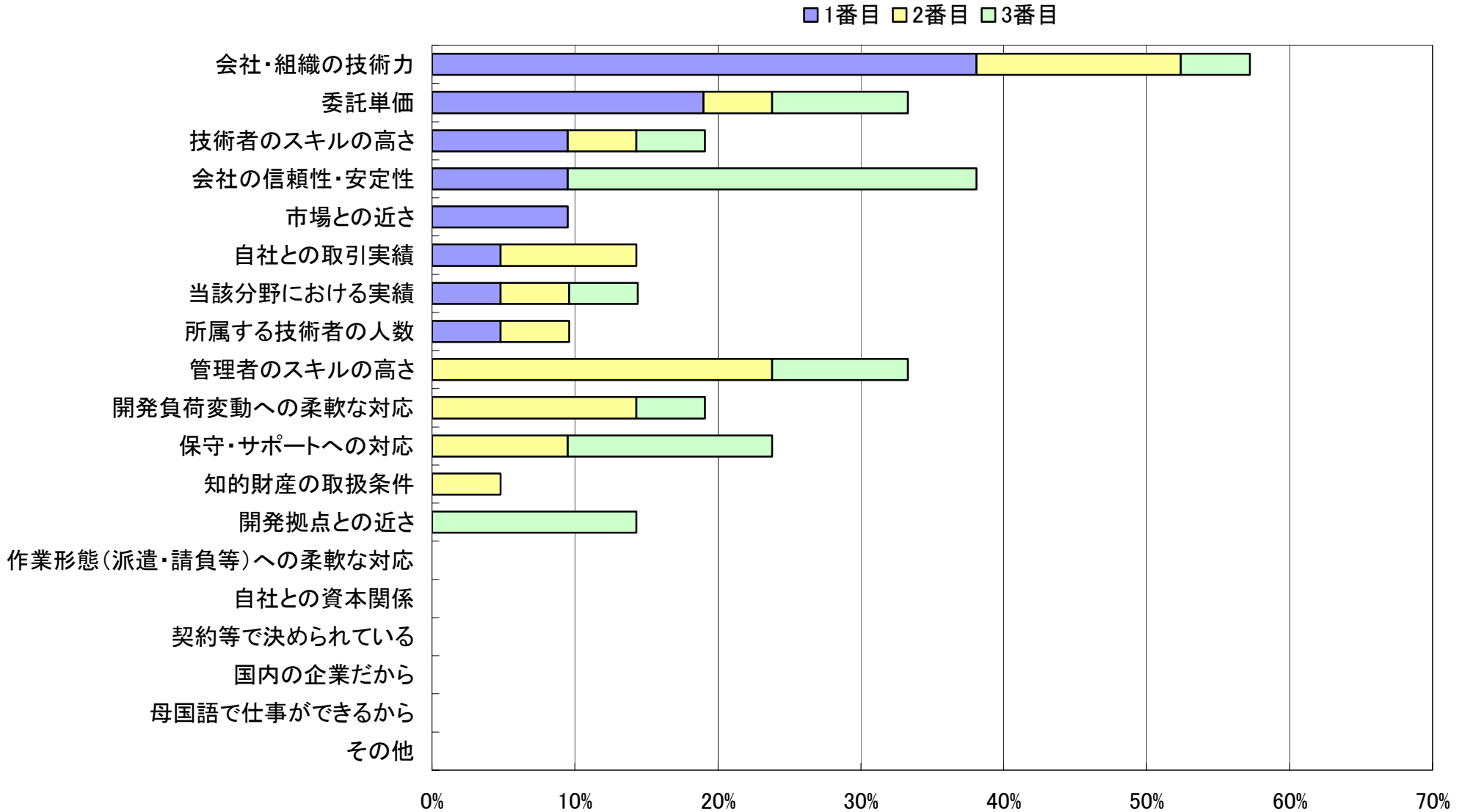


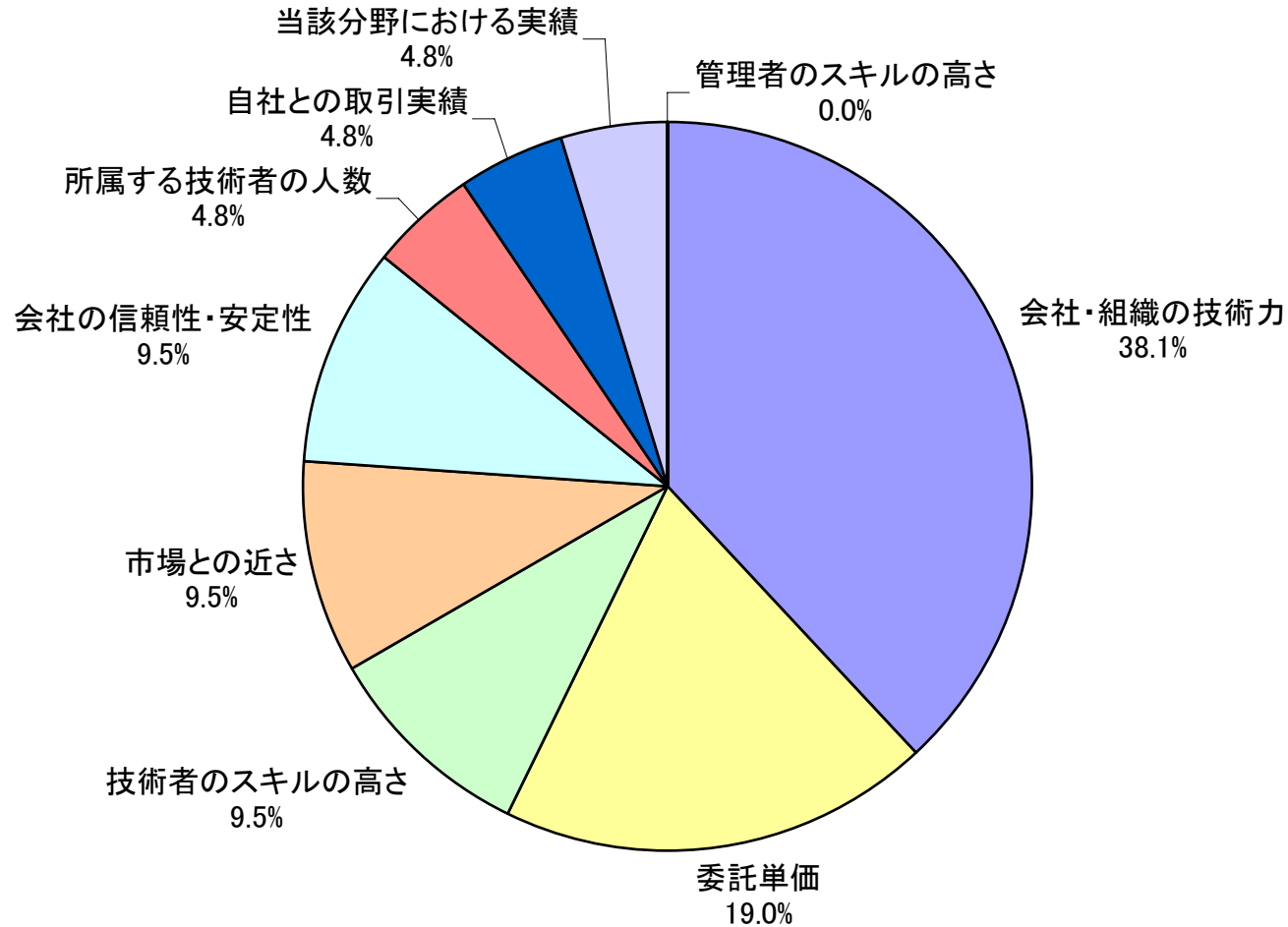


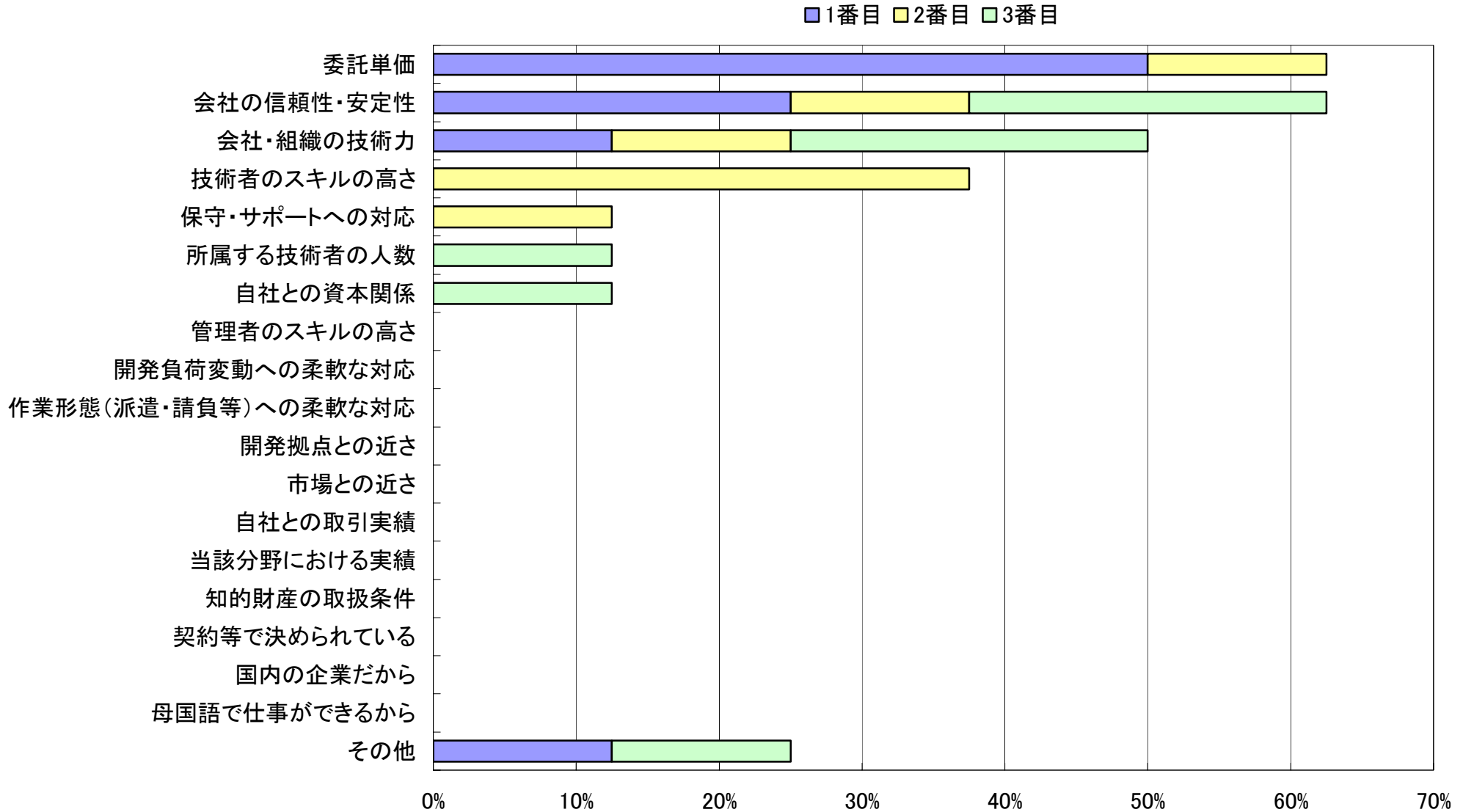


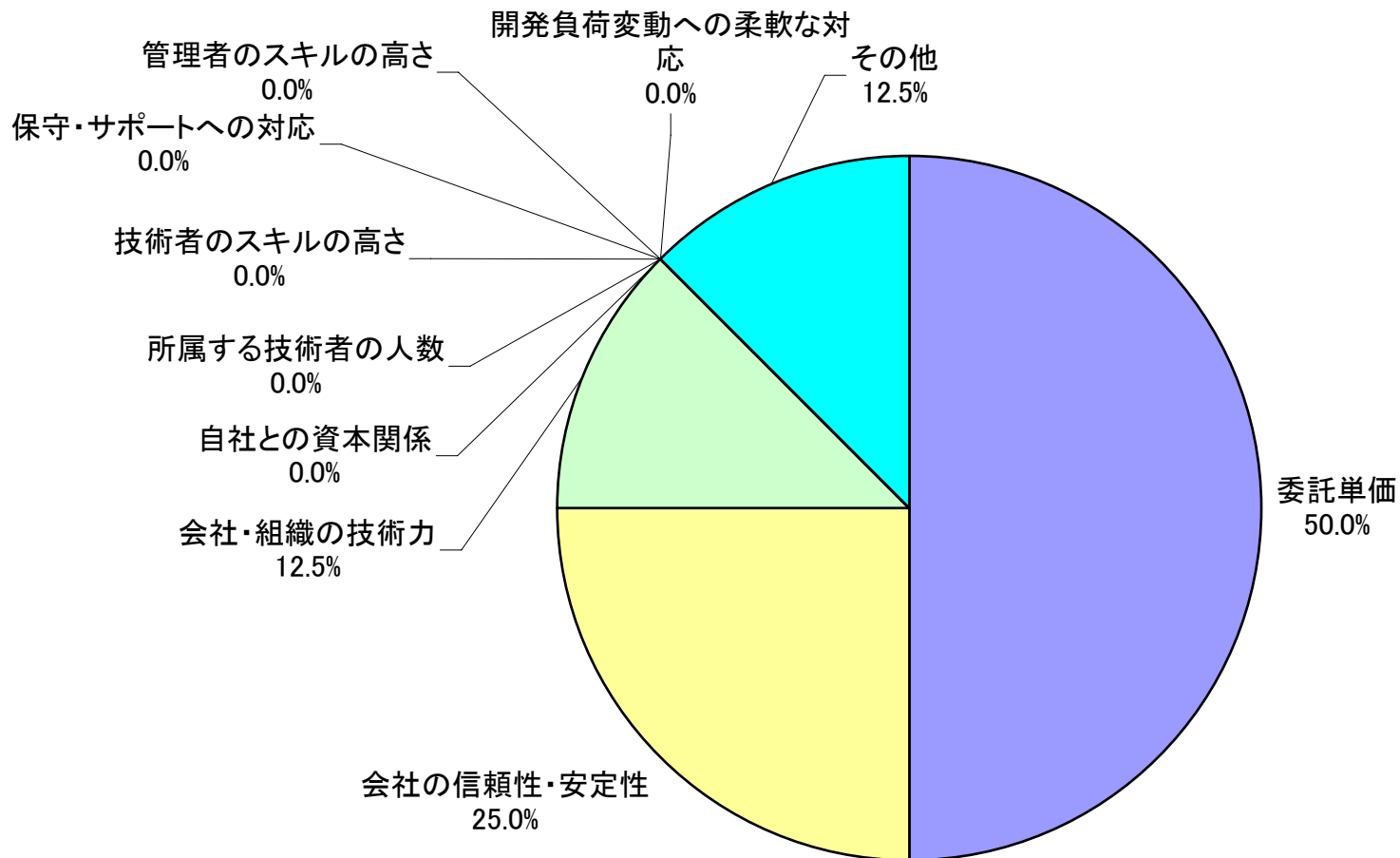


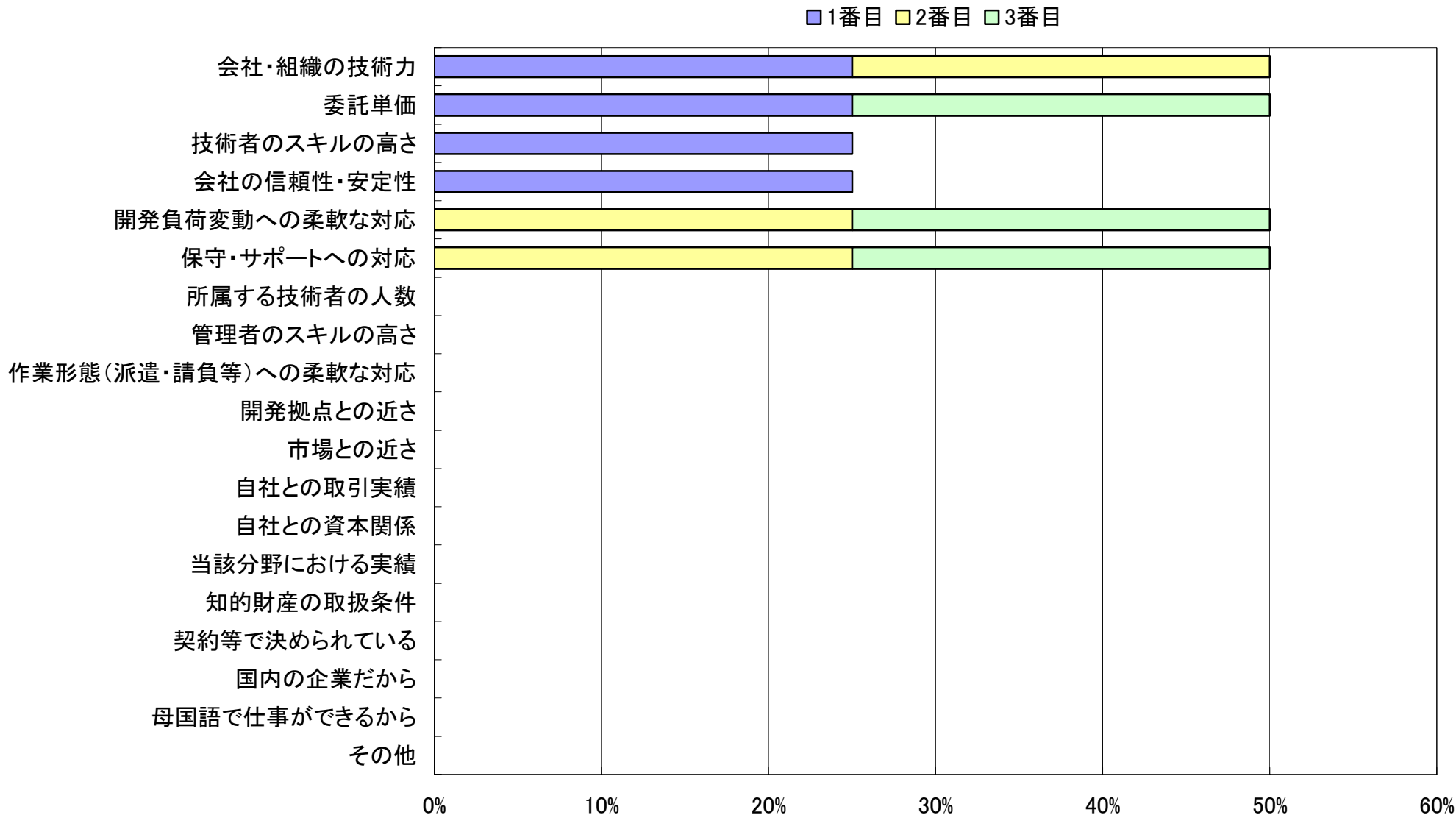


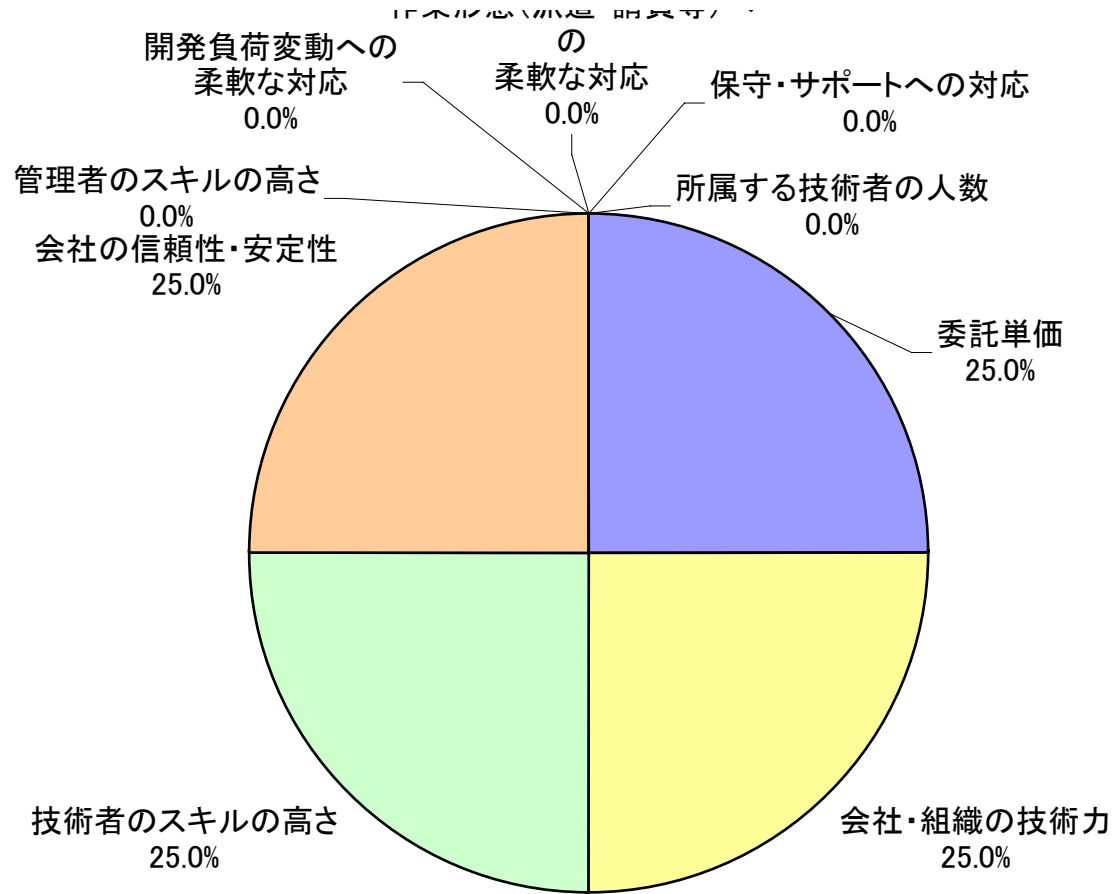


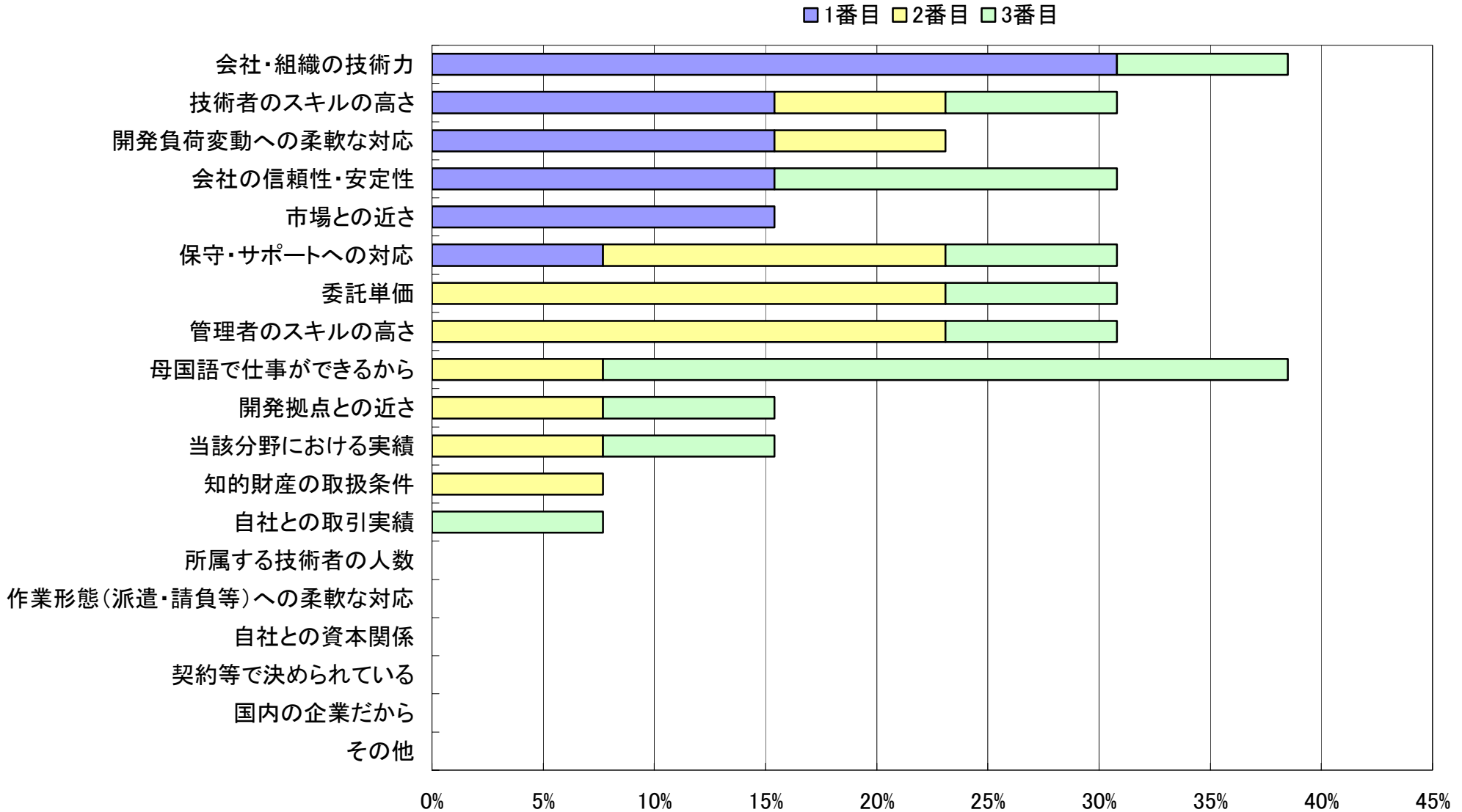


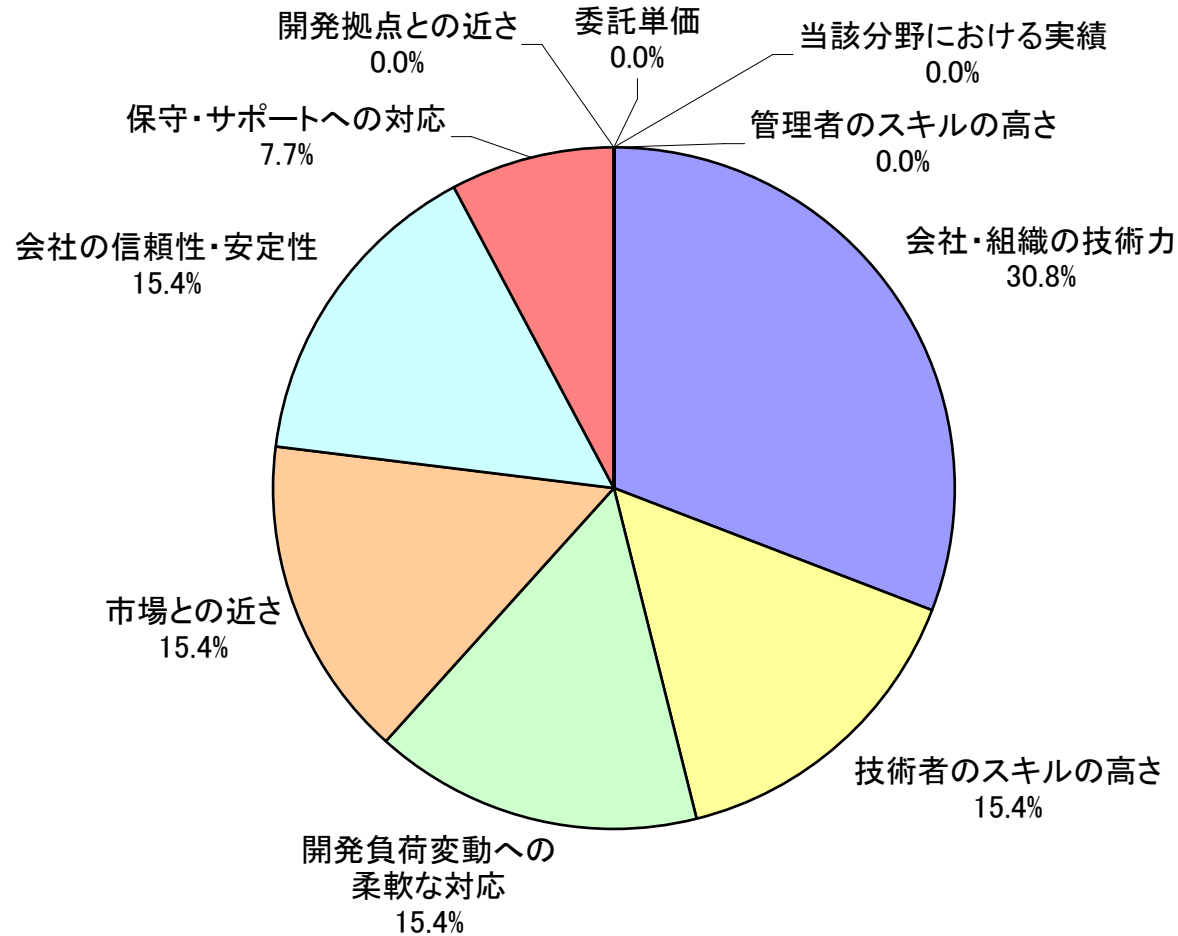


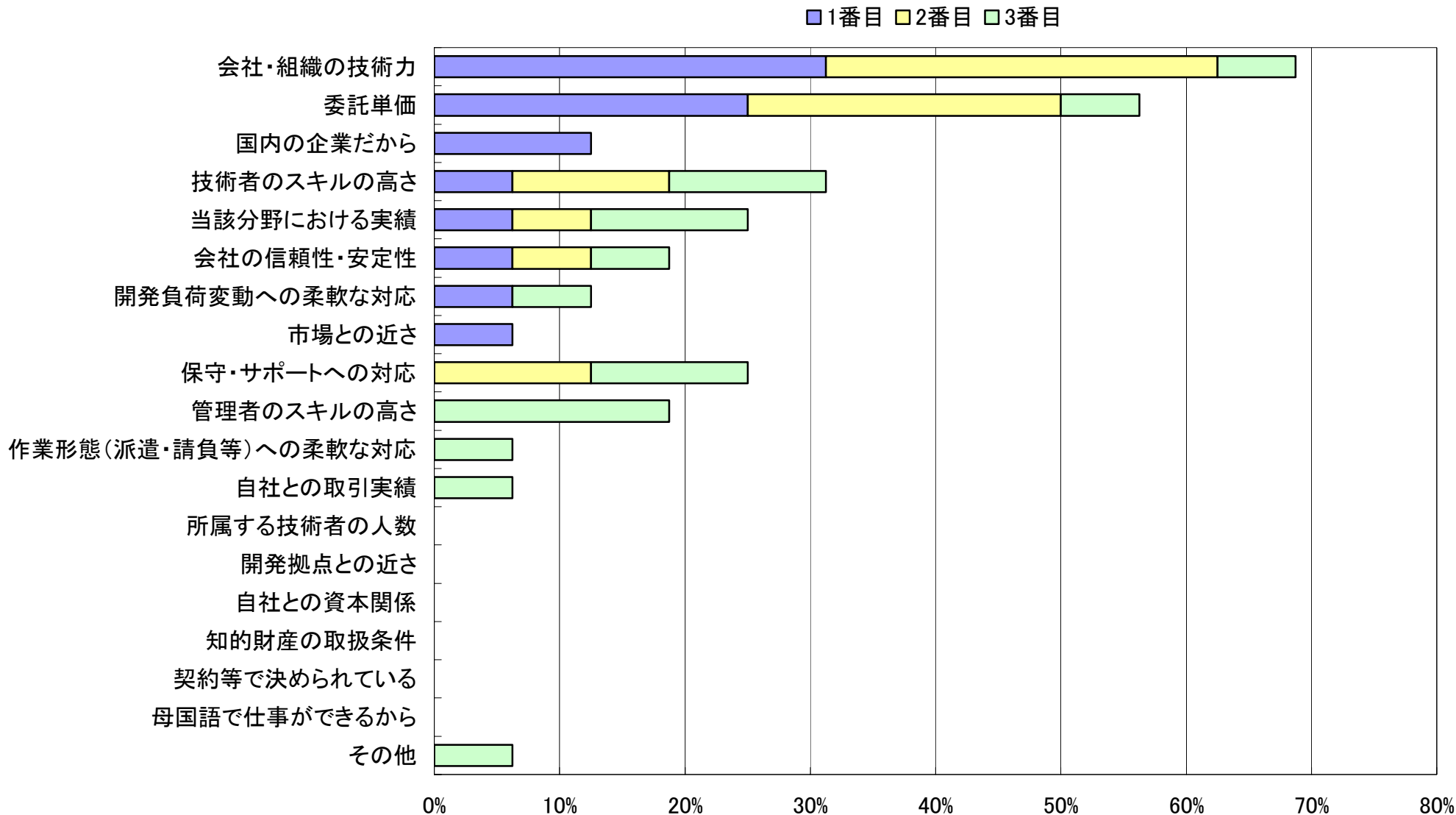


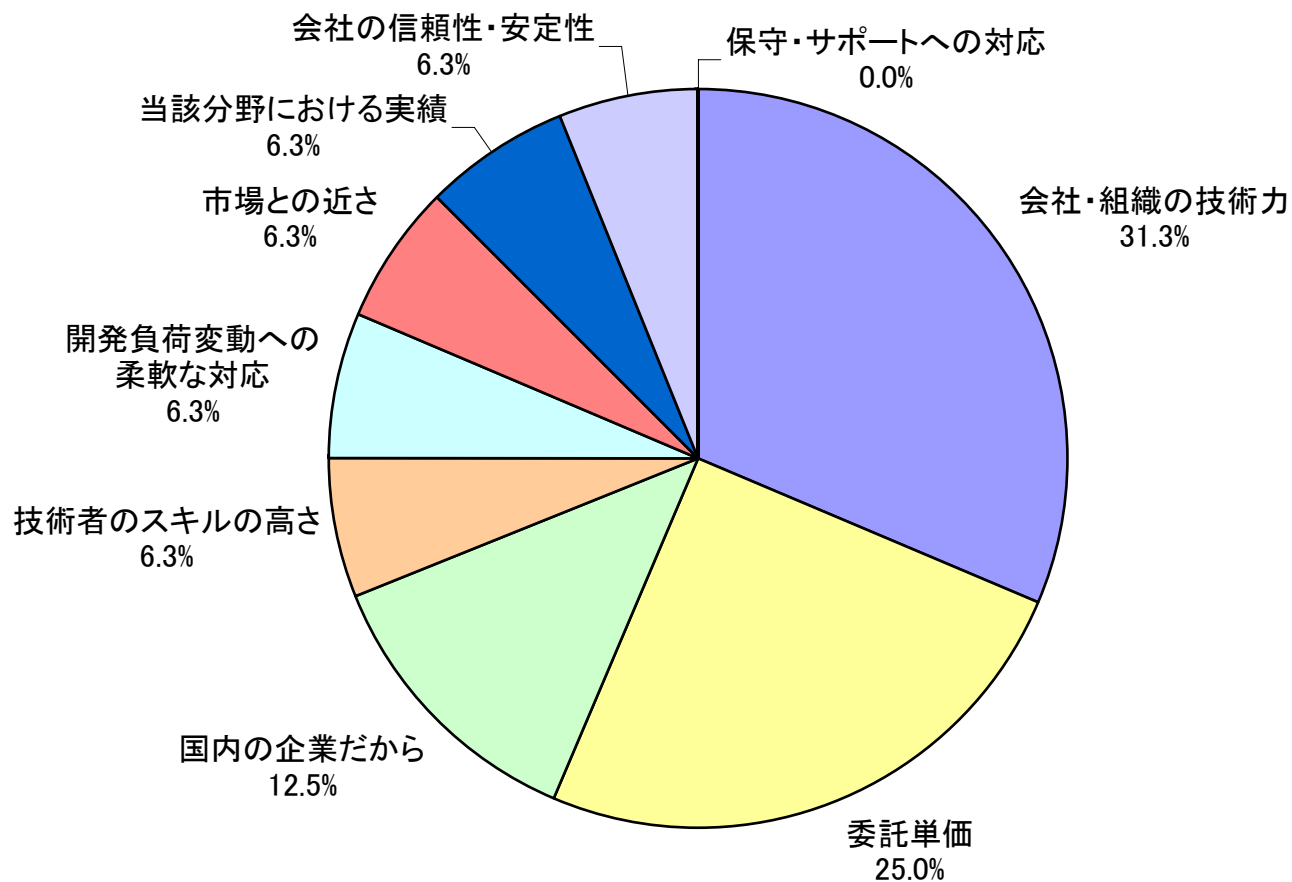


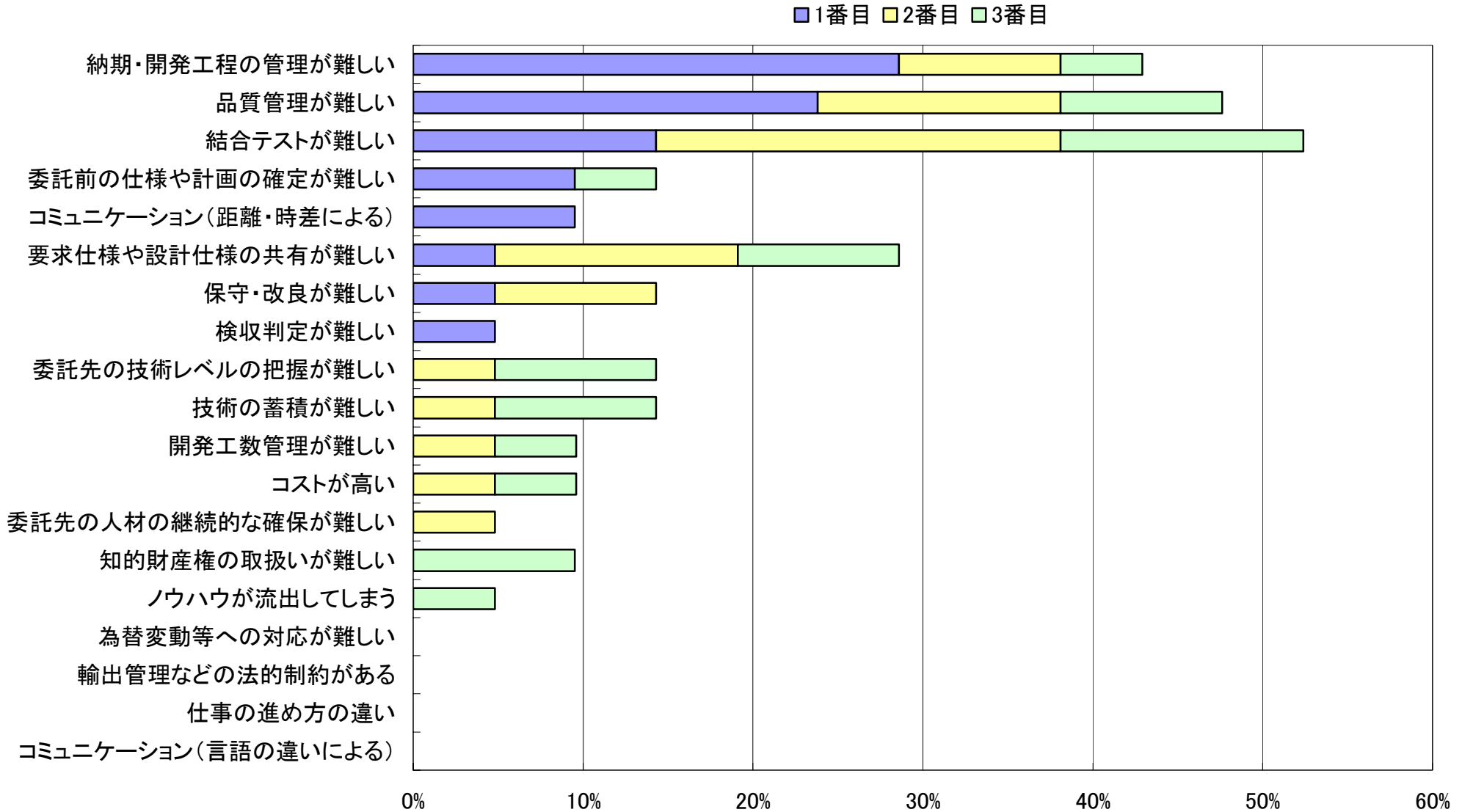


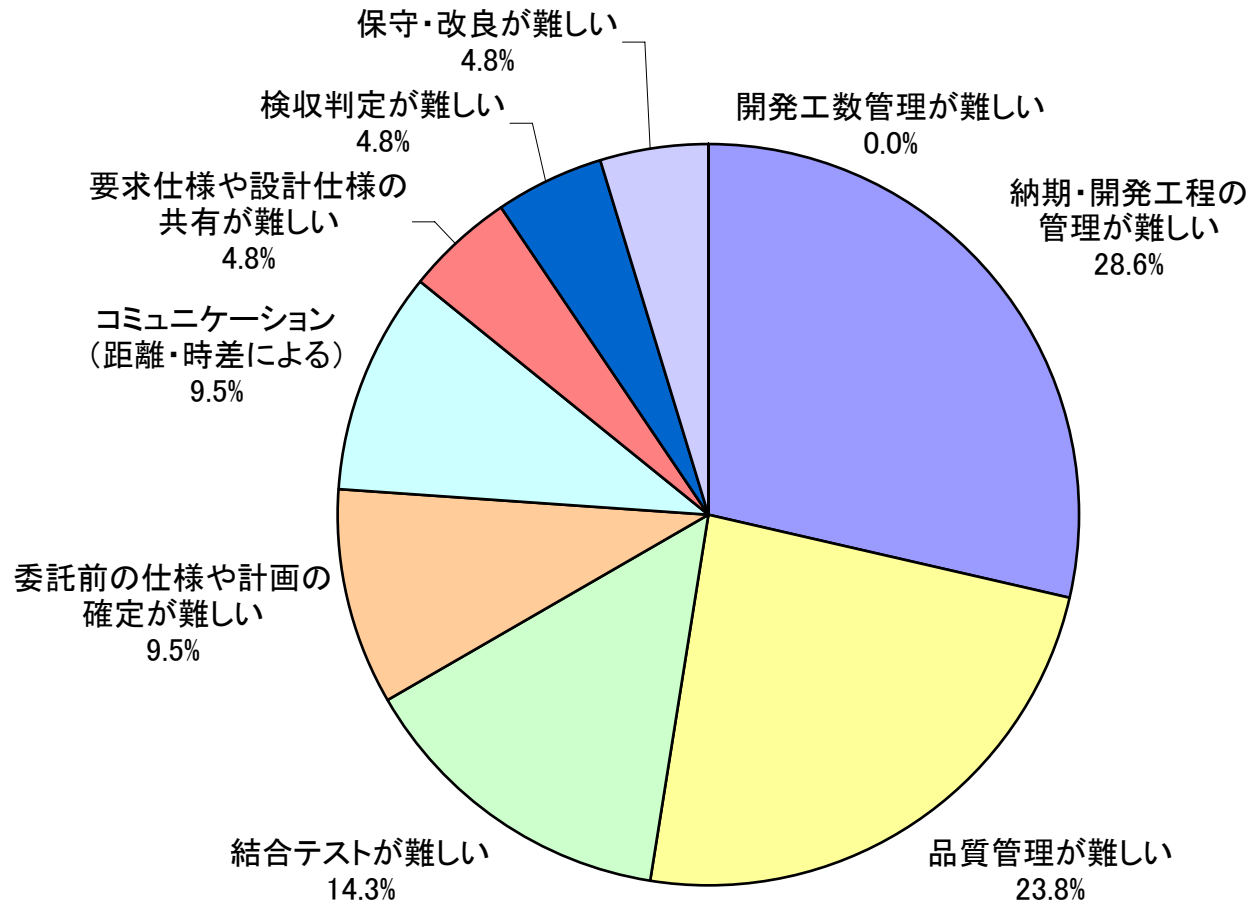


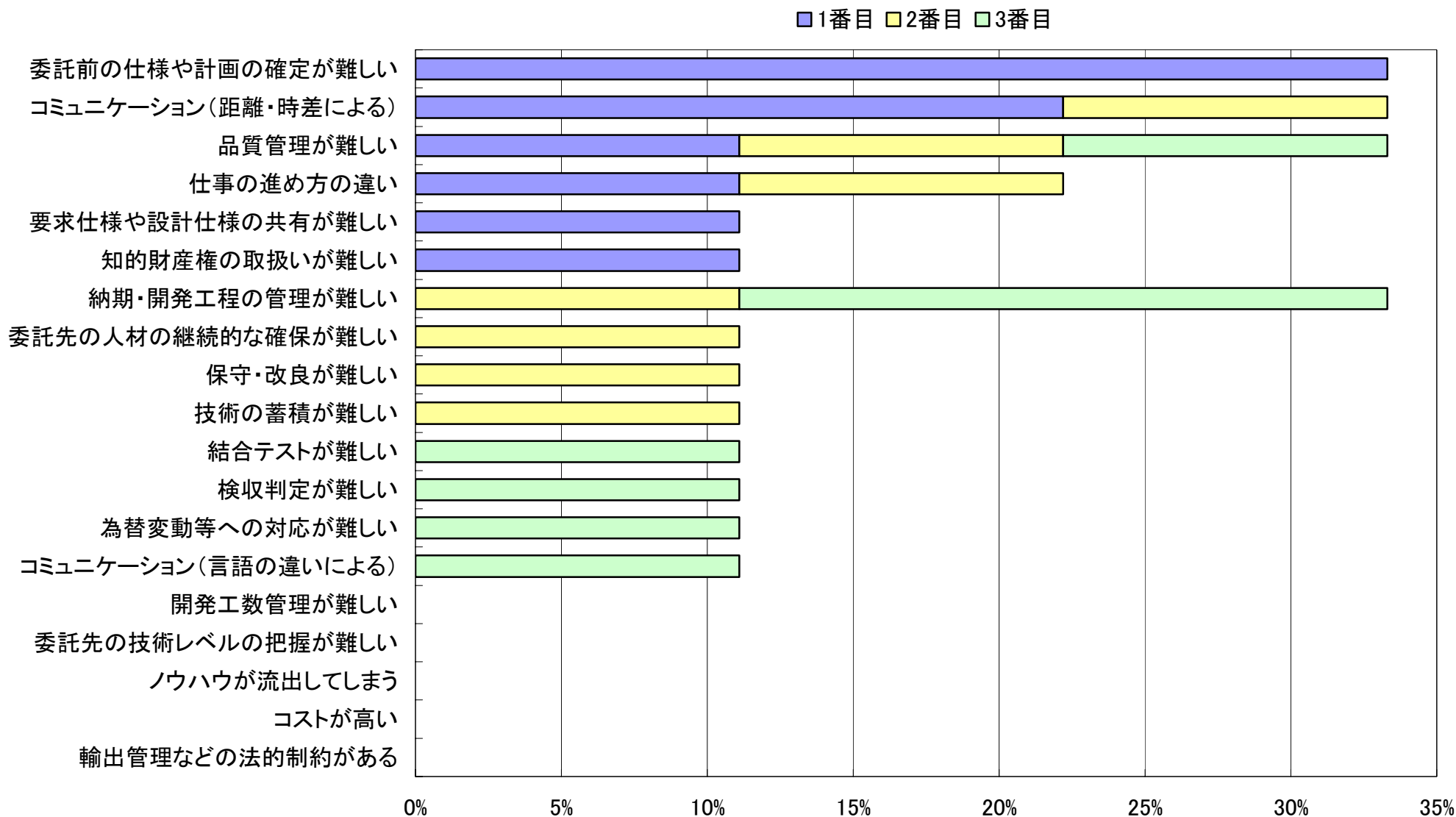


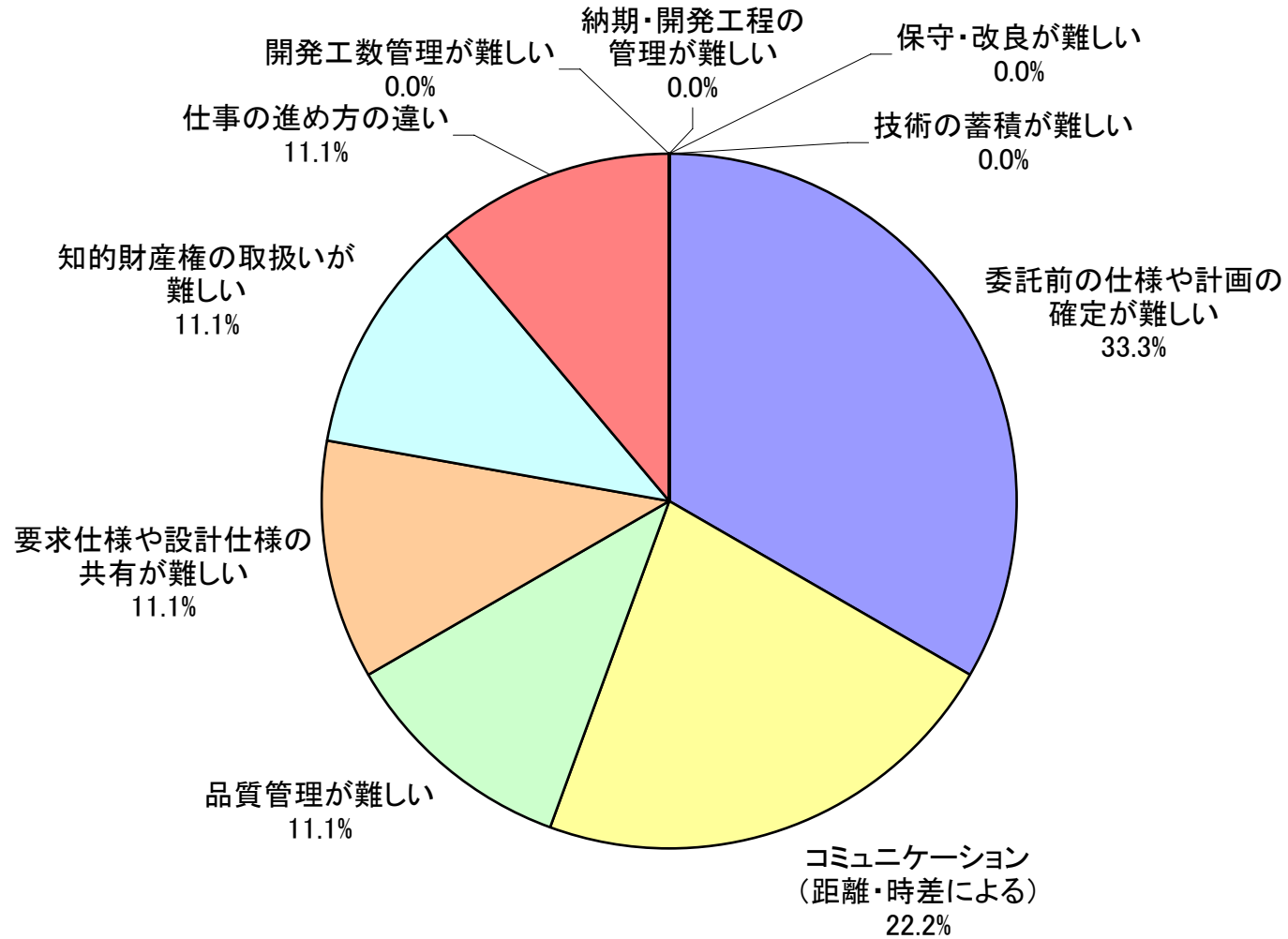


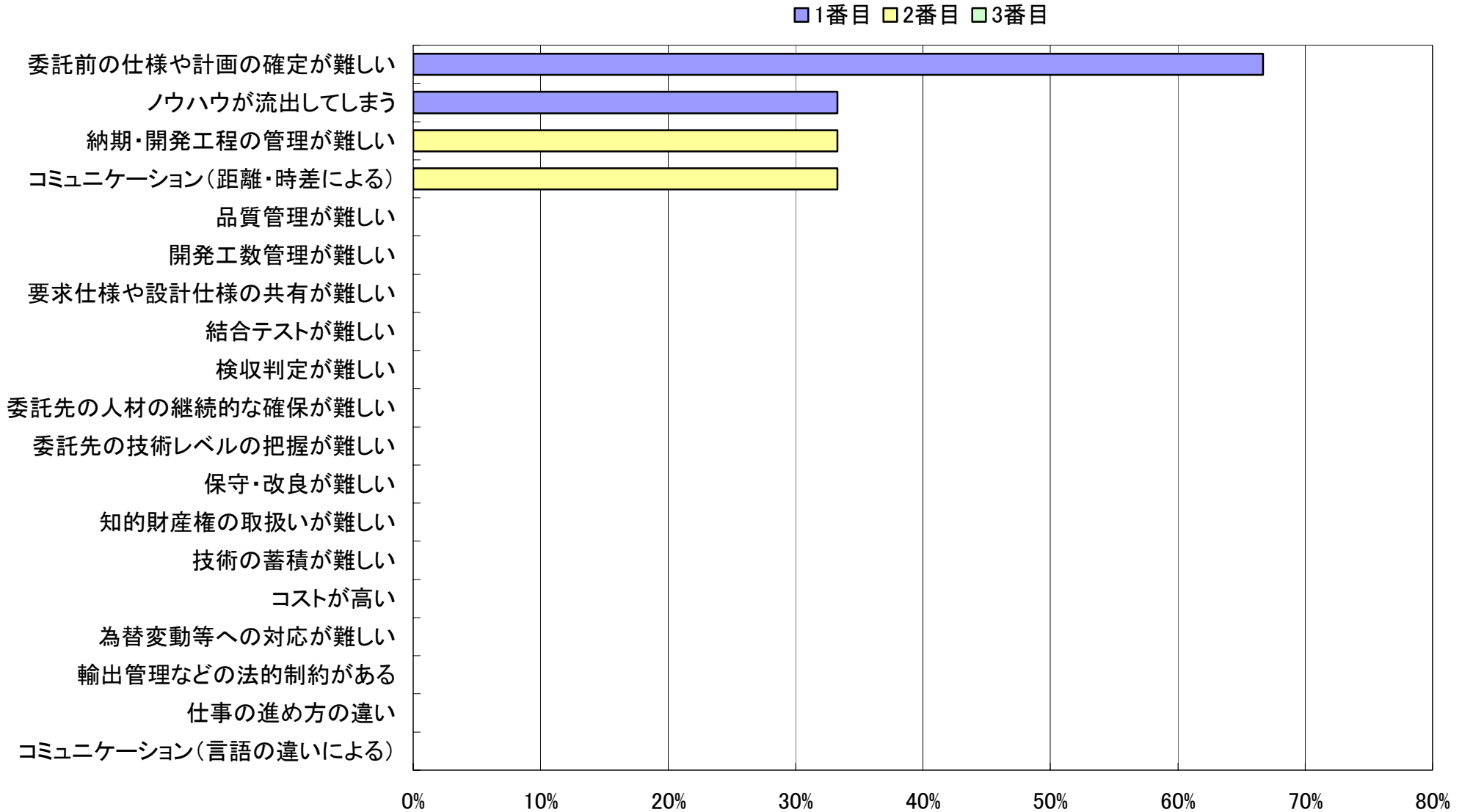


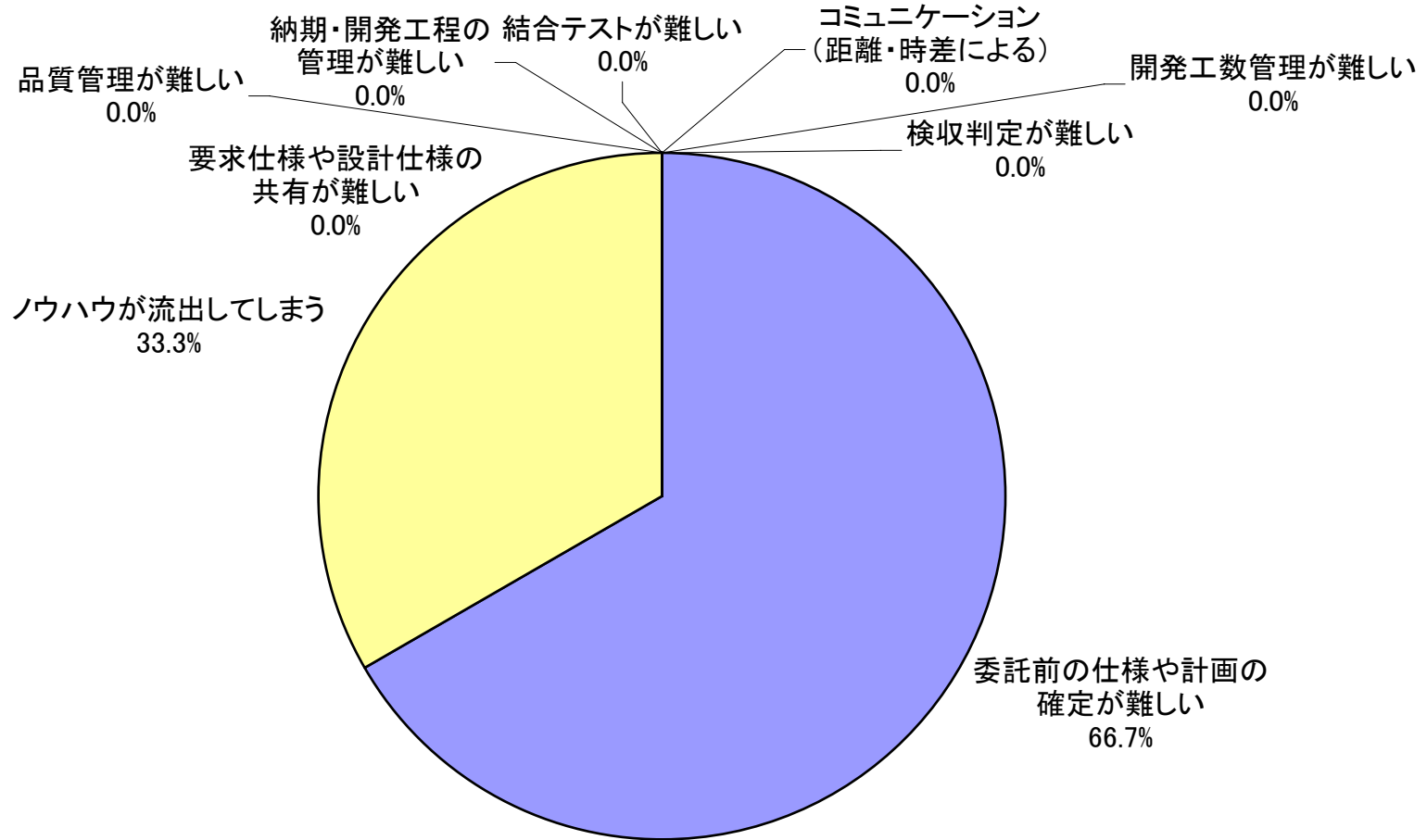


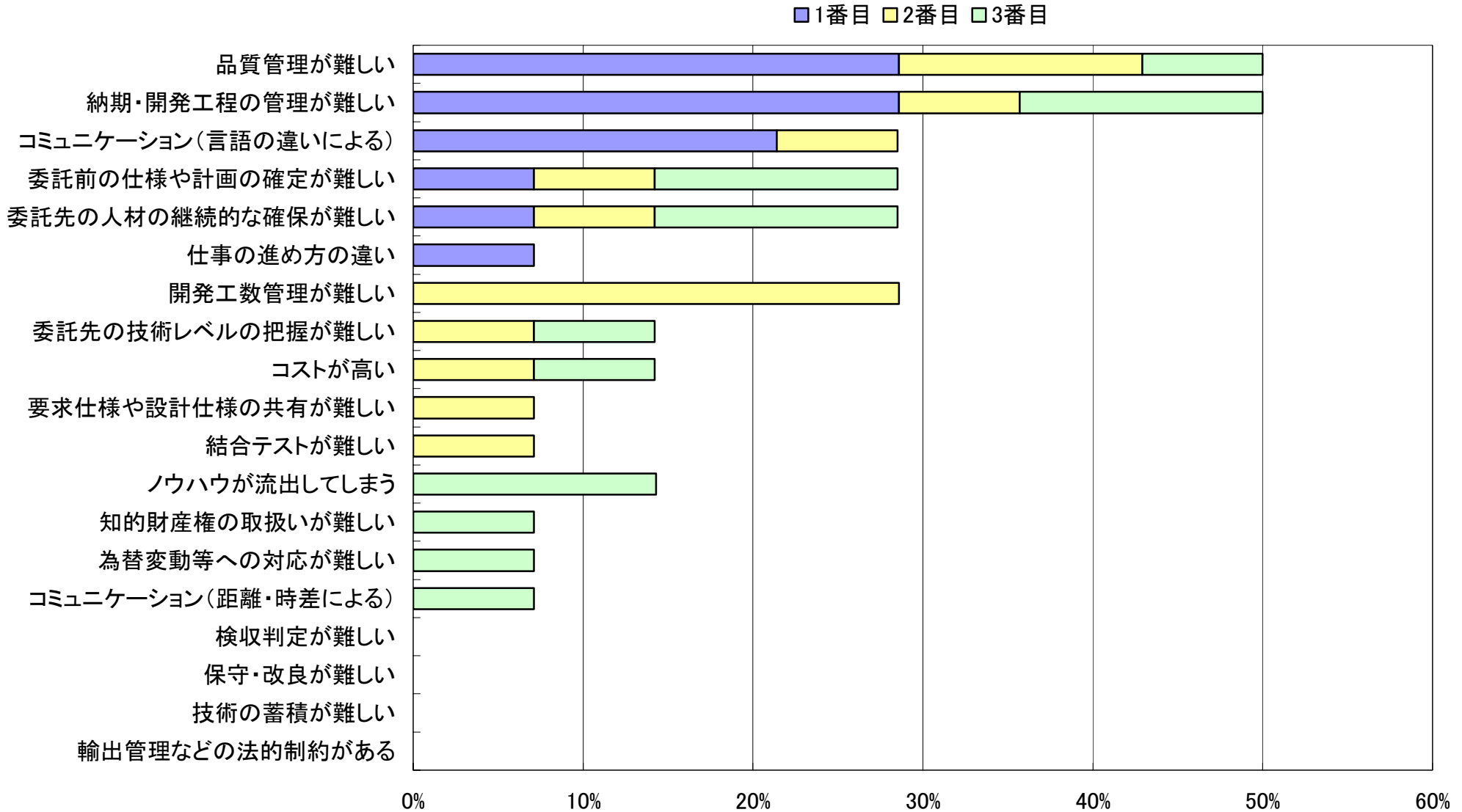


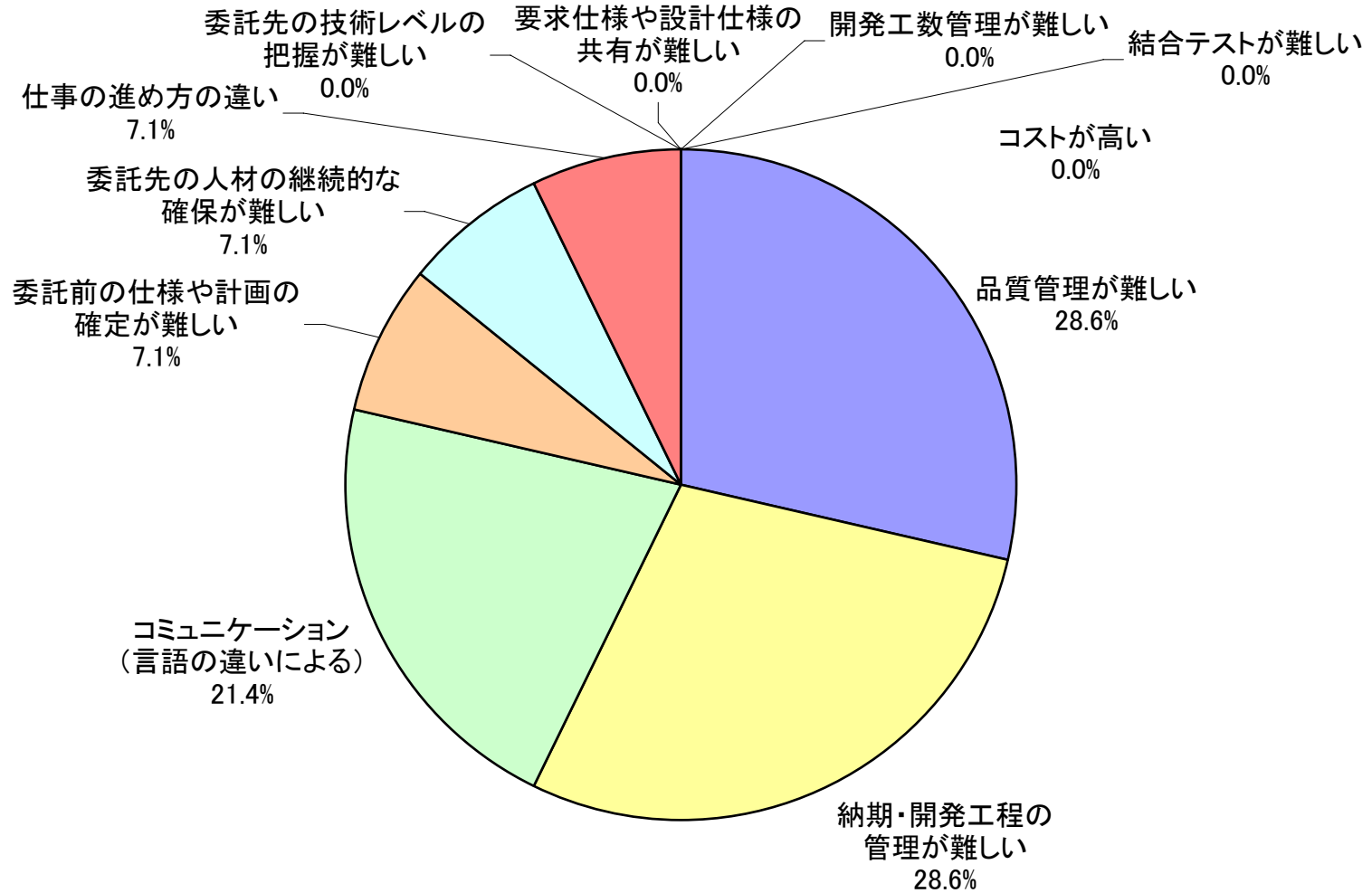


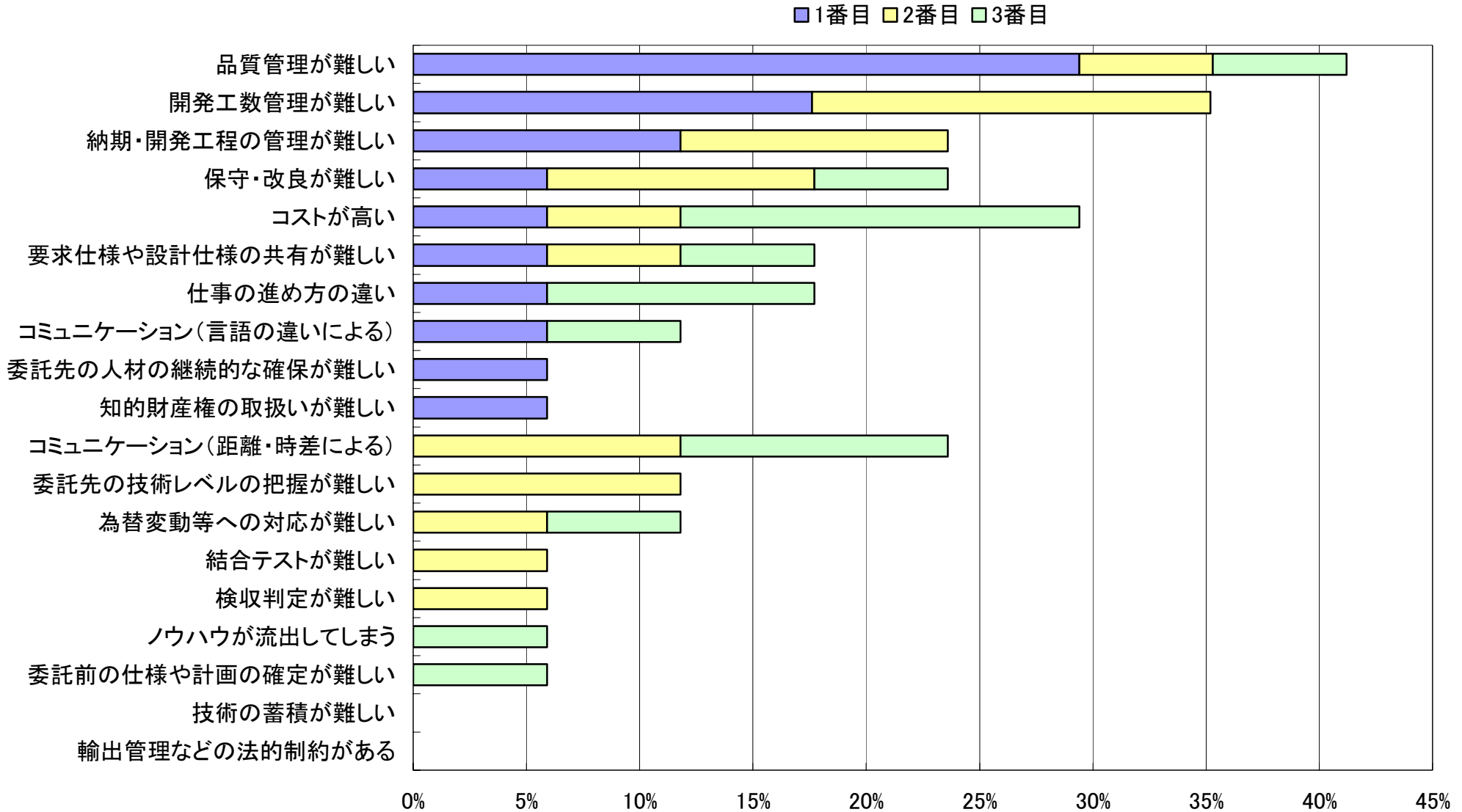


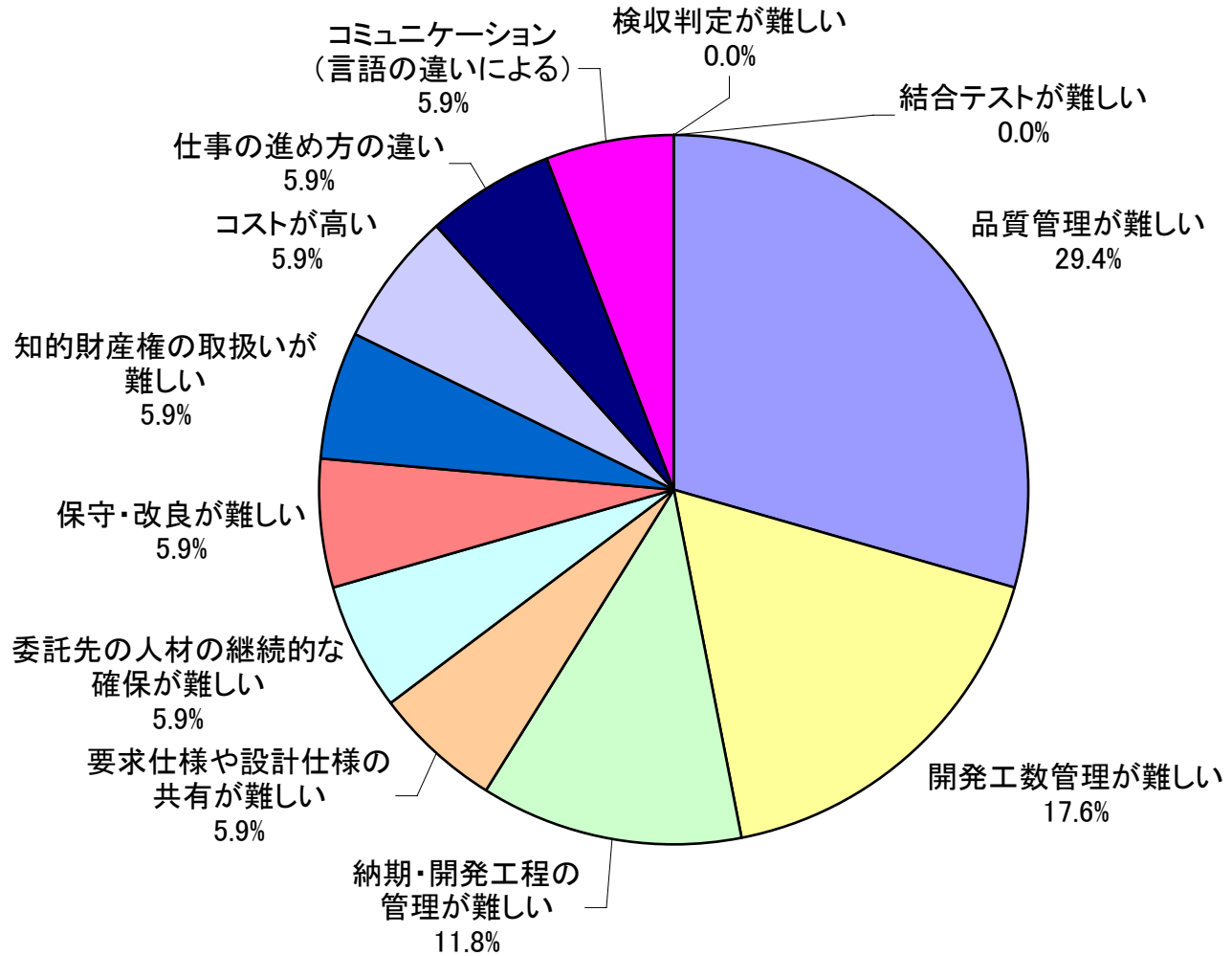




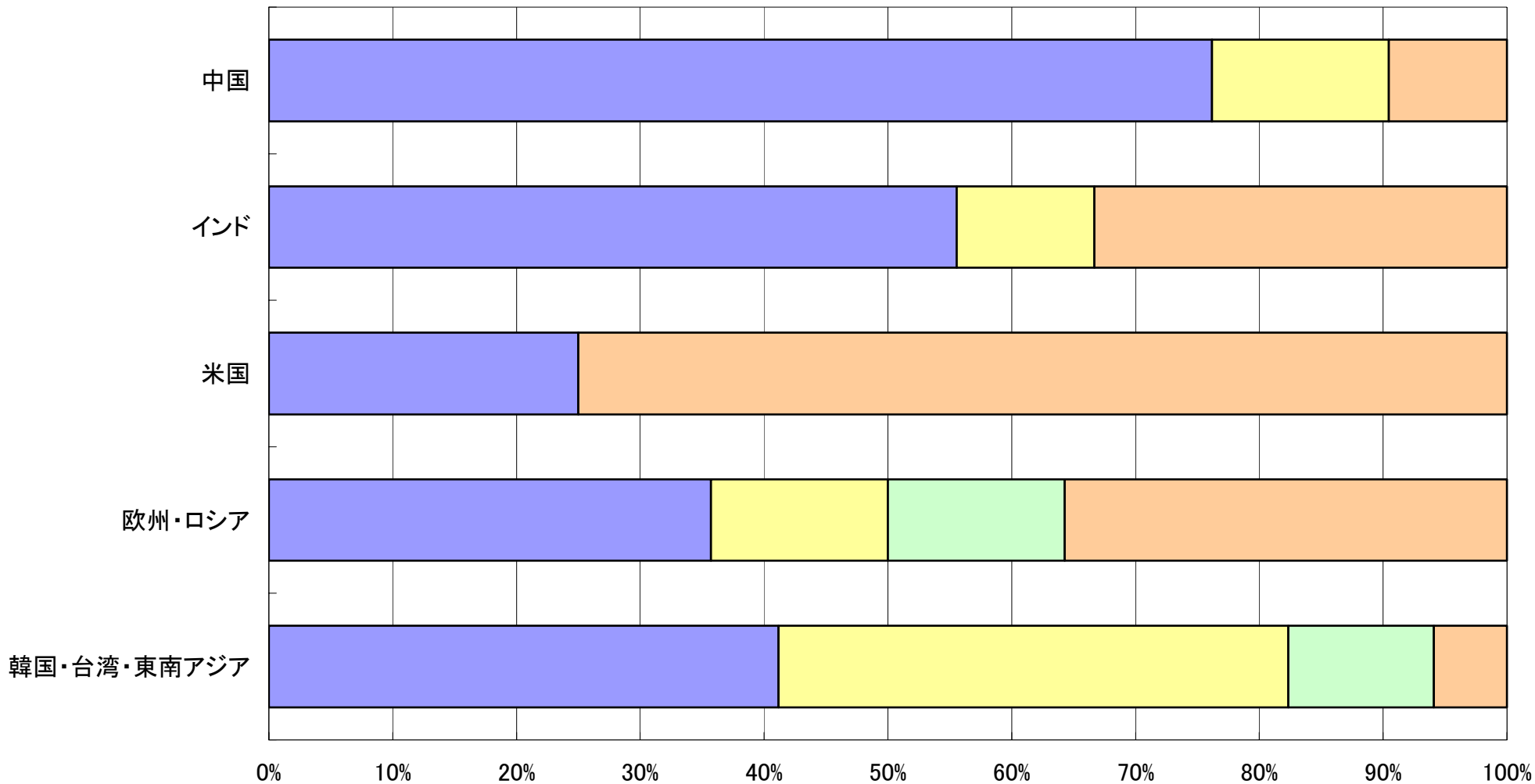




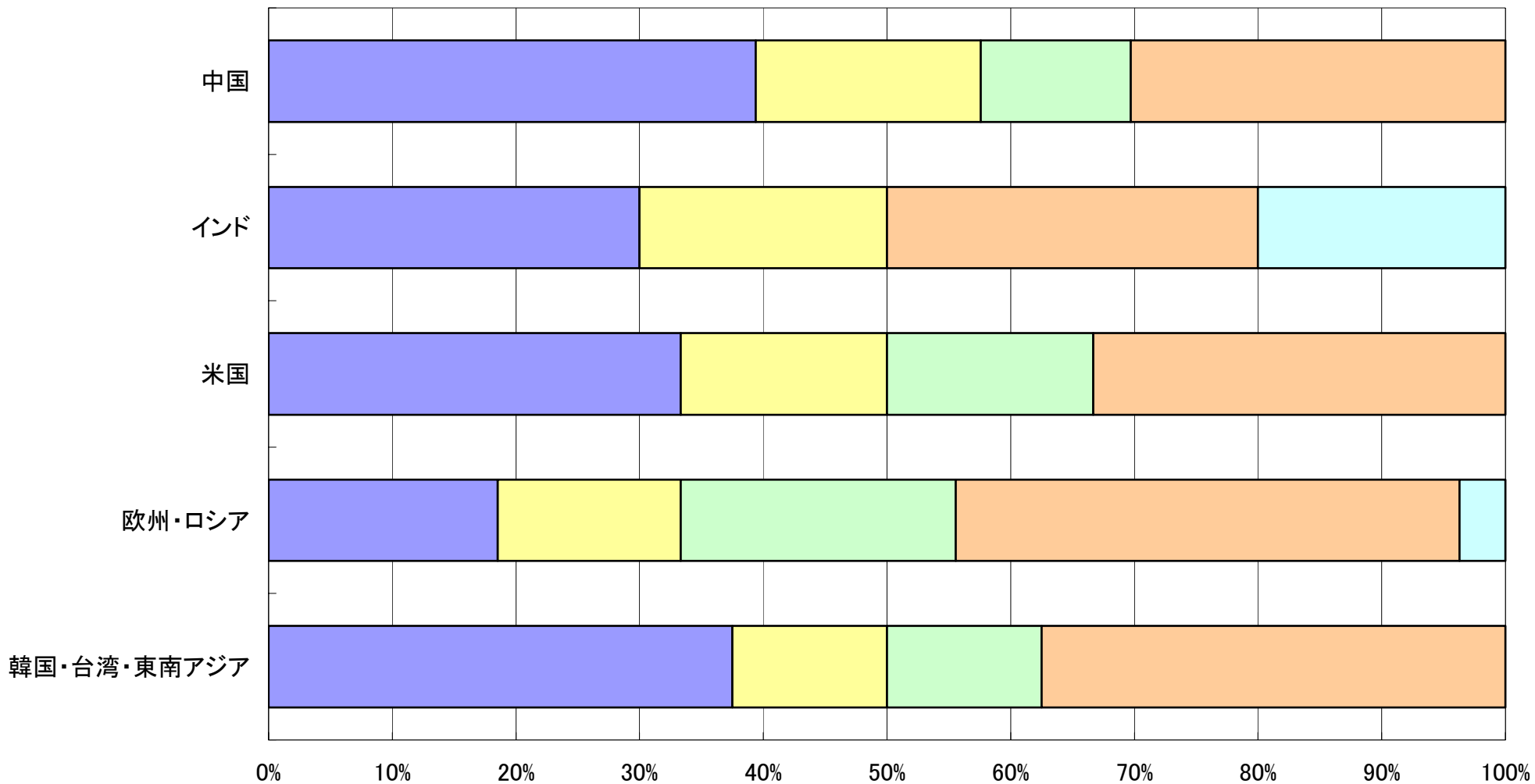




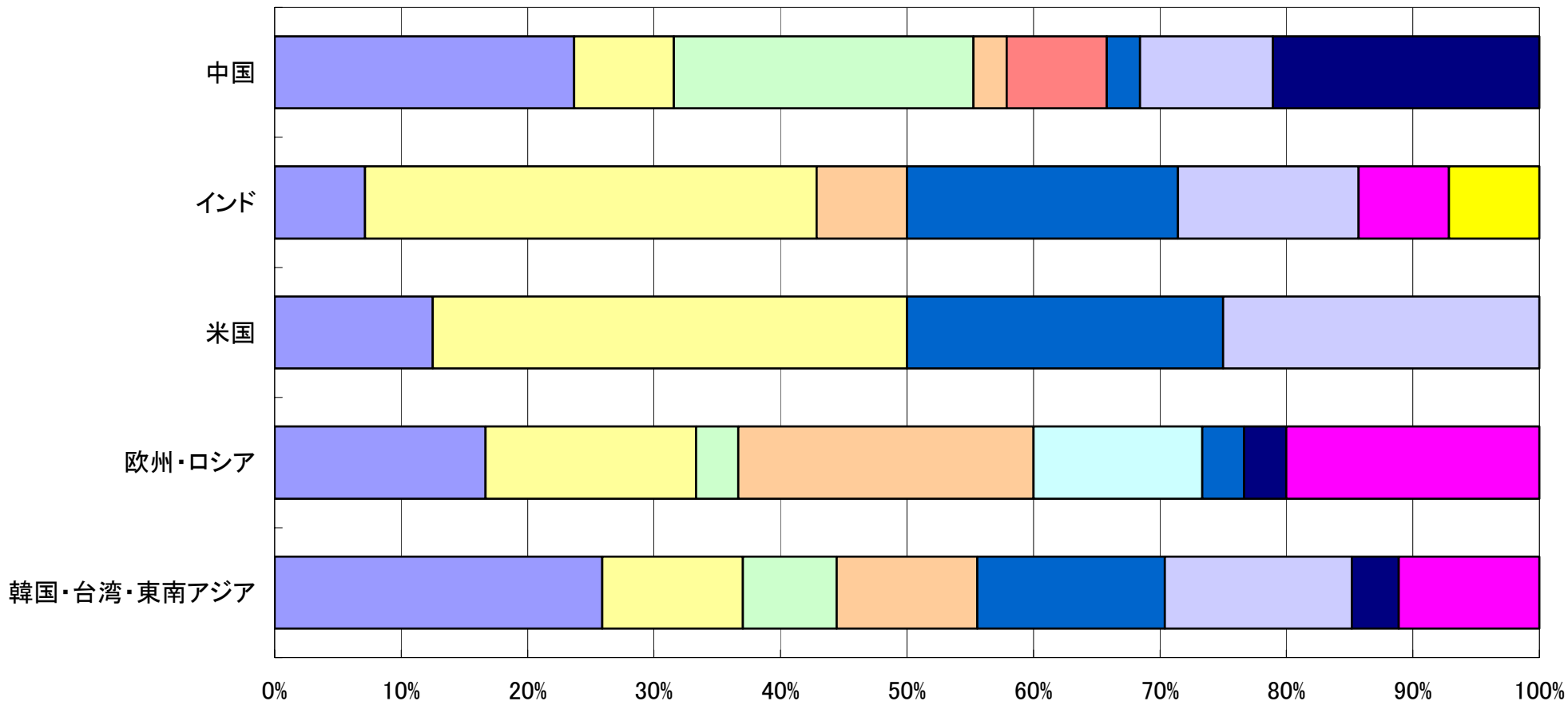
■ 技術部門 ■ 調達部門 ■ 法務部門 ■ その他



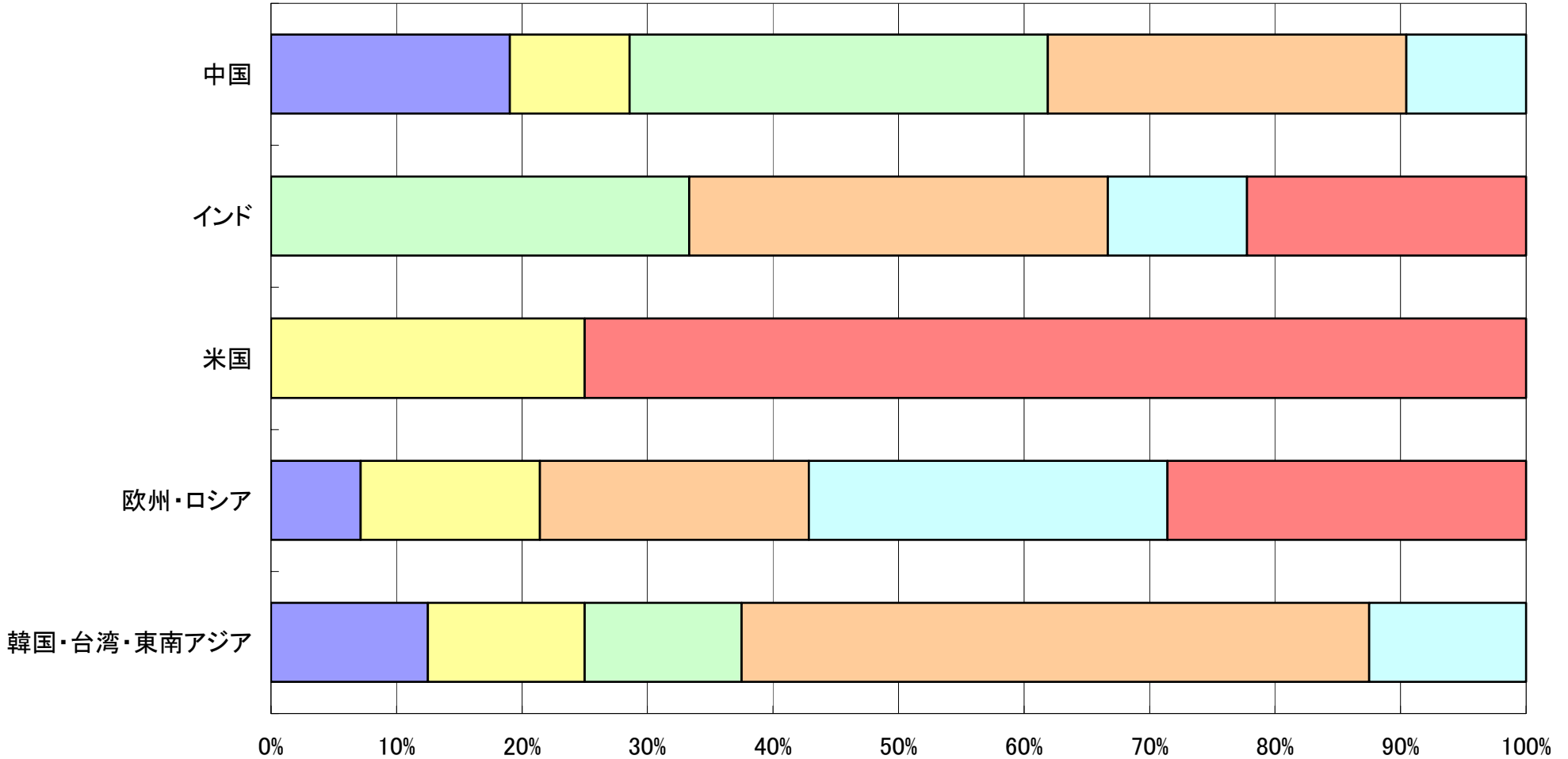
■ 一括
 ■ 期間別
 ■ 工程別
 ■ モジュール・機能別
 ■ その他



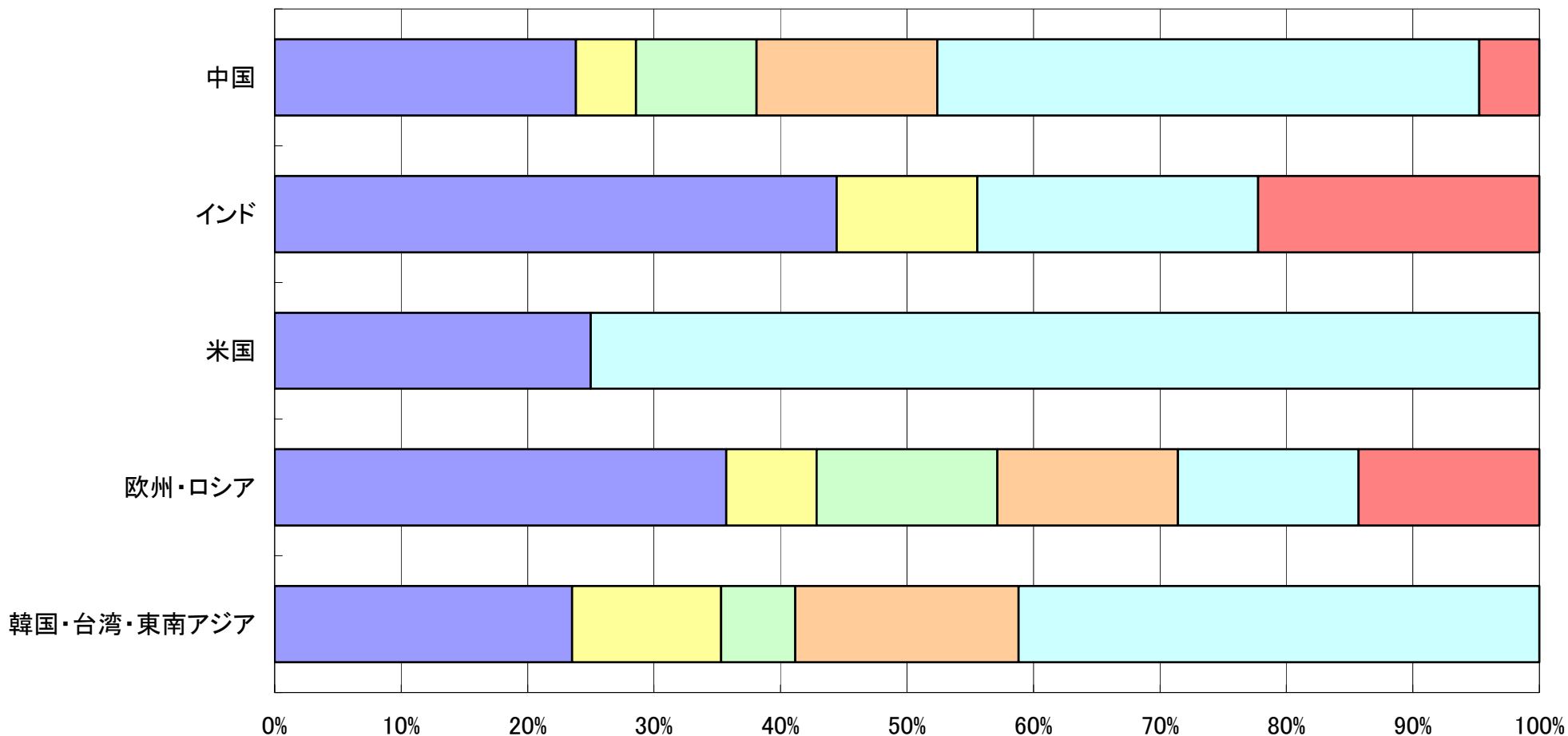
- 予算ベース
- 固定人月単価方式(工数ベース)
- 固定人月単価方式(拘束期間ベース)
- スキル別人月単価方式(工数ベース)
- スキル別人月単価方式(拘束期間ベース)
- ファンクションポイント法
- COCOMO法
- COSMIC-FFP法
- 開発行数ベース(LOC)
- 特に決まっていない
- その他



- 発注金額を上限として課している
- 一定金額を課している
- 自社の事業規模に応じて課している
- 事業損失に応じて課している
- 上限を定めず瑕疵担保を課している
- 瑕疵担保は課していない



- 全て発注者に帰属
- 外部委託先に帰属(エスクロウ契約・ラインバースメント契約あり)
- 外部委託先に帰属(エスクロウ契約・ラインバースメント契約なし)
- 共有にする
- 部分ごとに帰属先を決めている
- その他



付録：インタビュー質問票

Embedded Software
Questionnaire
4014

INTRODUCTION

RECEPTIONIST: Hello, my name is [first and last name] calling on behalf of The Ministry of Economic Trade and Industry, Japan. **IF NAME ON LIST:** May I please speak to [first and last name]? **IF NO NAME ON LIST:** May I please speak to the manager of your software development or R&D (**AS NECESSARY:** Research and Development) department? **AS NECESSARY:** We are not selling anything or headhunting — this is strictly research.

INTERVIEWER: **LIKELY JOB TITLES INCLUDE MANAGERS OF THE FOLLOWING TYPES OF ENGINEERS: SYSTEM DESIGN, SYSTEM DEVELOPMENT, SOFTWARE DESIGN, TESTING AND QUALITY MANAGEMENT ENGINEERS.**

RESPONDENT: Hello, my name is [first and last name] calling on behalf of The Ministry of Economic Trade and Industry, Japan. Today we are talking to people about embedded software, specifically software that is embedded in home appliances, automobiles, industrial equipment, etc. To thank you for your time, we will send you the key findings from this research. For quality control purposes, my supervisor might monitor this interview. **AS NECESSARY:** We are not selling anything — this is strictly research.

REFERRAL: Hello, my name is [first and last name] calling on behalf of The Ministry of Economic Trade and Industry, Japan. I've been referred to you by [name of referring person]. Today we are talking to people about embedded software, specifically software that is embedded in home appliances, automobiles, industrial equipment, etc. To thank you for your time, we will send you the key findings from this research. For quality control purposes, my supervisor might monitor this interview. **AS NECESSARY:** We are not selling anything — this is strictly research.

SCREENER

S01) Does your organization manufacture products or components that incorporate or develop embedded software? **SINGLE RESPONSE ONLY.**

Yes	1
No	2

Tally/politely discontinue

S02) Do you develop at least part of the embedded software internally? **Single response only.**

Yes	1
No	2

Tally/politely discontinue

S03) For this research, I need to speak with the person responsible for managing the embedded software development process in your organization. Would that describe you, or should I speak with someone else? **SINGLE RESPONSE ONLY.**

Describes respondent	1
Someone else more qualified	2
Nobody fits this description within the organization	3

Continue

Ask for referral

Tally/politely discontinue

ORGANIZATION QUESTIONS

Q01) ALL: Which, if any, of the following services or solutions does your organization offer?
READ LIST. ALLOW MULTIPLE RESPONSES.

Programmer; randomize 1-8, keep 9 and 10 last.

Embedded software development outsourcing services (IF NECESSARY: design services, development services such as coding, debugging, testing program generation) Programmer: logic check, respondents who say "yes" to this response must also say "yes" to Q30.	1
Embedded software development services (IF NECESSARY: human resource dispatching services, analysis services, testing, validation and authentication services, document management services, maintenance and operation services, intellectual property related)	2
Embedded system consulting services (IF NECESSARY: technology element consulting services, development technology consulting, management skill consulting, management (strategy) consulting)	3
Embedded software (IF NECESSARY: operating systems, middleware, application modules, software platform)	4
Embedded software development, environment tool development (IF NECESSARY: design and analysis tools, implementation and testing tools, management tools, hardware tools development platform)	5
Embedded software technology development (IF NECESSARY: basic technology development such as algorithm, theory construction, application technology development such as MPEG4, H.264, IPv5)	6
Embedded hardware product development (IF NECESSARY: semiconductor, boards, modules hardware platform)	7
Technical training related to embedded software development for engineers or managers (IF NECESSARY: training system and materials)	8
Other embedded software products or components	9
DO NOT READ: None of these	10

Programmer: Response choice 10 is mutually exclusive.

Q02) ALL: What types of products that incorporate embedded software does your organization develop? READ LIST. ALLOW MULTIPLE RESPONSES.

Programmer: randomize 1-14, keep 15 last.

Audio and visual equipment (IF NECESSARY: TVs, DVD recorders, video recorders, digital still cameras, video camcorders, set-top boxes and audio equipment)	1
Home appliances (IF NECESSARY: microwave ovens, air conditioners, washing machines and refrigerators)	2
Personal information tools (IF NECESSARY: PDAs, GPS and car navigation)	3
Educational or entertainment products (IF NECESSARY: game machines, electric musical instruments, electronic dictionaries and robots)	4
Computers, peripherals or office automation products (IF NECESSARY: printers, scanners, storage devices, copy machines, fax machines, POS terminals and data entry terminals for business use)	5
Industrial terminal devices (IF NECESSARY: POS)	6
Communication devices (IF NECESSARY: telephones and mobile phone terminals)	7
Communication equipment (IF NECESSARY: routers, switches, broadcasting equipment and radio equipment)	8
Transportation or construction equipment (IF NECESSARY: automobiles, motorcycles, ships, airplanes, bulldozers and tractor shovels)	9
Industrial control machines or factory automations (IF NECESSARY: plant control devices, industrial robots, printing devices and sewing machinery)	10
Consumer utility equipment (IF NECESSARY: elevators, escalators, vending machines, lighting equipment and air conditioning equipment)	11
Medical and healthcare equipment (IF NECESSARY: diagnostic and test equipment, and personal medical check devices)	12
Analyzing and measurement devices (IF NECESSARY: spectrophotometers, logic analyzers, mass analyzers and scanning electron microscopes)	13
Military and defense	14
Other embedded system development	15

PROJECT RELATED QUESTIONS

For our first set of questions, please choose a project your organization recently completed and refer only to that project as you respond.

Q03) ALL: How much did you spend for software development on the project? Your best estimate is fine. PLEASE RECORD RESPONSES IN LOCAL CURRENCY.

\$	Enter whole number
	Record currency type

Programmer: Allow DK/Refused.

Q04) ALL: How many team members were involved in this project; please specify both in-house and outsourced resources? Your best estimates are fine.

Programmer: Allow Don't know or Refused.

1.		In-house project team members
2.		Outsource project team members

Q05) ALL: I am going to read you a list of career levels. Please tell me the percentage of engineers involved in this project that best fit each job description, including in-house and outsource project members. INTERVIEWER: DO NOT READ "LEVEL". READ JOB "DESCRIPTION." RECORD PERCENTAGES. TOTAL MUST SUM TO 100%.

Level	Description	Current % of engineers
1. <i>Entry Level</i>	Can perform his or her job according to the instructions given by upper level personnel.	%
2. <i>Middle Level</i>	Can perform his or her job autonomously according to the mission.	%
3. <i>High Level</i>	In addition to the description of preceding role, can also make an analysis and improvement, as well as give instruction to subordinates.	%
Total	MUST EQUAL 100%	%

Programmer: Total must sum to 100%.

Q06) ALL: Thinking about the same project, what was the total number of lines in the source code, including comment lines, or the total of existing lines and newly developed lines? Your best estimate is fine. DO NOT READ: ALLOW DON'T KNOW.

	number of lines in source code
--	--------------------------------

Q07) ALL: And what percentage of the lines are *newly added or developed lines*, including comment lines? Your best estimate is fine.

	%	Percentage of newly added or developed
--	---	--

Q08) ALL: In the newly developed software, what percentage of the total lines of code are written in each of the following programming languages? Your best estimate is fine. Your responses must total 100%. READ LIST. RECORD PERCENTAGES. TOTAL MUST SUM TO 100%.

1.	Assembler	%
2.	C	%
3.	C++	%
4.	Java	%
5.	Other	%
	Total	100% Sum to 100%

Programmer: Total must sum to 100%.

Q09A) ALL: Roughly how many staff hours were used to complete this project? Please include in-house and outsourced resources in your total estimation.

	Staff hours used to complete
--	------------------------------

Q09B) ALL: What percentage of the total project hours were spent on project management by all team members, including in-house and outsourced resources? We define project management as time spent performing integration, time, cost, quality, organization, risk or procurement management. Your best estimate is fine.

	% of project hours on project management
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Programmer: Do not allow over 100%.

Q10) ALL: How many defects were found in the whole project process? Your best estimate is fine.

	#
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Q11) IF Q10>0: Of the total number of staff hours used for this development project, please tell me what percentage of hours were used to correct defects. Your best estimate is fine.

% Staff hours used for correcting defects (0 to 100%)

Programmer: Do not allow over 100%.

Q12) IF Q10>0: What percentage of the total number of defects could be traced back to earlier stages of the development process or life cycle in the project? For example, a problem found in the Coding stage that stemmed from an oversight in the Architectural Design phase, etc. Your best estimate is fine.

% of total defects

Programmer: Do not allow over 100%.

Q13) ALL: How would you say the project performed overall in each of the following areas? Please use a scale of one to five, where a "1" means *poor performance* and a 5 means *excellent performance*.

Programmer: Randomize list.

	Poor performance		Fair		Excellent performance	DO NOT READ: Don't know
1. Product or service function and performance	1	2	3	4	5	DK
2. Quality	1	2	3	4	5	DK
3. Budget	1	2	3	4	5	DK
4. Schedule	1	2	3	4	5	DK

GENERAL DESIGN METHOD QUESTIONS

I'd now like to ask some general questions about your approach to embedded software design projects.

Q14) ALL: What is your main method for devising a development plan document (including work-schedule) for a project? Do you refer to ...? **SINGLE RESPONSE ONLY.**

Programmer: randomize 1-5, keep 6 last.

A development plan document from the past	1
A standard development plan document created by your company	2
A standard development plan document created by your division	3
A standard development plan document commercially available	4
A development plan document you created specifically for the project	5
No documented plan	6

Q15) ALL: What is your primary method for estimating staff hours for each development process before a project begins? **READ LIST. SINGLE RESPONSE ONLY.**

Programmer: randomize 1-4, keep 5 and 6 last.

Refer to an estimate standard stipulated by your organization	1
Based on historical data	2
Based on individual experience	3
Adjusted to project conditions	4
DO NOT READ: Other	5
Do not estimate staff hours in advance	6

Q16) ALL: Does an independent reviewer perform a complete review or inspection at the completion of each activity of the development process in a project? READ LIST. SINGLE RESPONSE ONLY.

Yes, reviewer performs a <i>complete</i> inspection of <i>all</i> activities	1
Yes, reviewer performs a <i>complete</i> inspection of <i>some</i> activities	2
Yes, reviewer performs a <i>partial</i> inspection of <i>all</i> activities	3
Yes, reviewer performs a <i>partial</i> inspection of <i>some</i> activities	4
No review	5

Q17) ALL: Which modeling methods have you adopted in project development? READ LIST. ALLOW MULTIPLE RESPONSES. Programmer: randomize 1-10, keep 11 and 12 last.

UML	1
State transition diagram	2
State transition table	3
SDL	4
Petri-net	5
Flow-chart	6
Timing chart	7
DFD	8
MSC	9
Task-related de-synchronization	10
DO NOT READ: Other	11
No standard development process model used	12

Q18) ALL: Which software components, such as middleware, have you purchased or do you have licenses for? READ LIST. ALLOW MULTIPLE RESPONSES. Programmer: randomize 1-13, keep 14 and 15 last.

Communication protocol (TCP/IP)	1
Security functions	2
Language processing	3
Media compression/extension (MPEG, codec)	4
Image processing, image recognition	5
Voice recognition, synthesis	6
User interface	7
File systems	8
Mathematical library	9
OS	10
Device driver	11
Fonts	12
Application software module (Web browser, mail function)	13
DO NOT READ: Other	14
Have not purchased or do not have licenses	15

Programmer: Response choice 15 is mutually exclusive.

Q19) ALL: Which software development tools do you use? READ LIST. ALLOW MULTIPLE RESPONSES.

Programmer: randomize 1-15, keep 16 last.

Design and analysis tools	1
Source code analysis tools	2
Mathematical analysis tools	3
Static code check tools	4
Compiler/debugger tools	5
Integrated development environment tools	6
Software configuration management tools	7
Testing tools	8
Verification tools	9
Project management tools	10
Quality management tools	11
Document management tools	12
Evaluation boards	13
In-circuit emulator tool	14
Analyzer or measurement tools	15
Do not use these types of software tools	16

Programmer: Response choice 16 is mutually exclusive.

PRODUCT PROBLEMS AND BUSINESS RELATED QUESTIONS

Q20A) How many product problems, not including production quality problems, did you experience after a product delivery? By "products" we mean end products, including components, in which embedded software is incorporated. Your best estimate is fine.

Q20B) IF Q20A>0: Of the total number of product problems you experienced after product delivery, what percentage was caused by each of the following: READ LIST. IF RESPONDENT SAYS NO QUALITY PROBLEMS WERE EXPERIENCED, RECORD 100% FOR OPTION 7. TOTAL MUST SUM TO 100%.

1.	Improper specification of a product		%
2.	Software problems		%
3.	Hardware problems		%
4.	Production problems		%
5.	Operation and maintenance problems		%
6.	Other		%
7.	DO NOT READ: No quality problems experienced after the product delivery		
MUST SUM TO 100%		100	%

Programmer: Response choice 7 is mutually exclusive. Total must sum to 100%.

Q21) IF Q20A>0: And what percentage of product quality problems resulted in each of the following? Your best estimate is fine. READ LIST.

1.	Death of users		%
2.	Severe damage to users		%
3.	Minor damage to users		%
4.	Environmental pollution		%
5.	Significant financial loss to users		%
6.	Minor financial loss to users		%
7.	DO NOT READ: Too difficult to quantify.		

Programmer: Response choice 7 is mutually exclusive.

Q22) ALL: I am going to read you a list of issues that your organization may face when developing embedded software. Please rank the top 3 items in order of importance with a "1" being the highest priority, a "2" being the second priority, and a "3" being the third priority. READ LIST. PLEASE RANK 3 OPTIONS ONLY.

Programmer: randomize 1-10, keep 11 last.

	Rank
1. Improving design quality	
2. Reducing development cost	
3. Shortening development time	
4. Increasing production efficiency	
5. Increasing development capability (quantity)	
6. Securing product safety	
7. Developing new technology	
8. Developing new products	
9. Expanding market	
10. Improving product quality	
11. Other	

Q23) ALL: Now I am going to read you a list of measures that your organization may take to address the issues I just mentioned. Please rank the top 3 measures in order of effectiveness with a "1" being the most effective, a "2" being the second most effective, and a "3" being the third most effective. READ LIST. PLEASE RANK 3 OPTIONS ONLY.

Programmer: randomize 1-11, keep 12 last.

	Rank
1. Ensuring the appropriate number of <i>project managers</i> are retained or hired	
2. Improving skills of <i>project managers</i>	
3. Ensuring the appropriate number of <i>engineers</i> are retained or hired	
4. Improving skills of <i>engineers</i>	
5. Improving <i>development methodologies</i> and/or development technology	
6. Improving <i>management methodologies</i> and/or management technology	
7. Introducing and/or developing new technology	
8. Preparing and/or improving development environment	
9. Retaining (an) outsourcing service provider(s) and/or improving current provider's abilities	
10. Reducing and/or optimizing the number of developing products and/or development quantity	
11. Understanding executive and/or investor needs	
12. Other	

Q24) ALL: Does your company *utilize* or *provide* outsourcing services related to embedded software development? **SINGLE RESPONSE ONLY.**

1.	Utilize	1
2.	Provide	2
3.	Both	3
4.	Neither utilize or provide outsourcing services	4

Programmer: If Q24 =4, Skip to "Close".

UTILIZING OR PROVIDING OUTSOURCING SERVICES RELATED TO EMBEDDED SW DEV.

Q25) IF Q24=1, 2 OR 3, ASK: To which regions do you have embedded software development outsourcing partnerships? **READ LIST. ALLOW MULTIPLE RESPONSES.**

U.S.	1
England	2
France	3
Germany	4
Denmark	5
Sweden	6
Norway	7
Finland	8
Poland	9
Czech Republic	10
Russia	11
India	12
China	13
Japan	14
Taiwan	15
Korea	16
Thailand	17
Malaysia	18
Singapore	19
An other region	20

Q26) IF Q24=1, 2 OR 3, ASK: Now, I will read you a list of possible reasons for having an embedded software development outsourcing partnership. Please rank the top 3 reasons in order of importance with a "1" being the most important reason, a "2" being the second most important, and a "3" being the third most important. **READ LIST. PLEASE RANK 3 OPTIONS ONLY. Programmer: Randomize all.**

	Rank	
1.	To compensate for lack of technology	
2.	To shorten the development schedule	
3.	To save development cost	
4.	To compensate for lack of resources	
5.	To manage fluctuation of workload	
6.	An affiliated company requires business connections with an affiliated embedded software development organization	
7.	Determined by contract or agreement, or master level agreement	
8.	Outsourcing service users are focusing on core technologies or using internal resources	
9.	OEM or upper stream outsourcer requires outsourcing	
10.	Market is close to outsourcing service provider's location	
11.	Outsourcing provider owns a high level of technologies or expertise	
12.	To improve the efficiency of operation, maintenance and support	

Q27) IF Q24=1, 2 OR 3, ASK: I will read criteria you might evaluate when considering an outsource partnership for embedded software development. Please rate the top 3 most important criteria, with a "1" being the most important, a "2" being the second most important, and a "3" being the third most important. **READ LIST. PLEASE RANK 3 OPTIONS ONLY.**

Programmer: Randomize 1-18, keep 19 and 20 last.

	Rank	
1.	Cost/Price	
2.	Number of engineers	
3.	Technology level	
4.	Skills of engineers	
5.	Skills of managers	
6.	Flexibility for responding to work load fluctuation	
7.	Flexibility for accepting various ways of outsourcing (dispatching engineers, contract as a defined scope, etc)	
8.	Good maintenance and support	
9.	Close to development locations	
10.	Close to market where products are sold	
11.	Past record of business with outsourcer	
12.	Capital relation	
13.	Past achievement in relevant area of development	
14.	Reliability and stability	
15.	Conditions for handling intellectual property rights	
16.	Determined by upper level contract or similar	
17.	Prefer domestic companies	
18.	Can communicate in native language	
19.	Other	
20.	DO NOT READ: Criteria not specifically determined.	

Programmer: Response option 20 is exclusive.

Q28) IF Q24=1, 2 OR 3, ASK: Now I will read possible difficulties regarding outsourcing partnerships for embedded software development. Please rate the top 3 most difficult, with a "1" being the most difficult, a "2" being the second most difficult, and a "3" being the third most difficult. READ LIST. PLEASE RANK 3 OPTIONS ONLY.

Programmer: Randomize list.

	Rank
1. Quality control	
2. Managing staff hours	
3. Managing development process and delivery date	
4. Sharing information about requirement specification or design specification	
5. Determining specifications and schedules	
6. Coordination of joint test process	
7. Accepting or rejecting the work of your partner	
8. Securing engineering resources	
9. Evaluating the technology level of your partner	
10. Difficult to maintain and upgrade the product after delivery	
11. Difficult to handle intellectual property	
12. Difficult to improve the technology level	
13. Concern about leakage of technologies or know-how	
14. Unbalance cost/performance	
15. Responding to fluctuation in exchange rate	
16. Legal constraint such as export trade control	
17. Difference in work approach (style or organization difference)	
18. Communication barrier due to distance, or time difference	
19. Communication barrier due to language difference	

Q29) IF Q24=1, 2 OR 3, ASK: Which department makes a decision on the contract price? Technical, procurement or legal? SINGLE RESPONSE ONLY.

Technical department	1
Procurement department	2
Legal department	3
DO NOT READ: Other, specify	97

Q30) IF Q24=1, 2 OR 3, ASK: In what manner do you place or receive an order? READ LIST. MULTIPLE RESPONSES ALLOWED.

As a whole project	1
Term based	2
Process based	3
Module based or function based	4
DO NOT READ: Other, specify	97

Q31) IF Q24=1, 2 OR 3, ASK: How do you estimate the price of each order? READ LIST. MULTIPLE RESPONSES ALLOWED.

Based on the prepared budget	1
Net Man hour based, which only include actual working hours	2
Gross Man hour based, which include every hour on duty	3
Net Man hour based, which only include actual working hour by skill	4
Gross Man hour based, which include every hour in duty by skill	5
Function point method	6
COCOMO Method	7
Cosmic FFP method	8
Based on the number of lines developed	9
DO NOT READ: Other, specify	97
Case by case	10

Programmer: Option 10 is mutually exclusive.

Function point method: A method for deriving a development cost based on the number of functions and the number of input/output, and its degree of complexity

COCOMO: A method for deriving a development cost from the number of lines with cost factor model (Object to be developed, platform, Skills and so on).

OSMIC-FFP Model: A one type of function point method extended to embedded software development

Q32) IF Q24=1, 2 OR 3, ASK: How do you primarily include guarantees against defects in a contract? READ LIST. SINGLE RESPONSE ONLY.

Set the upper limit on the contract amount	1
Impose a fixed amount	2
Determine an amount based on company's business size	3
Impose an amount based on loss or damage	4
Set no limitation	5
Not imposing a guarantee	97

Q33) IF Q24=1, 2 OR 3, ASK: How do you deal with intellectual property issues? READ LIST. SINGLE REPOSE ONLY.

All is owned by outsourcer	1
All is owned by outsourcee with Escrow clause or reimbursement contract	2
All is owned by outsourcee without Escrow clause or reimbursement contract	3
Co-owned, equal parts	4
Co-owned, unequal parts	5
Other, specify	97

CLOSE

ALL: We very much appreciate your help with our research. In the future, we will occasionally be contacting some of our research participants to ask them questions about embedded software development. Would you be willing to participate in our future research? **SINGLE RESPONSE ONLY.**

Yes	1	Continue
No	2	Politely end call

IF YES: To help us reach you again at a convenient time, what is generally the best time of day to call?

:	a.m.	1
:	p.m.	2

ALL: To verify that I have spoken with someone at this number, please verify your name. RECORD.

ALL: And your correct phone number, beginning with the area code, is ... ? READ NUMBER BACK TO RESPONDENT FOR VERIFICATION.

Phone (include area code)	
Time zone	

ALL: May I have your Internet e-mail address? (Not your internal e-mail address, but an address where you may be reached via the Internet or another online service.) **SINGLE RESPONSE ONLY.**

Yes	1	
No	2	

ALL: I have enjoyed this interview. Thanks again for sharing this information.

2009年版 組込みソフトウェア産業実態調査報告書 — 海外調査 —

発行日 2009年7月初版発行
発行 ©経済産業省 商務情報政策局 情報処理振興課
監修 組込みソフトウェア開発力強化推進委員会

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