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Part 1: Teamwork scenarios (circle (A), (B) or (C) and explain)

Question 1 (on team size): Assume that some developers should do a specific IT-related task for a customer – there is a customer representative available at all times who defines the work items and answers questions. How to assign people to get the task completed efficiently and predictably?

- (A) Software developer teams of 3-8 people are usually optimal.
- (B) Team size is determined by the urgency of the project and resources available.
- (C) Ideally a team should be 2 or 4 people to work in pairs and to do code inspections.

Analysis: Answer (A) is correct for most teams doing some IT-related task.

Answer (C) would indicate strong emphasis on a few specific development approaches (such as XP – Extreme Programming that uses pair programming). Answer (B) is generally wrong – large projects may indeed require many participants, but they are not all part of the same team.

Question 2 (on cross-functional work). IT projects rely on different skills; what is the best way to ensure that your team has sufficient skills for the assigned tasks:

- (A) Each team member should prepare to cover several roles in a project.
- (B) The development team should collaborate with other development teams.
- (C) Development team should have the set of skills necessary for the current development cycle.

Analysis: Answer (C) expresses the essence of the teamwork (single team should possess all the necessary skills).

Answer (A) may be true in some cases, when people learn new skills to be able to replace somebody else. Answer (B) is a misconception – nobody should expect that core tasks for their team will be solved by somebody else. (We do not exclude collaboration and some resource sharing, but the idea for an IT team is to be self-sufficient in some basic sense.)

Question 3 (on backlog). Most projects maintain a “backlog” - a prioritized TODO-list of work items that have to be planned and delivered. What is the main criterion to order the items in the backlog?

- (A) The value of the items being delivered
- (B) The relative size and complexity of the items being delivered
- (C) The risk associated with the items

Analysis: Answer (A) is correct for most IT projects. IT projects strongly rely on ordering items based on their “business value” (which can mean different things for different organizations).

Value may cause increased profit or larger market share, or better efficiency, or happier customers, or have positive effect on our future growth.

Answer (B) is useful in some other contexts (as in “operations research” - we first do the fastest jobs, serve the easiest cases to reduce the overall waiting time. Answer (C) makes sense, if you know in advance that all work items need to be completed – in this case you start from the riskiest. But in IT risks are not as easy to estimate.

Question 4 (on iterations). Most large software projects are done as a sequence of short (2-3 week) iterations or “sprints”. Which of the following is delivered at the end of a typical project iteration?

- (A) A functional design document and user manual update.
- (B) An architectural design of the solution.
- (C) An increment of software that was done.

Analysis: Answer (C) is correct. Whenever you submit your portion of work, you need an increment of software, a product version that is better for the customer or end-user. Architectural design (answer (B)), functional design or user manuals (answer (A)) may be important for some iterations, but they are not as universal.

Question 5 (on exit conditions). Assume that a team is currently working on an iteration. Under what circumstances the iteration can be canceled?

- (A) When the project backlog sets radically different priorities.
- (B) When the developers cannot continue, because the required information is missing.
- (C) When a customer representative says so.

Analysis: Answer (C) is correct – IT project cannot proceed without at least some level of customer involvement and commitment. Answer (A) is wrong – even if priorities change suddenly, the current iteration should be completed to leave the product in a consistent state. Answer (B) is also wrong – until customer (or generally “project owner” - which could be also our own manager for internal projects) drops the project, we should not give up collecting information.

Question 6 (on iterative approach). In order to try iterative project management (submitting work in short cycles), which kind of project looks most accommodating for this:

- (A) Building a residential house using the newest energy-efficient technologies.
- (B) Math education experts creating series of math assessments and multiple-choice exams to include the newly approved curriculum of high-school education.
- (C) Developing a solution for a government institution where the project phases, costs and decisions should be approved by a committee of officials.

Analysis: Answer (A) is the best use-case for iterative project. It is a project that involves lots of uncertainty (newest technologies of whatever), building houses in such context is not that different from building software, if we care about the project management principles. Answer (B) is a use-case for a waterfall or something similar – uncertainty is not high; math education experts probably know how to create multiple-choice exams for a new skillset. Answer (C) is also not very conducive for iterative project management, since “committee of officials” signals that it is difficult to get approvals and make important decisions in the middle of the development.

Question 7 (on SMART goals). In order to try SMART guidelines (all goals should be Specific, Measurable, Attainable, Relevant, Time-bound), which type of project best matches this:

- (A) Developers starting work in a totally new programming language that they still have to learn.
- (B) A call center receiving customer calls about an accounting software and consulting users.
- (C) A group of aides helping British PM Boris Johnson to implement Brexit until October 31.

Analysis: Answer (C) is the best use-case. By default it is a chaotic situation, where SMART guidelines can introduce some order.

While SMART goals may be applied in most situations, answer (A) – starting a new programming language – is a difficult case, since it is very difficult to do time estimates and predict what are the structured goals that SMART requires. Answer (B) is not a good use-case either, because customer calls make a fast and unpredictable pipeline, you cannot plan much in advance. Issue management tools (to plan massive amounts of open issues) such as Kanban boards work best in these cases.

Question 8 (on knowing statuses). Assume that a team has some introvert members and others do not always understand what they are doing for the project. Any remedies?

- (A) Team members should get together and agree who is responsible for what.
- (B) Team members should send out their statuses regularly and others should read that.
- (C) Team should look for a coach and do some team-building exercises.

Analysis: Answer (B) is most typical to solve these cases – this gives visibility for all the team members at all times (in Agile/Scrum methodologies very similar status reporting is done by everyone during daily Standup meetings – where people stand up to discourage very long speaking). Answer (A) may have some merit (it is indeed necessary to agree on the tasks), but it does little to understand the introvert team members and you cannot hold meetings to remind about the responsibilities every day. Answer (C) relies on some external miracle-workers, but team should organize their own resources first.

Question 9: Please list which communication channels you prefer to work in a team. Please specify the tool, if any, if you have particular experience with that.

- (A) Sending emails and uploading documents to some shared file folders (such as Sharepoint, Google docs, version control such as Git, etc.).
- (B) Using chat-based applications such as Messenger, WhatsApp, Skype chat.
- (C) Using live desktop sharing and phone calls such as Skype desktop sharing, Adobe Connect, WebEx.

Analysis: Team needs to have some approach to communicate remotely, because it is not practical to do all work while everyone is in the same room. Therefore some tools are necessary, but the choice of a tool depends on the goal we want to achieve. There is no one “right answer”. Some considerations:

Option (A) allows to communicate complex matters – emails preserve longer conversation threads, attached documents. They are not very intrusive, people can answer emails whenever they have free time. On the other hand, relying on email/version control alone requires disciplined workers and predictable environment.

Option (B) and also phone conferences represent much “hotter” way to communicate – it allows to resolve matters immediately. It may also waste lots of time, if used incorrectly. For example, if people start sending WhatsApp messages (or other broadcast-type messages) to large audiences, who cannot take any action on this. To inform other people, email usually works best. Chats are not appropriate to communicate lots of information – they work best for very short remarks.

Option (C) combines the complexity and speed – you can . On the other hand, it requires some technical infrastructure (free version of Skype might have bad quality). Using solutions like Adobe Connect, WebEx, Microsoft Zoom, GoToMeeting/GoToTraining and their virtual meeting rooms may lead to subscription fees.

Part 2: Math appreciation (perform the tasks)

Question 10: The table shows GDP per capita (Purchasing power parity, PPP) for some large economies – it expresses all the goods and services produced in that country (in US dollars) divided by its total population.

Country	Their per capita GDP in 2016	GDP growth during 2017
China	15500	6.90%
United States	58000	2.27%
India	6600	6.62%
Japan	41000	1.71%

Order the countries by their GDP growth during 2017:

- (1) _____ (fastest growing, largest increase of the GDP)
- (2) _____
- (3) _____
- (4) _____ (slowest growing)

Analysis: This question asks you to be careful about the units of measurement. GDP per capita is **measured in US dollars** (it was mentioned in the question itself); it is not measured in percentages. If we multiply the base value (year 2016) with the percentages, we get these GDP increases:
 China: $15500 \times 0.0690 = 1069.5$ USD (this is the amount by which an average Chinese got richer during 2017 compared to the previous year); United States: 1316.6 USD, India: 436.92 USD, Japan: 701.1 USD. So, if we order in decreasing order:

- (1) United States: during 2017 one person there got richer on average by **1316.6 USD**
- (2) China: **1069.5 USD**
- (3) Japan: **701.1 USD**

(4) India: 436.92 USD.

This means that India (regardless of the impressive 6.62% growth) is currently falling behind; the GDP (and, perhaps, also income) gap between an average Indian and an average American, Chinese and Japanese is likely to increase. Just because the value of goods and services is measured in dollars, but not percentages.

Question 11: At the beginning of the school year 70% from all the students could pass a certification exam in Chinese. After one month of studying 77% from all the students could pass that same exam. By what percent did the number of Chinese-certified students grow?

Analysis: If there are 100 students in a school, then initially just 70 of them were certified; later 77 were certified. This means growth by 7 students from the initial value of 70 students. The growth is by $1/10$ or by 10%.

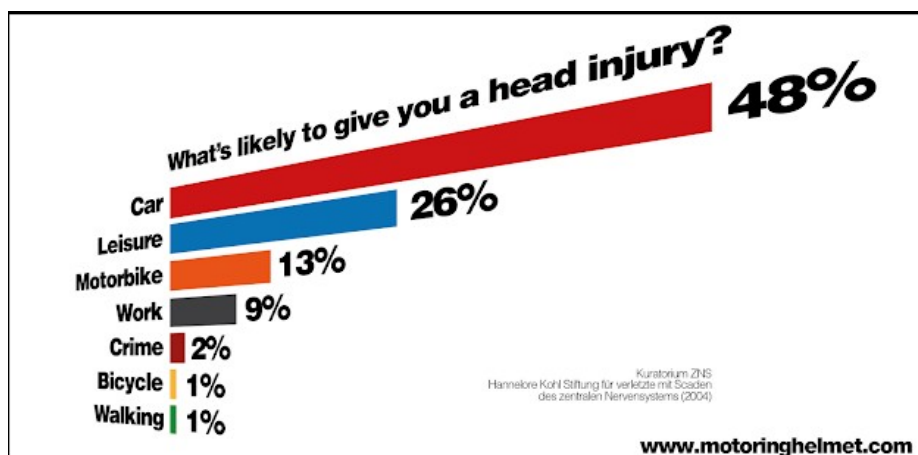
It would be wrong to tell that the growth is $77\% - 70\% = 7\%$, because the growth is always relative to the initial value. This is also the difference between **percentages** and **percentage points**. In this situation a growth by 7 percentage points means the same as growth by one tenth or 10%.

Question 12: Originally, in a forest 99% of the trees were pines and 1% of all the trees were birches. After that some pines were cut down, and now 98% of all the trees are pines and 2% are birches. What percentage from all the trees in the forest were cut down?

Analysis: Since the number of birches did not change, their number was initially 1%, later 2%.

This means that the total number of trees decreased exactly two times. This means that exactly one half (or 50%) of all the trees were cut down. For example, if initially there were 99 pines and 1 birch (exactly $1/100$ or 1% of the trees are birches), then after 50 pines are cut off, there are just 49 pines and 1 birch (it is now $1/50$ or 2% of all the trees).

Question 13: Would this chart convince you to wear a helmet when driving a car? Explain your reasoning. (Data about the head injury causes from a German foundation “Hannelore Kohl Stiftung für Verletzte mit Schäden des Zentralen Nervensystems”).



Analysis: The intriguing part about this picture is that bicycles account just for 1% of all the head injuries, but cars account for 48% of all the head injuries. Still, bicycle helmets are mandatory in some countries, but car helmets are virtually unheard of.

Still, the seemingly obvious recommendation to wear helmets in a car is also problematic for

various reasons.

(A) Data is from 2004 (very small print on the diagram), so the data may be old,

(B) Car driving in 2004 was much more common than bicycle riding; so we should speak not of absolute numbers, but of **conditional probabilities**: If we assume that you spent 1hr driving a car, is your chance to be injured higher than the chance for somebody who spent 1hr riding a bicycle?

(C) The diagram does not tell who was injured by a car – the driver, the passengers or, perhaps, pedestrians hit by a car.

(D) Cars are not designed to accommodate people wearing helmets, helmets may actually increase risks (reduced visibility, people getting tired).

(E) Nobody wants to wear helmets, and you could hope to start a car-helmet business, only if there are friendly politicians who decide that this should be mandatory.

(F) Bicycle helmets are not very helpful either; the largest lobby for them is car industry – to enforce an opinion that riding a bicycle is an inherently dangerous activity.

All this reasoning was present in some of your comments – it was very helpful!

Question 14: In Google search bar you can write Boolean expressions (word1 OR word2), quotations – possibly with some words omitted ("we hold these truths" or even "we hold * self evident"), avoid some terms (real estate -sale) search particular Web domains (e.g. site:bbc.co.uk) or filetypes (some topic filetype:docx)

(1) Write Google search that would find phrase "mellow fruitfulness" (but would avoid the poem "Autumn" by John Keats).

Google query: "mellow fruitfulness" -Keats

(2) Write Google search that finds some PowerPoint presentations on Agile or Scrum project management.

Google query: (Agile OR Scrum) project management filetype:ppt OR filetype:pptx

(3) Write Google search that finds Latvian Websites that mention *Betula Pendula* (ordinary birch tree):

Google query: "Betula Pendula" site:lv

Note that there may be several other options how to write Google queries to find the things specified.

Question 15: In statistics there are two ways to summarize a set of n numbers – arithmetic mean (you sum all numbers and divide by n) and median (a middle number that has half of the numbers above it and another half below it). Circle, which would be the most informative summarization regarding the students (grades 10-12) in Bauska (circle "mean" or "median" in each row):

(1) **Height in centimeters:** mean / median

(2) **Household income in EUR:** mean / median

(3) **Average score in history exam:** mean / median

Analysis: Answers are (1) Mean, (2) Median, (3) Mean.

Height in centimeters comes from a normal distribution, arithmetic mean is typically used to analyze it (and it does not differ much from the median). Household incomes are very unevenly distributed (so the arithmetic mean could change a lot, if there is some super-rich household).

History exam depends on a sum of many little numbers, so it will also be roughly normal-distributed. Nobody can get more than 100% score in this exam; therefore arithmetic mean is the

simplest choice. Therefore media often speak of “average height” and “average exam score”, but “median income”.

Part 3: General ideas about the course (please answer the questions)

Question 16: Some people claim that large student teams (more than 3 people per team) may lead to very uneven involvement – only some people do all the relevant work. Do you agree? Is there a way to remedy this?

Analysis: Different remedies were suggested – most sound very good; they usually mean better communication (having meetings, setting clear goals, reporting statuses), and also better commitment (enthusiastic and motivated team members).

Question 17: What is your level of interest in learning and practicing the following skills (relative to other goals in this study year)? Circle one answer in each row of the table:

(A) Software project process and tracking the progress, taking remedial steps.	Low	Below average	Medium	High	Very high
(B) Developing content (websites, multimedia, user guides and training)	Low	Below average	Medium	High	Very high
(C) Developing software (databases, user interfaces and the business logic)	Low	Below average	Medium	High	Very high
(D) Interacting with customers and users, refining the requirements.	Low	Below average	Medium	High	Very high
(E) Testing the solution, reviewing documents, creating errata lists (things to fix).	Low	Below average	Medium	High	Very high

Analysis: The response statistics (1 = Low, 5 = Very High)

- (A), controlling software engineering process: 3.05 (BITL - 3.57, BBA - 2.78)
- (B), content development: 3.82 (BITL - 4.10, BBA - 3.68)
- (C), programming: 3.25 (BITL - 4.05, BBA - 2.83)
- (D), customers and functional design: 3.00 (BITL - 2.71, BBA - 3.15)
- (E), testing: 3.23 (BITL - 3.33, BBA - 3.18)

Question 18: Have you previous experience with any of the following tasks? Circle one answer in each row of the table.

(A) Writing small software programs	No prior exposure	Can do with assistance	Can do this task	Can help others
(B) Writing HTML and other web documents	No prior exposure	Can do with assistance	Can do this task	Can help others
(C) Collective editing of the same document at the same time, tracking versions of your files.	No prior exposure	Can do with assistance	Can do this task	Can help others

(D) Working remotely (e.g. from home) for any kind of team project.	No prior exposure	Can do with assistance	Can do this task	Can help others
(E) Assisting over the phone (e.g. consulting a relative on how to use some office software).	No prior exposure	Can do with assistance	Can do this task	Can help others

Analysis: Answer statistics (totals) are given below:

Skill levels: **None** - no exposure, **Low** - can do this task with assistance, **Medium** - can do this task, **High** - can assist others.

Skill	None	Limited	Medium	High
Write software	36	17	5	3
Write HTML	21	28	7	5
Edit documents collectively	9	22	23	7
Work remotely	3	6	43	9
Explain an IT task over a phone	11	13	24	13

Question 19: Decision making in a large team may sometimes be tricky. There are different “business cultures” how to ensure that all people are in sync and are working for the same goal. Which method best reflects your preferences? Please explain your answer.

(A) A team needs a manager who is responsible for most external communication and ensures that everyone is involved and nobody is stuck.

(B) A team needs a to meet and to discuss things so that decisions can be reached by consensus.

(C) A team should create several specific assignments and each assignment should have somebody responsible who can delegate to others.

Analysis: These were the response statistics (others were combinations or variants):

- A, leader/manager: 15 responses
- B, consensus: 18 responses
- C, small projects with delegation: 22 responses

(Decision-making may depend on the preferences of the team and the task they have to do; so the question is not specific enough to decide.)

Question 20: If you need to learn a new technical skill (such as fancy editing your photos etc.), which way of receiving that information works best for you. Please comment your answer.

(A) You prefer having a live training, where somebody shows and explains this to you.

(B) You prefer a video-based training, where the relevant steps are recorded and can be replayed, in case you missed something.

(C) You prefer a written document that explains all the options you have.

Analysis: This is the response statistics:

(A), 24 participants prefer live explanations,

(AB), 6 participants prefer either live or video-based explanations,

(B), 22 participants prefer video-based explanations,

(C*), 6 participants mention written documentation (as the preferred option or one of the two preferred).

(There is no one right way. Every method has advantages: Live trainings can have more questions, videos can be replayed whenever needed, documents can be searched – one does not need to wait until the needed information arrives.)

Occasional Misconceptions regarding Teamwork

1. Shorter deadlines mean that team needs to be larger; team size depends on the urgency and the size of project. (In fact, adding more people may delay the project.)
2. Other teams may have skills that one team does not, so they should all work together. (IT teams may sometimes collaborate, but ultimately everyone is responsible for their own tasks.)
3. Since tasks change, every iteration may need a different set of people in a team. (We need to work with whatever resources we have.)
4. More complex and time consuming work items are most valuable. (In fact, there often is an opposite tendency - as in Pareto Principle, where 20% of all effort produces 80% of the value for the customer and vice versa.)
5. If there is no information from the customer or other project owner, work should stop, because there is no meaningful way to proceed without the information. (Information is very important, but gathering information is our core activity in IT - we cannot expect that it will magically delegate to someone else.)
6. Iteration model should be applied first and foremost in the places, where there is sufficient information and when it is easy to split work into stages. (Iterations work best in those cases, where there is uncertainty and we may be initially unable to see the big picture or plan more than 1-2 iterations. The tasks, which can be well understood and analyzed in advance do not need iteration model.)
7. When all people in the team meet and the team works together, it is most productive. (In short distances meeting often and rushing your work by sitting together may get something done, but it is not sustainable for longer efforts.)