

Elements of an e-procurement reform part 1: suggested roadmap and software development plan

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Glossary

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1. Introduction

1. Introduction

- On 09 December 2021 we gave a workshop to employees of the Armenian Ministry of Finance on the German, Georgian and Ukrainian e-procurement systems.
- The Ukrainian e-procurement system ProZorro has been discussed in detail.
- In this context, follow-up questions regarding a timeline for the reform process, auction types and cybersecurity arose, which are discussed in this policy study part 1. Questions regarding procurement analytics, appeal process analysis, e-catalogues and cross-border procurement are discussed in policy study part 2.

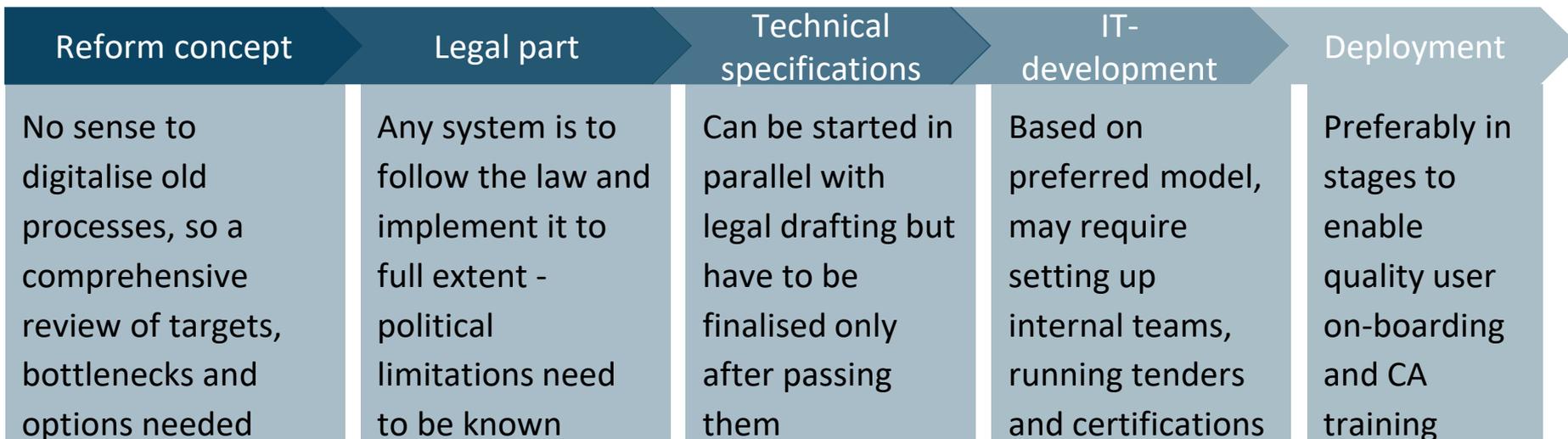
2. Suggested timeline for the reform process and roadmap

2. Suggested reform process roadmap (1/8)

- Any reform starts with assessment of current situation and future targets to reach:
 - Armenia is a relatively small country in the sense that it needs a straightforward yet robust solution. There is no market space for several procurement systems, costly solutions are not recommended
 - Armenia needs a solution that is open to foreign bidders as there are many tenders with limited local competition
 - Successful tender closing may be more of a challenge as opposed to handling massive and volatile competition - thus it's extremely important to analyse barriers to tender participation. It's recommended to make tender access as easy as possible and foresee different methods to 'remedy' a flawed bid (i.e. with some technical errors)
 - It seems reasonable to drop excessive requirement for tender guarantees
- We suggest selecting several basic key performance indicators to track:
 - Overall number of businesses that participate in PP
 - Share of successful tenders
 - Share of competitive tenders
 - General user feedback

2. Suggested reform process roadmap (2/8)

- Building and launching an e-procurement system requires several key steps:
 - Overall reform design with key policy and implementation decisions
 - Drafting new e-procurement legislation
 - Developing technical specifications for a new e-platform
 - Running a tender and executing the contract with the IT-developer
 - Drafting all necessary by-laws (forms, dictionaries etc.)
 - Testing or limited/parallel availability period
 - Full-scale deployment
- Most of these steps have to be run in parallel and require good synchronisation to be able to meet the tight deadline



2. Suggested reform process roadmap (3/8)

- **REFORM DESIGN:**

- Key decisions to be made (assuming no major changes to PP law are made):
 - Multiplatform vs hybrid vs monoplatform
 - Level of commercial sector involvement (state only, private only or mix)
 - Development and support model (full outsource, staff augmentation, all-inside)
 - Financing model (100% budget, mixed or 100% self-financing)
 - Level of digitalisation and integration with other government systems (budget, treasury, registers, law enforcement etc.)
 - PP procedures to be digitalised and stages of their roll-out
 - Level of transparency: what data to be considered confidential, if any
 - Technical and security requirements and methods of their implementation (cloud vs own servers, what can be kept outside of the country, if anything, acceptable level of online availability, security vetting and certifications)
 - Data formats, auction time, additional services, third party access and other technical details
- Usually requires several rounds of public-private dialog to have everyone heard and prepare the market to future changes

2. Suggested reform process roadmap (4/8)

- **LEGAL PART:**

- Eventually e-platform is policy implementation, so any actions can't precede policy itself. Legal changes may be unpredictable and subject to a political compromise, besides, spending any public funds on development prior to the change becoming real is unwise
- Given that Armenia's PP law provides a lot of flexibility on e-solutions, we assume only CabMin's bylaws are required. Still, usually implementing comprehensive IT-solutions may require unexpected tweaks to lots of documents - related to PP, budgeting and payment, appeals and forms of documents, eliminating requirements for paper copies and providing possibility to law enforcement to use e-documents from the platform in courts. Sometimes changes to documents dealing with IT-security, e-signatures, e-documents and other general legislation is needed as well
- Legal changes also have to deal with:
 - **Timing of change** - leaving ample time for system development, testing, certification (if needed) and deployment
 - **Parallel co-existence of old and new PP processes** - i.e. last 'paper' procedures in Ukraine closed 2 years after ProZorro was obligatory for all PP. One needs to keep in mind old contracts execution, possible litigation, keeping copies for future audits etc.

2. Suggested reform process roadmap (5/8)

- **TECHNICAL SPECIFICATIONS:**

- One can start to develop them once the concept of reform is approved and finalise once the legal changes come into force
- Given the recommended scenario (staff augmentation and core IT-team employed by the government or SOE), this is the time to start building the IT-team and getting them up-to-speed with legal changes and required tasks
- Technical specifications will basically mirror the PP e-platform legal part with more details and additional explanations
- Specification also has to take into consideration:
 - Technological stack
 - Hardware level of deployment
 - Potential outsourcers/IT-developers to do the job
 - Cost of support in future
- Drafting technical specification can be outsourced to consultants (still preferable for the core IT-team to be in the loop):
 - Business analysts will go through each process in the law/bylaw and describe it in details clear to IT-developers
 - Overall the text will be reviewed to ensure quality and upgradeability

2. Suggested reform process roadmap (6/8)

- **IT DEVELOPMENT:**

- Running a tender, aside from technical specifications requires extra care to:
 - Research the market and make sure key suppliers are aware and ready to apply
 - Have a list of requirements for able local/foreign companies to apply - relevant experience and qualified personnel
- IT-development itself may be a fairly uncomfortable black-box unless a core IT-team is assembled and can follow it. Design mock-ups and usability tests are always a good idea. Besides IT-developers will often have additional questions and suggestions to the technical specification, it's impossible to foresee everything - thus agile type development is highly recommended
- Policy-makers should be ready for a potential tender budget increase - while unpleasant, it is often unavoidable in complex projects
- MVP vs full-scale product - it may be wise to plan development in stages - i.e. building an MVP for under-the-threshold procurement to test and give more confidence to users and policy makers
- Testing and user feedback is extremely important to gain trust. Even if you are confident in reform design, different types of users should have possibility to play with mock-ups and MVP. Not only valid suggestions may arise, but it decreases political pressure and opposition to change!

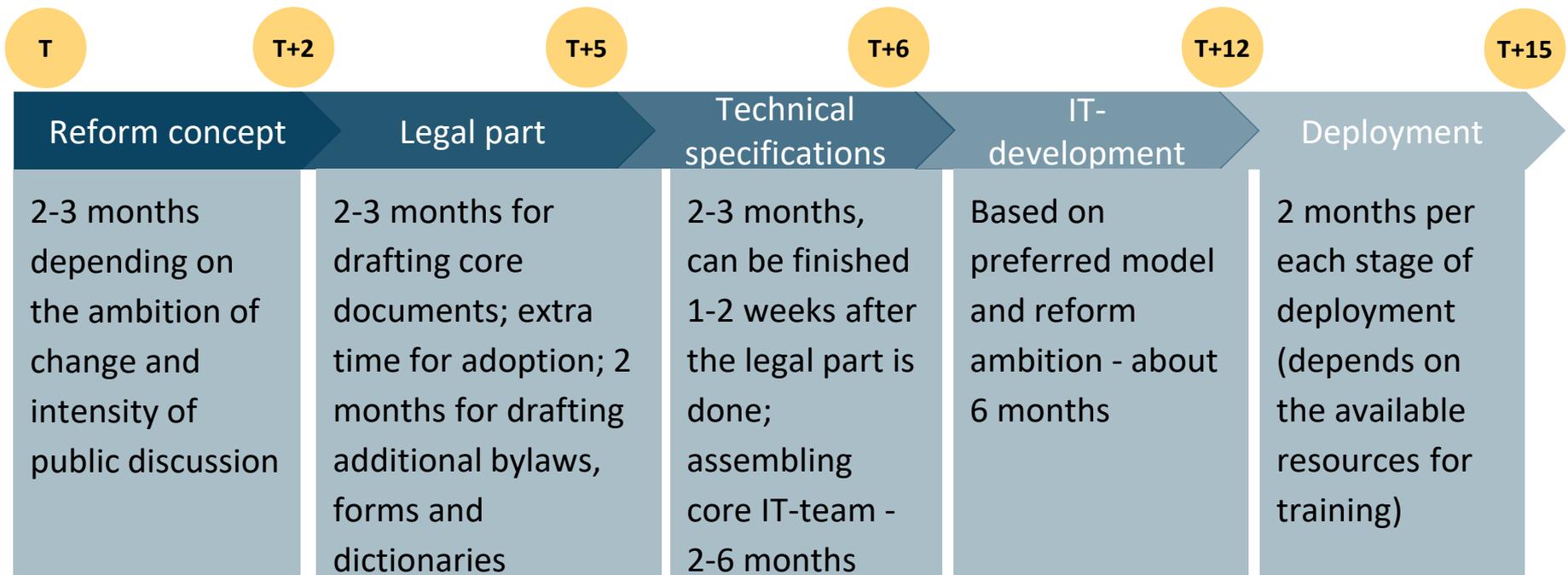
2. Suggested reform process roadmap (7/8)

- **DEPLOYMENT:**

- Timing of deployment is important: ideally it should be at the time of the year with minimum procurement and somewhere mid-month, all CAs have to be informed that critical procurement should happen prior to new system deployment
- Glitches are unavoidable: response plan and relevant legal mechanisms should be in place to ensure no ramifications to, say, inability to post a document in time
- Stages: should be carefully considered. Going in stages makes education and transition easier. From the other point it increases confusion for CAs and creates possibility to hinder reform and prolong deployment. Probably 2 stages (central CAs+SOEs/utilities and municipal CAs) are optimal
- Training is a must: several teams have to visit each region and advocate change, answer questions and troubleshoot any glitched. Video-guides and Q&A text are to be prepared beforehand
- Feedback loop: reform is a process, not a on-off switch, it's important to keep urgency for further improvement and error correction, collect and analyse statistics and launch PR activities to support change, reward champions and fingerpoint saboteurs. For example, one can have a leaderboard of 'best CAs'

2. Suggested reform process roadmap (8/8)

- Overall preliminary timeline:



- What can be done to make it faster than 1 year from start to deployment?
 - Less ambitious concept - not everything needs to be done at once - Ukraine spent lots of time of complex and rarely used procedures
 - Reusing concepts, software, procedures
 - Having IT-core team in place from day-1 will save a lot of time
 - Legal part rarely can be shortened

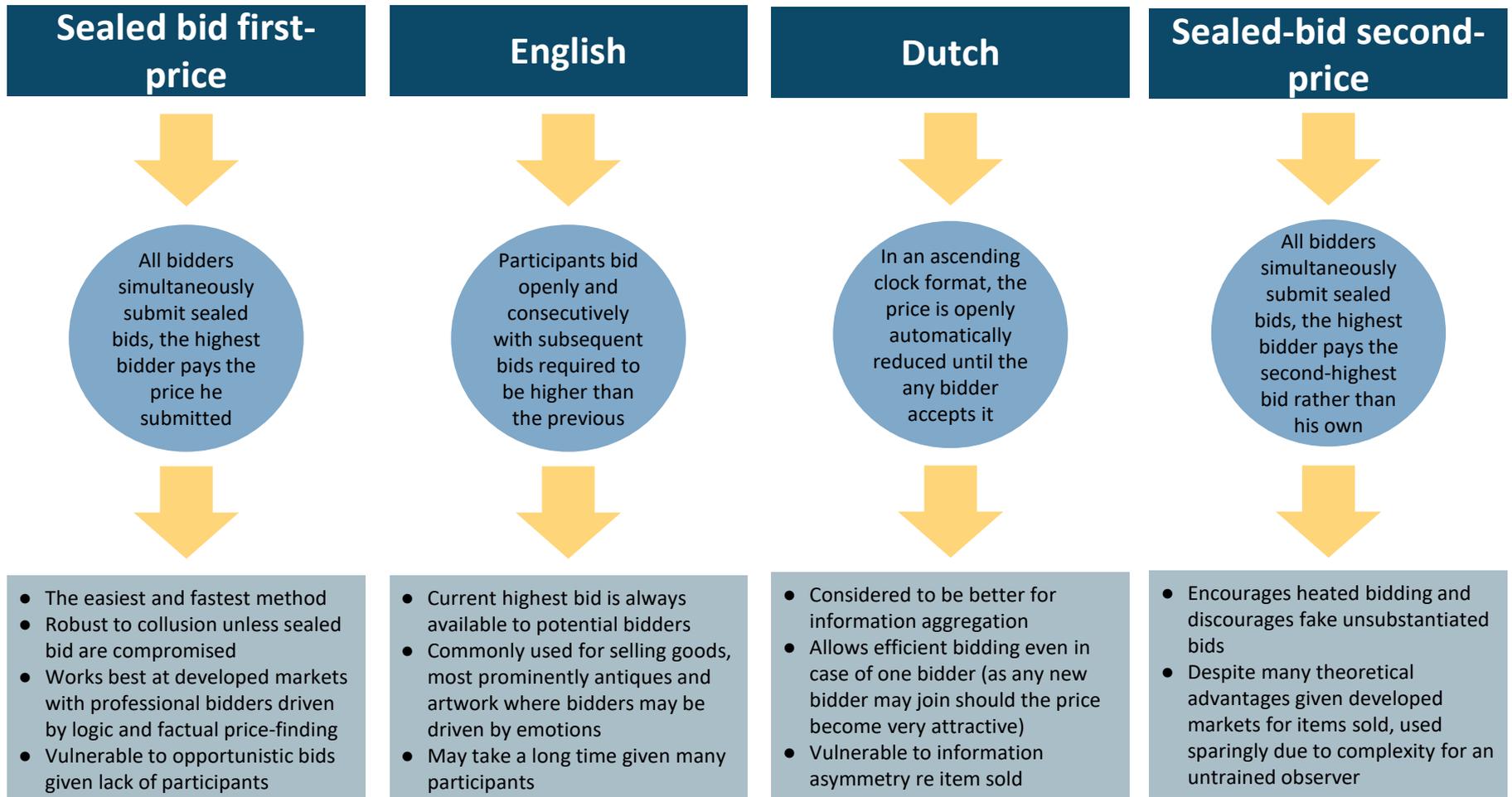
3. Auction theory brief and auction types

3. Auction theory brief and auction types (1/6)

- Auctions come in a variety of types and categories, which are sometimes not mutually exclusive. Depending on the market conditions, type of items sold/purchased and available information about them auctions performance can be compared in terms of their capacity to:
 - Bring high revenue of items sold/low cost of items purchased
 - Ensure efficient allocation of assets/contracts
 - Stimulate competition (including related benefits of providing ample access to SMEs, decreasing risks of monopolisation etc.)
- While auction performance in theory can be estimated with high certainty, in real life it's difficult due to:
 - Lack of 100% repeatability of auctions (no 2 tenders are 100% alike)
 - Constant market education (say, market conditions, trust, confidence and professionalism of agents differ greatly at ProZorro launch and in 2022)
 - Political difficulties of making controlled experiments, especially with original auction types

3. Auction theory brief and auction types (2/6)

- Most popular/known auction types (examples for sale of items):



3. Auction theory brief and auction types (3/6)

- Ukraine uses 2 types of auction:
 - **ProZorro auction** - a combination of sealed bid first-price and English auctions (used for PP and for asset sale) - bidders start from the expected budget/reserve price, and make blind bids. After that, there are 3 rounds of open bids, in each of them every bidder may make its bid consecutively one after other. The winner of the previous round bids the last in the current round to motivate aggressive bidding as opposed to wait-n-see approach to assess level of competition
 - a **hybrid Dutch auction** - a combination of Dutch auction and sealed bid first-price (used for asset sale) - the downward clock starts at a balance value of an asset. Every 5 min the price decreases by 1%. When one of the bidders makes a bid equal to the price displayed, the auction stops. After this, all bidders make blind bids. The one who stopped the clock has a right to bid last. This design allows price discovery for all participants after the first round.
- Both are modified cascading versions of classic auctions to enable:
 - Better protection from the risk of collusion
 - More stimulus to submit higher sealed bids
 - Easier price finding in case of assorted items not well known to the market
 - Opposition to suppression of competition because of asymmetric information

3. Auction theory brief and auction types (4/6)

- Ukraine's PP law implements **compulsory anonymous ProZorro type auctions for all competitive types of procedures**:
 - 3 steps auction was picked as a statistical compromise to ensure reasonable timing (even with this type an auction can last several hours given 10+ bidders)
 - Auction is totally anonymous, bidders, external observers or system administrator can not see who is taking part in an auction until the end
 - Supplier with the highest initial price will get a chance to reduce his offer first. As a result the bidder with the lowest initial price has the highest chance to win as he is the last to react to his competitor's counter-offers
 - The logic behind is to stimulate bidders to offer their best prices already at the initial offer stage. Otherwise the best strategy of a bidder would have been to maximise initial price and decrease it during the auction only should competition happen to be unexpectedly high

Початкові заявки

Учасник №8	3 600,00 грн
Учасник №5	3 725,50 грн
Учасник №1	4 029,25 грн
Учасник №6	4 800,00 грн
Учасник №7	5 256,70 грн
Учасник №4	5 775,00 грн
Учасник №3	5 838,00 грн
Учасник №2	5 919,05 грн

3. Auction theory brief and auction types (5/6)

- In 2017 Ukraine had a chance for **natural experiment in comparing two types of auctions** used. Deposit Guarantee Fund (DGF), an institution in charge of disposing of bankrupt banks' assets, used ProZorro auction only in Oct-16 – Oct-17, after which it supplemented it with a hybrid Dutch auction
- [Kyiv School of Economics](#) produced a paper* to compare results of 4,481 auctions within ~21 months:
 - DGF recovered ~24% of the total face value of the NPLs sold via hybrid Dutch
 - DGF recovered ~19% of the total face value of the NPLs sold via ProZorro
 - Speed of selling via hybrid Dutch auction is higher than for ProZorro: it takes on average 2 months to sell the lot via the hybrid Dutch auction and 3 months to sell the lot via ProZorro auction
- Another analysis** by [CEP](#) showed that ProZorro auction performs substantially better than English auction

* <https://kse.ua/wp-content/uploads/2019/05/NPL-KSE-04.22.2019.pdf>

** <https://cep.kse.ua/article/choho-vartyy-auksion-prozorro-Rezultaty-eksperymentu/pdf.pdf>

3. Auction theory brief and auction types (6/6)

- In general it's hard to give a straightforward answer which auction is better without having deep knowledge of the market in question, such as trust to the sealed bid keeper or typical market behaviour
- Often theoretical efficiency is secondary to the political motivation - i.e. it's difficult to explain to stakeholders why sealed bid second-price seemingly leaves money on the table in each individual auction but provides better average results
- As A/B testing is seldom a real option, it is recommended to opt for the simple method and keep more complicated methods as a theoretical option in law (that is the reason why Ukraine's PP doesn't use hybrid Dutch)
- Reserve price, auction guarantees and other features are to be considered as well

4. Building an e-procurement system - Ukraine's experience

4.1 Building an e-procurement system - principles

- There may be many methods to build a complex IT-product, but usually government systems set rigid limitations on what and how can be constructed:
 - Lower expertise due to public sector jobs being less competitive
 - Longer and rigid planning and budgeting cycle
 - Slow cycle of updates due to political limitations ('too much goodwill invested')
 - High and often politically motivated requirements for security, personal data protection, certification procedures
 - G-IT solutions are usually obligatory to use so usability is rarely a factor
- 3 key options to procure a G-IT system:

Buy (license or SAAS)

- Usually an optimal case when available and ongoing support is not an issue
- Favored by MinFin due to clear cost structure and finite procurement cycle
- Guarantees delivery of an adequate but not tailored product
- Unfortunately is **not an option in PP** - no generic solutions available, requires regular updates and tweaking

Outsource

- Design loose requirements and hire an experienced contractor to design from scratch, manage and support
- Works when contractor is well-aware of the system he is building
- Makes you **fully dependant on the contractor** for any future support
- Creates **huge operational risks** in case something happens to the contractor

Used by SOE ProZorro

Build

- **Requires creating and funding IT core-competence** at the state level
- Allows more flexibility and less reliance on outsourcers
- Allows to continually develop the product in line with changing needs
- Less convenient for budgeting purposes
- Better chance to get a custom-tailored solution

4.1 Building an e-procurement system - principles

- ProZorro utilises corporate sector best-practices in IT-development to the full extent to which this is possible under public limitations - because this is what works to create the most successful and popular products worldwide

Agile development instead of waterfall



Product development is done in short sprints instead of 100%-or-nothing approach. This means the system is constantly evolving and the PP law provides necessary flexibility of technical implementation

T&M pricing model instead of Fix Price



As is customary for agile development SOE ProZorro buys man-hours of specific skills, when the system is upgraded. This provides flexibility and allows competition between subcontractors

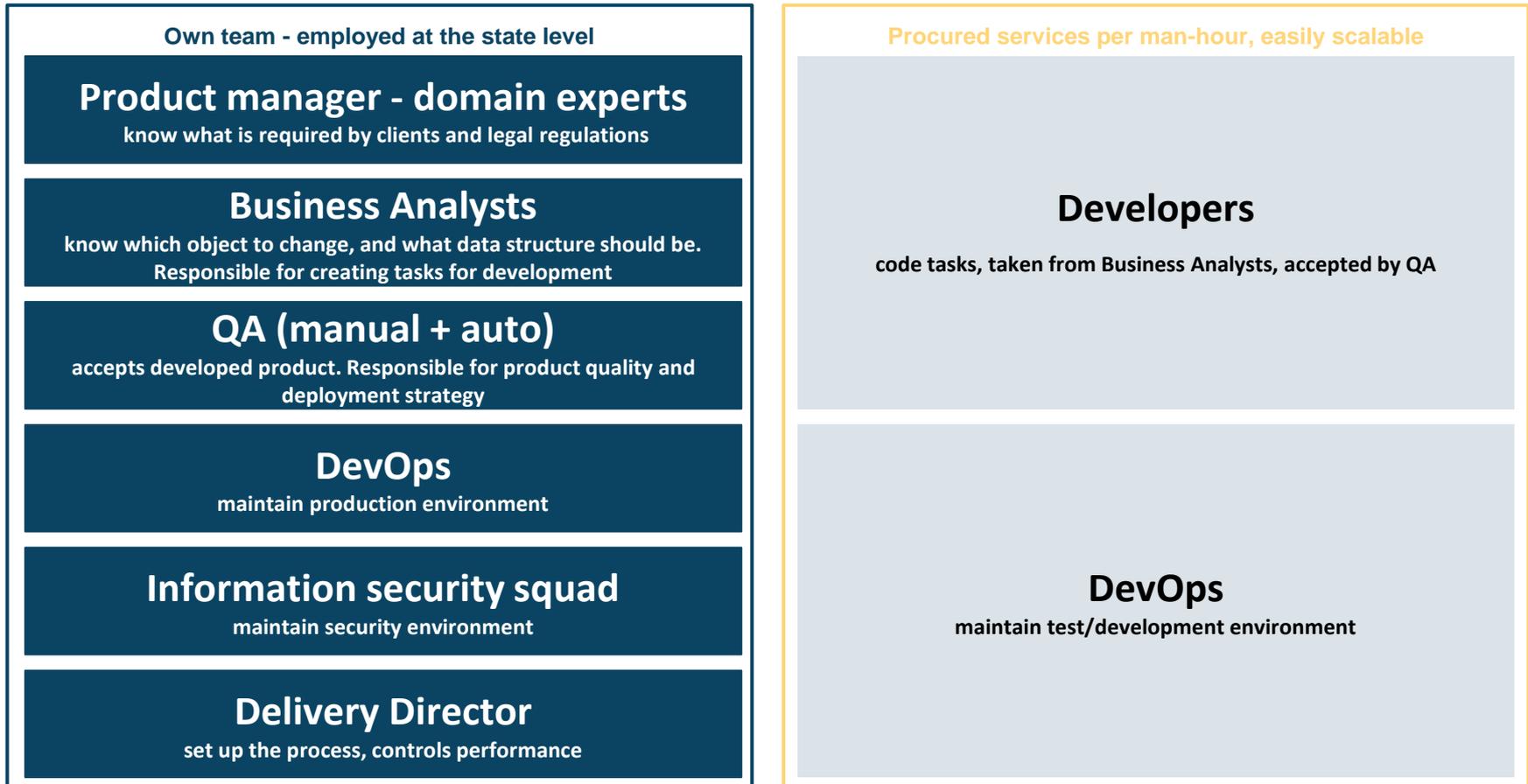
Staff augmentation instead of managed services as a delivery



All management is on the public sector side - it's eventually cheaper and more resilient to build a small capable core-competence team and add contracted 'programming muscle' when needed

4.2 Building an e-procurement system - personnel

- Personnel-wise this is what is used to maintain and further develop the IT-system:



4.2 Building an e-procurement system - personnel

- Examples of skills required for relevant positions - these people should be mostly inside the core-team:

Technology / Skill	Python developer	DB administrator	PHP, JS developer	DevOPS	Team Lead	QA engineer
Experience with non-relation databases (CouchDB, MongoDB) and relational (MySQL, MariaDB, InfluxDB) or similar	Yes	Yes	Yes	Yes	Yes	Yes
Object storage that works with SWIFT or S3 drivers - size above 20TB	Yes	Yes	No	No	Yes	No
Monitoring tools: Zabbix, NetData, Grafana	Yes	Yes	No	Yes	Yes	No
Exeperience with OSs of the Red Hat distributive family	Yes	Yes	No	Yes	Yes	No
Linux - CentOS or Fedora	Yes	Yes	No	Yes	Yes	No
PHP: Laravel Framework or similar, JavaScript, html, css	No	No	Yes	Yes	Yes	No
Elastic Search	Yes	No	No	Yes	Yes	No
Python programming language: Pyramid framework or similar	Yes	No	No	No	Yes	Yes
Balancer: HaProxy, Nginx	No	No	No	Yes	Yes	No
Autotesting tools: Robot Framework, Selenium\Selenium bindings (Python) (front-end testing), Jenkins CI, Load Performance Testing	Yes	No	No	No	Yes	Yes
Authorisation and DNS systems: FreeIPA, ELK stack, Bastion, OpenVPN	No	No	No	Yes	Yes	No
Virtualisation systems: VMware, KVM, Hyper V	No	No	No	Yes	Yes	No
Continuous Integration tools: Ansible/Buildout Tools	Yes	Yes	Yes	Yes	Yes	Yes

4.3 Building an e-procurement system - procurement

- Prior to procurement we recommend **establishing a small core IT-team** which will be tasked with building capacity for managing complex IT-projects. It shouldn't be big (i.e. ProZorro IT staff is 19, one can start from 7-8 people and scale up if needed) but should be government vetted and full-time employed
- Outsourcers/developers can be situated anywhere and one should aim for optimal expertise/cost balance
- **Core-team should develop major system requirements**, including the technological stack to be used for development
- IT-development contract may be structured as follows:
 - Item to be procured: amount of man-hours for specific skills
 - Tasks to be assigned by the core-team Sprint-by-sprint (3 weeks)
 - Tasks eventually lead to the creation of separate services/PP processes
 - Contract paid in monthly payments based on man-hours used
 - In-house tracking of job reports (SOE ProZorro uses Jira+Confluence)

4.3 Building an e-procurement system - procurement

- ProZorro's [technical specifications \(2017\)](#) consist of:
 - General requirements (i.e. guaranteed speed of database response or general system availability)
 - Forms/lists/directories (i.e. forms of documents approved by the CMU that the IT-system must produce or CPV-codes to classify procurement items)
 - Separate services/PP processes (i.e. as follows):
 - Process 1. 'Procurement Plan'. The process ensures the creation and publication of procurement plans, annexes to the annual plan and changes to them.
 - Process 2. 'Below-the-threshold procurement'. The process in which the procurement provided for in paragraphs 4 and 5 of Part 1 of Article 2 of the Law is automated.
 - ...
 - Process 4. 'Open Bidding (EU)'. The process by which the procurement provided for in paragraphs 2 and 3 of Part 1 of Article 2 of the Law is automated and the information that is published in English in accordance with Part 4 of Article 10 of the Law (more than EUR133,000 for goods and services and EUR5,150,000 for works).
 - ...
 - Process 8. 'Report on contracts concluded without the use of the e-procurement system.' The process implements possibility of submitting reports in accordance with Article 10 of the Law, in the case of procurement of goods, works and services without the use of the e-procurement system, given that the value of the procurement is equal to or exceeds UAH50,000 and is less for the value established in paragraphs 2 and 3 of part 1 of Article 2 of the Law.
 - Process 9. 'Appeal'. The process by which the submission / review of Claims for below-the-threshold Procurement and appeals of above-the-threshold Procurement is automated.
 - Process 10. 'Working with contracts'. The process by which the process of contract management is automated.
 - ...

4.3 Building an e-procurement system - procurement

- List of tasks for the IT-development contract:
 - Approval and creation of Technical Architecture
 - Approval and creation of the Functional Specification
 - Development of Precedent Chart and Precedent Description (BPMN Chart, DFD)
 - Generated product code for all system components
 - Changes to the API description
 - Updated Tutorials
 - Created deployment packages (buildout, Ansible)
 - Update support documentation
 - Create API level and site level tests
 - Manual tests
 - Unit tests
 - Self-tests (90% coverage)
- Results to be provided for each service developed
 - The decision must be based on the OCDS standard
 - The result of the development is deployed in a pre-productive environment
 - The development code and script package for deployment is stored in the repository at corresponding branch (Production)
 - Updated usage scenarios for existing or new services
 - Updated test scripts for each UAT level on Confluence (TestCase)
 - API data structure updated

Example of service description (i.e. ecological non-price criteria)

When announcing the procurement, the CA is able to:

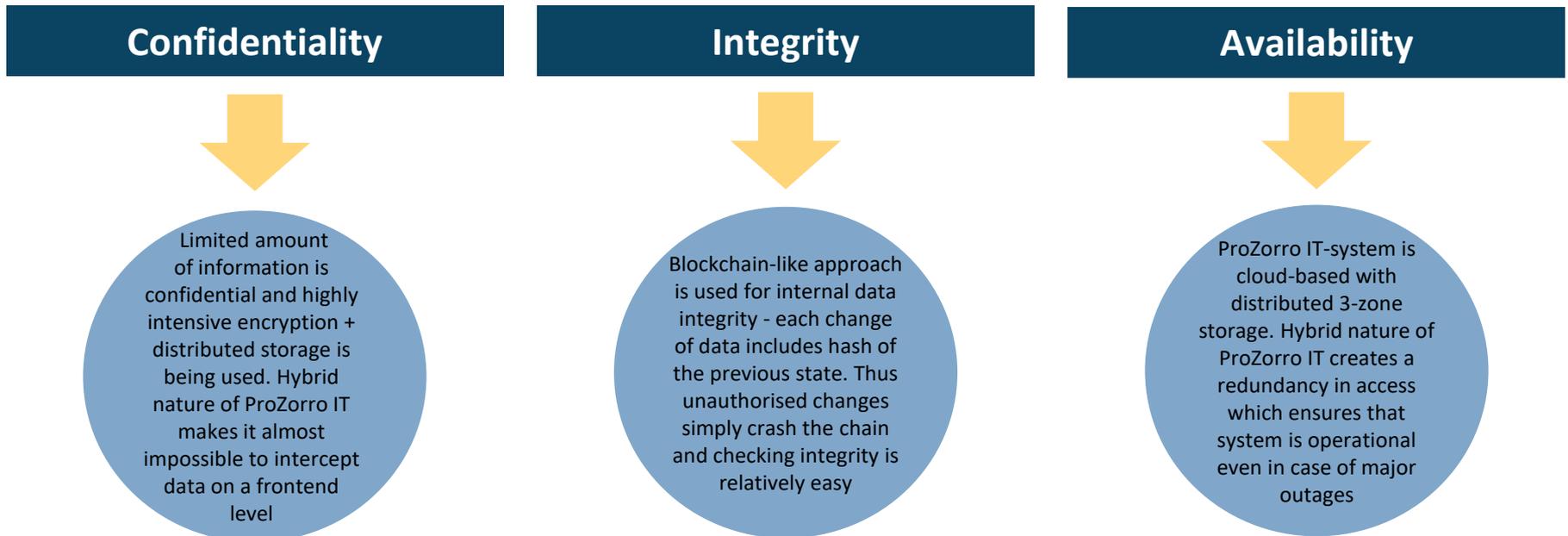
- specify the environmental criteria as a qualification an/or non-price
- specify a list of documents to confirm this requirement in the electronic fields of IT-system

The supplier is able to filter all or part of those procurements where environmental requirements are set, and obtain a complete list of documents required by the CA in the form of machine-readable fields.

The observer is able to analyse the quantitative data of procurement with environmental criteria and the impact of using these criteria on the course of the procedure: competition, success rate, etc.

4.4 Building an e-procurement system - security

- Large IT-system security must be treated as a process and not as a one-time requirement. Security needs have to be considered at planning stage and carefully balanced against cost and risk consequences
- ProZorro aims to concentrate on the following 'CIA' criteria:



4.4 Building an e-procurement system - security

- Legal requirements for IT-security in Ukraine:
 - The central database to be hosted on cloud services that meet state requirements by the State Service of Special Communications and Information Protection
 - IT-system certified based on ISO/IEC 27001 as proven by an accredited organisation
 - Electronic digital signature used to undersign documents
 - ProZorro marketplaces have to provide internal audits of information security on an annual basis as well as quarterly scans (external and internal) of its website for vulnerabilities
- Security authorisation procedure for ProZorro marketplaces:



4.4 Building an e-procurement system - security

- Since 2019 ProZorro has an ongoing bug-bounty program and pays fees to ‘white hackers’ that report vulnerabilities in line with program rules:
 - Hackers have access to pre-production environment and copies of databases, cabinets and marketplaces as well as all API and source code info
 - Any vulnerabilities found are classified in line with [BugCrowd taxonomy](#) classification and hackers receive ‘points’ for finding any exploits. There is a public dashboard of most successful security specialists should they want fame
 - Major vulnerabilities found are rewarded with cash prizes ranging \$300-\$1000
 - Should hackers work in line with the public offer documents they are legally insulated from any law infractions (Ukraine’s criminal code still is vague about ethical-unethical code breaking)



4.5 Building an e-procurement system - opensource

- Opensource code for a state IT system is important on different levels:
 - **Increases IT-security.** Instead of ‘security by obfuscation’ you get possibility to proof-check the code by different parties. It actually increases level of trust policy-makers should have in the system as they don’t rely just on one state certification report. As security is a process, continual monitoring of code quality works much better
 - **Increases public trust** in the system. Lack of trust to state decisions and instruments is a major barrier to efficient PP in the developing nations. There is no better method to prove that e-procurement system has no backdoors or hidden functions than to show it to the public
 - **Decreases risk of state capture.** Very often state IT-systems de-facto are controlled by their administrators/outsourcers/developers that find ways to profiteer from this (ranging from unauthorised access to selling rip-offs of software developed using public funds)
 - Is **popular among developers** as it shows governments desire to use industry best-practices and helps in personnel hiring and retention as well as allows free code-commits to improve the system

4.5 Building an e-procurement system - opensource

- Maintaining open-source for ProZorro required the following legal and financial architecture:
 - Initially in 2015 the code was developed by [NGO “Transparency International Ukraine”](#), a chapter of the world-renowned anticorruption organisation. TI Ukraine was a part of intergovernmental memorandum to develop ProZorro e-procurement system and transfer it to the MoE free of cost and brought:
 - Trust - all parties, including developers and donor community, had much more trust to TI Ukraine than to any state agency
 - Financing - TI Ukraine accumulated donor funds and used them to finance IT development, including paying salaries to the core IT team which eventually joined the SOE ProZorro after it was set up
 - Speed - budget cycle requirements, lengthy public service hiring processes risked to substantially delay IT development
 - Intellectual Property Rights - it was easier to clear IPR and authorship through an intermediary. All developers signed contracts with waiver of property rights for all the code developed and TI Ukraine initially transferred non-exclusive property rights to the state while maintaining a ‘clean’ open-source copy of software
 - MoE received a clean legal opinion for the IPR transfer which was very important from the policy-maker’s point to avoid any criticism

4.5 Building an e-procurement system - opensource

- Since that time TI Ukraine transferred the GitHub code repository to SOE ProZorro, the state-owned company that is ProZorro IT-system administrator. SOE ProZorro maintains:
 - [REST API](#) description for external users
 - [Technical specifications](#) for ProZorro development
 - [GitHub code](#) repository for commits and additions
- ‘External’ code version is currently maintained by one of ProZorro’s developers - [Quinta Group](#): <https://openprocurement.io/en/documentation>
 - There is obviously some difference between opensource and proprietary versions of ProZorro code as SOE ProZorro uses public funds to upgrade the system and additional time is often needed to upgrade open-source code to be free of some country specific parts
 - Still source code potentially may be transferred to third parties on the basis of non-exclusive usage rights, it’s elements were used to develop parts of different solutions in [Moldova](#), Lithuania as well as sell-side auction of [Prozorro.Sale](#) etc.

Glossary

AMCU	Antimonopoly Committee of Ukraine
CA	Contracting Authority
CDB	Central database - government owned 'backend' of ProZorro IT System
CMU	Cabinet of Ministers of Ukraine
CPB	Central procurement body
DASU	State Audit Service of Ukraine
DGF	Deposit Guarantee Fund
MoD	Ministry of Defence
MoE	Ministry of Economy
MoF	Ministry of Finance
MoH	Ministry of Healthcare
NGO	Non-governmental organisation
PP	Public Procurement
SOE	State-owned enterprise

About the German Economic Team



Financed by the Federal Ministry for Economic Affairs and Energy, the German Economic Team (GET) advises the governments of Moldova, Georgia, Ukraine, Belarus, Kosovo, Armenia and Uzbekistan on economic policy matters. Berlin Economics has been commissioned with the implementation of the consultancy.

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