RED FLAGS for integrity: Giving the green light to open data solutions

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I: Introduction: Running data up the (red) flagpole

1. What are we even talking about?

One of the four primary use cases for open contracting is promoting integrity. Public contracting and procurement is government's single greatest corruption risk, a fact highlighted by the OECD, the UN Office of Drugs and Crime, and the European Commission.[1,2,3,4] Some 57% of foreign bribery cases prosecuted under the OECD Anti-Bribery Convention involved bribes to obtain public contracts.[5]

One of the exciting promises of real-time data and analytics in public procurement is that corruption and fraud can potentially be detected and prevented before they occur, rather than leaving government to pick up the pieces afterwards. Similarly, potentially anomalous patterns of bidding or contract allocation can be scrutinised directly to check for potential problems as they occur, supporting innovative, data-driven policy solutions to reinforce the most promising practices in integrity and fairness. An additional value of open data is that it allows different actors to check the integrity of the system at different times from their own unique user perspective, enabling a more robust analysis and potentially preventing a single point of failure.

What *isn't* so clear is how to translate the will for positive change into action. Collecting data for data's sake just doesn't cut it when it comes to tracking suspicious behavior. Following the principle of the "Data Revolution," when making action plans for combatting illicit behavior, we must ask ourselves, "data for what, data for whom?" Before we can begin hunting corruption, we must have a clear sense of what data are needed and who will use them to do what. This guide is an attempt to answer those questions. It was completed after engaging integrity experts across the globe to explore the data opportunities and challenges they have witnessed in their research and field work. We have also consulted partner governments about what they see as the biggest threats to integrity in their individual contexts, all the while searching for common threads and shared interests across these contexts.

The result of our efforts is this introductory guide to how countries can reference their procurement data against a set of over 150 suspicious behavior indicators, or "red flags." These flags occur at all points along the entire chain of public procurement-from planning to tender to award to the contract, itself, to implementation-and not just during the award phase, which tends to be the main focus in many procurement processes.

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[1] http://www.oecd.org/gov/ethics/public-procurement.htm
[2] OECD. 2012. Progress Made in Implementing the OECD Recommendation on Enhancing Integrity in Public Procurement. http://www.oecd.org/gov/ethics/combined%20files.pdf, p 14-15.
[3] UN Office of Drugs and Crime. 2013. Guidebook on anti-corruption in public procurement and the management of public finances. p.1. https://www.unodc.org/documents/corruption/Publications/2013/Guidebook_on_anti-corruption_in_public_procurement_and_the_management_of_public_finances.pdf
[4] http://ec.europa.eu/dgs/home-affairs/e-library/documents/policies/organized-crime-and-human-trafficking/corruption/docs/acr_2014_en.pdf, p.21
[5] OECD. December 2014. The OECD Foreign Bribery Report. An Analysis of the Crime of Bribery of Foreign Public Officials. http://www.oecd.org/corruption/oecd-foreign-bribery-report-9789264226616-en.htm, p.8.

It is also clear that by specifying and implementing data models such as the Open Contracting Data Standard (OCDS) to the maximum extent possible and even adding in additional context-specific data fields, you can calculate a much greater quantity and better quality of red flag indicators and create reusable tools for these monitoring efforts. Equally importantly, the OCDS -and open data more generally- has fostered deeper collaboration among corruption risk researchers and implementers. Given that a tangible result of open data efforts has been the rapid innovation of new methodologies and red flagging tools, we see that improved communication and knowledge sharing has directly fed back into the burgeoning integrity feedback loop. In this way, the OCDS and this Guidance piece are tools for promoting the recent uptake of interest in corruption risk monitoring.

At this point, it is worth pausing to emphasize that a red flag is something anomalous that deserves further investigation. It is *not* proof that anything is wrong or that a transaction is corrupt, collusive, fraudulent, or otherwise illicit. A flag cannot, and is not intended to, prove corruption in the procurement process. Flags can, however, offer insight into the risk of corrupt or illicit behavior in individual contracts and signal troubling patterns across the procurement system worthy of further investigation. The use of analytics for red flagging may also showcase more general opportunities to increase integrity and value for money across the procurement process.

As well as building on the expertise and insights of experts worldwide, this Guidance also develops ideas behind the G20's Anti-Corruption Open Data Principles and has been informed by our collaboration with the Open Data Charter's Anti-Corruption Open Data Package. We aim to build on these ideas to provide a deep dive into the data fields, analysis methods, and associated use cases that will be important to public integrity in the procurement system.

Before delving into the specifics of our developing methodology, we would like to define the terms we will employ throughout this work and our associated quantitative analysis, as precise definitions vary across the field of integrity.

a. Procurement phases: 1. Planning; 2. Tender; 3. Award; 4. Contract; 5. Implementation
b. Buyer: The party that finances a tender
c. Procuring Entity: The party that issues the tender (which may or may not be the same as the buyer)
d. Bidder: A party who bids on a tender
e. Supplier: The bidder who is awarded a tender
f. OCDS: The Open Contracting Data Standard common data model that enables disclosure of data and documents at all stages of the contracting process
g. Fraud: Knowingly misleading others for personal gain
h. Corruption: The exchange of anything of value to influence another's actions
i. Collusion: Agreements between two or more bidders to commit fraud
j. Red flag: A direct or indirect indication of potential corruption, collusion, fraud or other illicit behaviour
k. Integrity promotion: Minimizing the threat of corruption, collusion, or other illicit behaviors

2. The good that comes from goodness: why we care about integrity

Conversations around corruption, fraud, and collusion inevitably have a negative and punitive tone and tend to shift over into headhunting individual wrongdoers. Unfortunately, this approach often fails to generate meaningful and sustainable results due to the difficulty of effectively punishing wrongdoers. It can pay to recast the discussion towards more systemic thinking around the massive scale and scope of the benefits of reinforced integrity. It may also be more effective to focus on developing proactive rather than reactive approaches to monitoring public procurement through flagging. It is through this data-driven monitoring that we can craft effective technical and policy interventions that will enable us to address problems in real time and bring about tangible and lasting results.

Adopting proactive, pro-integrity flagging and detection methods allows us to track and deter illicit behavior at its source and identify and promote positive practices. It also supports us in developing innovative tools and technologies to help deliver better system-wide outcomes and shift our thinking from simply compliance with paperwork to managing systemic performance. Furthermore, by detecting suspicious behavior, we may be able to identify overall weaknesses in the procurement ecosystem and recommend policy or technical changes to unprove those weaknesses. In this way, flagging is a proactive, and not just a reactive, tool.

Improving integrity also directly promotes the other three main use cases for open contracting: greater value for money, improved competition and fairness, and better service delivery. Monitoring anomalous procurement behavior, even when that behavior isn't actually the result of a corrupt or illicit process, can help governments identify and resolve overarching inefficiencies in the procurement ecosystem.

The idea of promoting integrity is hardly controversial; after all, who *would* be opposed to increasing fairness and quality of service provision while at the same time generating massive government savings? In practice, however, there is little consensus about the most efficient, effective, and fair ways to do this as part of a systemic change strategy. Always eager to meet a challenge head on, we have attempted to make some progress and move the field forward.

3. Enough chatter: so what did we do?

Given the many benefits of increasing integrity across the procurement process, we were thrilled to research promising practices in the field of integrity and apply these learnings to our three Showcase and Learning (S&L) projects in Ukraine, Nepal, and Mexico City, thanks to the generous support of the John and Laura Arnold Foundation. Before beginning our work, we agreed on a vision of a successful product: one which would serve as a pragmatic "first steps" guide and tool that our partners could put into immediate use in promoting integrity across their procurement systems.

To identify what this tool would look like, we first reviewed literature and interviewed experts from across the field. In consolidating their ideas, we identified common threads and gained a rich understanding of the most pressing challenges and opportunities in the field. We came to see that we already had one of the best possible resources available to begin building a preliminary tool: the OCDS. The OCDS provides a flexible, extendible schema for unifying documents and records across the entire procurement system. This allows for disparate data fields or data models to be translated, organised, mapped and transposed onto one another.

In Section II, we will summarize our literature review and conversations with integrity experts and show how these conversations informed the development of our mapping methodology. In Section III, we will provide a detailed account of our methodology and explain why we chose to center it on the OCDS. We will then deep dive into six sample calculations to show the pragmatic application of the flagging methodology to OCDS datasets. In Section IV, we will introduce the mapping tool and summarize our red flag indicators. In Section V, we discuss lessons learned through applying this mapping methodology to Ukrainian OCDS data. We summarize with a discussion of next steps in Section VI.

II: Are you game? Key Players in Flagging

Our conversations with top integrity researchers and practitioners across the world showcased wide and sometimes disagreeing ideas about the best ways to allocate resources to the flagging and investigating of suspicious behavior in public procurement. While some experts focus on constructing global measures, for instance, others stress the importance of context-specific solutions. Across our conversations and review of integrity literature, we were able to identify three common points of interest: the need to contextualize red flag indicators, the benefits of triangulation, and the importance of data quality and linking information.

1. Context is everything: how to localize indicators

The International Anti-Corruption Resource Center's Guide to Combating Corruption & Fraud in Development Projects provides an excellent overview of the major threats to integrity across the globe. The guide shows that though specific integrity threats vary by context, illicit behaviors fall into four general schemes: corruption, bid rigging, collusion, and fraud. In his extensive work on quantifying and tracking illicit behavior, Cambridge academic Mihály Fazekas of the DIGIWHIST (Digital Whistleblower) project has arrived at the same conclusion. While defined on the micro-level, he attests, indicators should be comparable across countries or regions, as long as the same corrupt behaviour exists across countries. Therefore, it is possible to apply the same underlying theoretical concepts and measurement approaches to a wide range of contexts.

Constructing globally-valid flag indicators is undoubtedly complex given the wide range of geographic, economic, social, and cultural contexts which they span. Valid risk proxies need to be adapted to local regulatory and market contexts and consider to what degree the different ways of corrupting the tendering process are substitutes or complementarities in a given context.

Solutions needn't be global in nature; in fact, contextualizing tools can be a way to ensure solutions work efficiently and effectively. In a recent consultation, Ian Makgill of Spend Network emphasized the importance of context in red flagging work. His extensive work on cartel tracking and more general integrity issues have centered on the theory of understanding what is normal in a given context in an attempt to spot abnormalities. Such abnormalities are the "red flags" of suspicious behavior, which warrant additional investigation. For example, a common flag referenced throughout the field of integrity is "short tender notice period," but what does "short" mean? Is it two weeks' notice? What about three? Where do we draw the threshold?

The answer, as in many aspects of red flagging, is that "it depends." What is a "short" or "long" period or "abnormally high" or "abnormally low" price rests on a number of context-specific factors such as geography, sector and time period. For example: due to the highly specialized nature of the field, aerospace tenders typically receive 2 or 3 bidders, whereas more general categories such as web design can have a dozen. Under this understanding, a web design tender with just 3 bidders could be flagged as suspicious. However, should the technical requirements of a web design tender include extremely specialized conditions, perhaps it would not be abnormal for this tender to receive only 2 bids. Therefore, in order to avoid generating false flags, it is extremely important to have a detailed understanding of both the nature of the

work requested, as well as the context in which the work will be performed.

2. Triangulation isn't just for squares

A serious risk of applying global averages to local contexts in this way is that of false flagging; for every generated flag, there can be a plethora of contextual reasons why that behavior is not actually suspicious. A way to circumvent false flagging is to employ a strategy of "triangulation," or grouping together multiple corruption proxies either from the same indicator group or from different groups in order to arrive at a more robust corruption proxy. Though they are not the only leaders in the field thinking critically about triangulation, Mihály Fazekas, Luciana Cingolani, and Bence Tóth provide an excellent explanation of triangulation in their work "A comprehensive review of objective corruption proxies in public procurement: risky actors, transactions, and vehicles of rent extraction". Specific triangulation methods will depend on the data available. For example, the availability of business identifier data in addition to just procurement data can allow for a wider spectrum of triangulation. Not only can triangulation help prevent false flagging, but it can also inform the specification of threshold values. That is, for example, given the difficulty in quantifying the exact number of days that defines "short" tender period, triangulating tender period length with related indicators can help define the best thresholds. Instead of generating a flag just based on tender period length, we can couple the indicator with factors like low number of bidders and unexpectedly short or long technical specifications to drive a more reliable and robust flag calculation.

A major caveat is that triangulated indicators must be localized; should they be global in nature, you risk generating massive amounts of false flags. Calibrating to local contexts, through hard data analysis and the generation of algorithms or through qualitative information gathered through focus groups and interviews, can ensure triangulation flags only truly suspicious behavior. Secondly, risk proxies can be collated and used for triangulation only if they capture the same type of illicit behavior; combining proxies for corrupt tender processes, such as short tender period, cannot reliably be coupled with proxies for collusive bidding, such as joint venture bids by firms that usually bid alone.

3. Dat'um? I hardly know 'em!: data quality and availability

The ability to define, quantify, metricize, and collate and triangulate risk indicators rests on the quality and quantity of data available. Experts have identified improving the quality of data available across long stretches of time to be a primary facilitator in improving their flagging methodologies. Crafting context-specific algorithms to define "normal" and automatically flag abnormal behavior is already very complex; doing so with a data sample that is limited in scale and scope could exacerbate miscalculation and false flagging. In this way, the detection of corruption risks is largely dependent on the amount and quality of data published. This is a clear nod to the importance of sharing open, accessible, and reusable data from public procurement systems. In this respect, technological preconditions underpinning or inhibiting more and better data release need to be directly considered. Data release rests on both de jure and de facto commitments to openness. These two factors, though related, are independent in nature, and should therefore be evaluated distinct factors in the procurement ecosystem. DIGIWHIST, for example, explores the strengths and weaknesses of national legal frameworks (de facto solutions) that mandate the central collection and public release of data in its comparative legal review of 35 countries and the European Commission. At the same time,

author Mihály Fazekas explores the de facto realities of the procurement ecosystem, such as data missingness, in country level studies.

Linking up data from disparate sources presents another logistical challenge. Experts agree that the best possible red flag analyses come from jointly analyzing procurement data alongside related information such as company registries, financial information, ownership information, and network analyses that connect buyers and bidders. Identifying networks has been a keystone in the work of István Tóth of the Corruption Research Center Budapest. In particular, his latest longitudinal study on Hungarian procurement showcases the power of analyzing the links that exist between actors throughout the procurement ecosystem in identifying and combatting crony capitalism. A key methodological issue is finding ways to establish "closeness" between actors. In flagging suspicious relationships, Tóth suggests thoroughly reading through all project documentation to identify suspicious personal relationships, such as links related to family, friends, college roommates, or even hiking partners. Tracking suspicious business relationships such as co-ownership is markedly easier, particularly with the rise of electronic databases of company registries such as that offered by the Hungarian Ministry of Justice. As Mara Mendes of DIGIWHIST explores in a blog post on identifiers, the use of unique business and buyer identifiers enables us to analyze not only relationships and bidding and spending patterns, but also overall efficiency.

Ian Makgill also believes that collating these data is important for far more than integrity purposes. He showcases in his recent Open Opps blog post how linking up data helps governments and citizens, alike, gain a richer understanding of who is doing what and where, which can lead to easier performance management, better service provision, increased competition, greater small business participation, and overall cost savings. The benefits of improving data quality, accessibility, and usability are clear, but how do we actually go about it?

Luckily, collecting standardized, comparable data across time is not as difficult as it may seem. Though defining "normal" and detecting abnormalities necessitates a data sample of thousands of documents, we must remember that the scale of government contracting is even more massive; global spending on contracting amounts to over $9.5 trillion USD each year, a staggering 15% of global GDP. If countries commit to the very basic step of publishing open data about their public contracting, they can generate large amounts of data very quickly.

Centralizing this documentation will not only facilitate the crafting of context-sensitive flagging algorithms, but will also constitute major cost and time savings across the procurement process. Standardized document retention and archiving practices directly put dollars back into the government budget, as data aggregators will not have to manually work through massive backlogs of paper and electronic documents. Furthermore, centralizing documentation, particularly through the use of e-procurement systems, reduces the possibility of human error in data processing, resulting in more reliable and more easily comparable data.

III: OCDS to the Rescue!

1. Our data-day operations: data analysis for the greater good

Our conversations with top integrity academics and practitioners around the world highlighted a disconnect between and among researchers and practitioners; though there is valuable research being conducted on corruption risk techniques and technologies, there have traditionally been few avenues for collaboration and sharing. The advent of OCDS and the increasing availability of open source tools have potential to enable widespread collaboration among corruption risk researchers and implementers. Hopefully, this will foster rapid iteration in the design of methodologies and individual flags. This presents a wonderful opportunity for increasing the rate of learning about corruption risk monitoring.

In this spirit of collaborative learning, we engaged with Development Gateway (DG) to develop the most pragmatic tool possible for our field partners: a mapping methodology that links the most commonly discussed flags to actual data fields. It is our hope that partners can directly use this tool to identify data gaps, revise publication plans to close these gaps, and develop local monitoring approaches.

Our approach to corruption detection is simple: we compiled red flags of corruption risk from across the public contracting chain, developed indicators for each flag, and defined these flags using clear, replicable calculations. We then mapped the equations using OCDS data fields, thus enabling anyone with OCDS data to calculate the indicators. Next steps include testing the indicators using a variety of OCDS data sources to gauge their integrity across procurement markets. We also hope that the open contracting community will collaborate with us to further develop indicators and build consensus around around approaches to integrity monitoring.

In what follows, we provide the steps we have taken to develop our indicators list along with several insights into our key early findings.

Step 1: Identify indicators

Drawing on our own experiences in developing procurement monitoring and evaluation tools, our first step was to compile a list of indicators that may help us learn whether or not a contract is at risk for corruption. One highly useful resource we found is the Red Flags of Corruption, Bid Rigging, Collusive Bidding and Fraud developed by the International Anti-Corruption Resource Center (IACRC). After sorting the list for flags that we thought were observable, collectible and relevant, we created a database of 60 red flags. We also adapted ideas and indicators from the valuable work of field leaders including DIGIWHIST, the Government Transparency Institute (Budapest), the Kiev School of Economics, and the World Bank. Though we did inform our methodology on a wide range of expert voices, we do not see our review as exhaustive or completely representative of the field of integrity as a whole. There are many documented methodologies we have yet to fully explore, and others that can only be applied through the manual review of large bodies of procurement documents. For these reasons, we see this Guidance and mapping methodology as living tools that we will continuously improve through extended expert consultation, iterative piloting of data techniques, and adaptive learning.

Step 2: Define each flag

Once we identified potential flags, we sought to transform these flags into discrete and quantifiable indicators. For instance, the red flag “losing bidders are hired as subcontractors or suppliers” became: “losing bidder = supplier/subcontractor.” Following this model for each flag helped us develop an understanding of the types of data we would need in order to monitor them successfully. In considering how to define our flags, we explored existing portals that automatically calculate risk scores and even flag individual tenders such a Red Flags and Indonesia Corruption Watch.

Step 3: Assign a specific corruption scheme

Drawing once again on the IACRC’s framework, we sought to ensure that each indicator was linked to one or more scheme: fraud, bid rigging, corruption or collusion. Due to a variety of factors, including lack of data, poor data quality, and the particularities of many government contracting processes, it is not unusual for contracts to activate one, or even more, flags. However, if multiple red flags are triggered and they all point to a specific possible typology of corruption, say bid rigging, the likelihood of corruption is increased.

Step 4: Map to OCDS

Mapping procurement data to OCDS enables us to plug the data into any open source tool or code chain configured for OCDS. Using OCSD fields within our flagging code enables us to test our indicators against a variety of data sets, which helps ensure the integrity of our indicators and our greater flagging system. In this instance, we sought to determine which OCDS data fields we would need to effectively track our indicators. In total, our indicators use over 35 OCDS fields to monitor these 60 indicators. They also rely on an estimated 15-20 fields that are presently unavailable in OCDS, and several data sources that are outside the scope of the data standard, such as business registries, listings of blacklisted companies, and registers of the asset disclosures of public officials. This emphasises the value of linked open data with unique identifiers as per the G20 Anti-Corruption Open Data Package.

The ability of the OCDS to incorporate user feedback on data needs and adapt to new contexts is one of its biggest strengths. The OCDS is a “living standard” that is undergoing constant revision in an attempt to make the data more accessible and actionable. In conducting this mapping exercise, we have discovered concrete ways to improve the current OCDS schema, such as considering how to operationalize and incorporate these 15-20 missing fields. Interested users can engage with the constant upgrade process through the OCDS GitHub.

Step 5: Assign contracting phases

There are five phases in the contracting process: planning, tender, award, contract, and implementation. In addition to mapping each indicator to a scheme, we found it helpful to link each indicator to a contracting stage. Doing so enabled us to anticipate what we would be able to learn about a specific contracting process, and when. Based on the data fields we identified through the OCDS mapping, we were able to determine which flags were linked to each contracting phase.

In the next phase of the project, we will develop equations for each flag and test them using real procurement data. As we continue this process, we’ll also begin to develop a platform to help users make use of the flags.

2. We're always schema-ing something

Before moving on to the results of this work, it may be helpful to step back and ask ourselves, "Why use the OCDS?" When there is a truly endless array of techniques to employ, why structure our red flag methodology on the OCDS schema? Is that really an effective, efficient, and reliable way to detect corruption?

First, let's explore why we care about data, generally. We believe illicit behavior manifests itself in detectable data, an idea supported across the field of integrity experts. By tracking the same data points across projects and time, we can recognize behavioral patterns that indicate risk. In order to conduct this longitudinal analysis, we must have access to the same data types across time. That is, we must be comparing "apples to apples," or the same information about tenders, suppliers, and buyers over time. That meant we needed to find a data source that would enable this sort of cross-regional, longitudinal analysis. Because OCDS allows for the standardized, detailed collection of like data across disparate contexts, projects, and actors, it is an excellent means through which to collect standardized, robust, and comparable data.

In examining potential non-OCDS-based solutions, we came to the conclusion that, though OCDS is not perfect (see our analysis of suggested revisions to the OCDS schema below for a concrete example), it is the best tool currently available for systematizing the calculation of red flags across the procurement cycle. For starters, OCDS strikes a delicate balance between generalizable and contextual: the standard is generalizable enough to allow for comparisons of data across time and countries, yet flexible enough to adapt to the on-the-ground realities of each implementer's unique data ecosystem. The availability of extensions is a concrete example of how the OCDS can adapt to local needs. Due to its stability, machine readability, and generalizability across countries, the OCDS is an excellent tool in and of itself. OCDS is also powerful when coupled with existing country-level templates, which often lack stability over time and are not operable with templates from other countries.

The adaptability of OCDS to a large range of contexts makes it a prime candidate as the global standard for risk detection. In this way, OCDS can be thought of as a risk management tool which can allow us to analyze procurement patterns across time. By identifying these patterns, we can give a localized general sense of what is "normal" procurement behavior in any given context. It is then possible to find the "outliers," or instances in which behavior deviates from the norm. Flagging abnormal behavior should not be thought of as a certain indication of illicit or unethical behavior; rather, it is a way to narrow down the pool of potential cases of corruption or collusion that warrant further analysis.

Not only does this flagging of abnormal behavior identify cases for further analysis, but it also highlights overall inefficiencies in the procurement ecosystem at large. Identifying what types of tenders typically receive a single bidder when they should be competitive or tracking conditions that lead to higher than anticipated bid prices, for example, can help countries gain a richer understanding of their own procurement systems. In this way, flagging through OCDS is much more than a simple integrity-promotion tool; it supports actors in achieving the other three identified use cases of value for money, improved competition, and better service provision. With these points in minds, we shaped our methodology to conform more with our four use cases instead of with actual corruption hunting.

Going forward, we hope to inform revisions to the OCDS schema to improve the quality and quantity of information it can track for use in both strictly integrity-promotion analyses and more general use case analyses. In the present, however, OCDS has already vastly improved the quality of data available and has provided a schema for routine and consistent monitoring.

3. "Sum" worked sample calculations

To show how these high level integrity concepts can be applied to actual data for the purpose of integrity promotion, we will now walk through six sample calculations. Two caveats before we proceed:

1. Even if a flag is generated for a tender, it is not a sure sign that illicit behavior is present; rather, as explained previously, a flag highlights an opportunity for further scrutiny into behaviors that may end up proving themselves: a) not at all illicit or suboptimal; b) not illicit, but suboptimal in terms of value for money, competitiveness, or quality service delivery; or c) illicit.
2. Some flags are binary in nature, meaning that they can be answered with a clear cut "yes/no" statement. Others generate answers that fall on a spectrum of values, and therefore depend on a threshold value. It is necessary to consult local experts when defining these threshold values to ensure the thresholds are sensitive to temporal, regional, sectoral, and cultural contexts.

For each flag calculation, we provide the following information:

1. In a table, we present the flag itself, an explanation of why that flag matters, the type of calculation, the data fields used (categorized as OCDS or non-OCDS), and a sample calculation;
2. The R code that can be used to calculate the flag in practice. R is a statistical software package that enables deeper statistical analysis. Although we recognize that many developers prefer to implement calculations in Python or other languages, the R code is included to illustrate the calculation in practice. One major advantage to using R is that both the language and its widely used interface, RStudio, are free and open source. This, combined with the fact R is a remarkably powerful and robust statistical tool, means it has gained strong interdisciplinary traction.
3. A plain language explanation of the R code. These explanations will be particularly useful to implementers of these flags, providing a clear explanation of each step needed to implement the flag.

The flags that we have sampled here seek to demonstrate variation in the use of OCDS and non-OCDS fields, in the complexity of calculations and in the integration of loops and other mechanisms for sifting through large data sets within each the calculation. The flags that we have identified for this sampling, ordered from least to most complex, are:

1. This tender featured a single bidder only
2. Allowing an unreasonably short time to respond to requests for bids
3. Bidder that has never bid previously wins tender
4. Bid is too close to budget, estimate or preferred solution
5. Bids are an exact percentage apart
6. Only the winning bidder was eligible to have received the contract for this tender

Flag 1: This tender features a single bidder only*

Flag	Why we care	Type	Fields	Sample calculation
This tender features a single bidder only	A single bid tender may indicate lower than ideal competition, which may result in award values above competitive market price	Binary	OCDS: tender/id; tender/tenderers	Add a binary flag (0,1)

***** *This flag is only valid if a single bid is received for an otherwise competitive tender. This flag is unlikely to be valid in the case that a single bid is expected (for example, in a highly specialized market).*

R Code:

```
23  matched <- cbind(seq=with(matched, ave(matched$tender/id, FUN=seq_along)).matched)
24  for(i in seq(nrow(matched)-1))
25  {
26    hello <- i+1
27    if(matched$seq[i]==1&matched$seq[hello]==1)
28    {
29      matched$seq[i] <- 0
30      matched$flag1[i] <- 1
31    }
32  }
```

R Code explained:

- Line 23: Create a sequential count for the suppliers within each tender. Thus, the first bidder within a tender is identified as 1, the second bidder 2, etc.
- Line 24/ 32: Loop through each row (bid) in the dataset.
- Line 27: Create a provision to identify when there are two subsequent rows for which “seq”==1. That is, if “seq”==1 and then ==1 again, that means the first row matched a supplier that was the only bidder for a given tender—i.e. there was no second bidder (“seq”==2) for that tender.
- **Line 29/ 30: Add a binary flag (0,1) for tenders that have a single bidder only.**

Flag 2. Allowing an unreasonably short time to respond to requests for bids

Flag	Why we care	Type	Fields	Sample calculation
Allowing an unreasonably short time to respond to requests for bids	Providing most bidders short notice to prepare bids may give an unfair competitive advantage to select bidders who receive early notification of the tender.	Threshold	*OCDS:* tender/tenderPeriod/endDate; tender/tenderPeriod/startDate	Add a binary flag (0,1) if the bid period is X days or fewer. **We have used 1 day for illustrative purposes.**

R Code:

58	matched <- cbind(ndays=(as.Date(as.character(matched$tender/tenderPeriod/endDate),format="%Y/%m/%d") - as.Date(as.character(matched$tender/tenderPeriod/startDate),format="%Y/%m/%d")),matched)
59	matched$flag11[matched$ndays<=1] <- 1

R Code explained:

- Line 58: Create a field “ndate” to represent the number of days of the tender period. It subtracts the tender period start date (tender/tenderPeriod/startDate) from the tender period end date (tender/tenderPeriod/endDate).
- **Line 59: Add a binary flag (0,1) if the tender was only open for bidding for 1 day or fewer**

Flag 3: Bidder that has never bid previously wins tender

Note:

Flag	Why we care	Type	Fields	Sample calculation
Bidder that has never bid previously wins tender	Experts such as Mihály Fazekas have warned against using this red flag indicator because new bidders winning tenders is sometimes a flag of integrity, as it can signal	Binary	*OCDS:* awards/suppliers/id; awards/status; tender/te	Add a binary flag (0,1) if it was the first time a supplier had ever bid and the bid won.

	that the procurement process is opening. We are currently working on a way to strengthen the validity of this this indicator by including additional component: supplier age. Supplier age is relevant because there is evidence to indicate that a first time winning supplier less than 1 year old can be a true flag, as could a young tenderer with multiple wins. Supplier age is not currently available in the OCDS schema.		nderPeriod/endDate	

R Code:

24	matched <- matched[order(matched$awards/suppliers/id,matched$tender/tenderPeriod/endDate),]
25	matched <- cbind(seq2=with(matched, ave(matched$awards/suppliers/id,matched$awards/suppliers/id, FUN =seq_along)),matched)
26	matched$flag42[matched$seq2==1&matched$awards/suppliers/identifier==”Y”] <- 1

R Code explained:

- Line 24: Sort the entire dataset first by the supplier ID (awards/suppliers/id) and then by tender closing dates (tender/tenderPeriod/endDate).
- Line 25: Add a sequential variable “seq2” for each time a supplier has bid on a tender. Thus, “seq2” would equal 1 for a supplier’s first ever bid.
- **Line 26: Add a binary flag (0,1) if “seq2”==1 and the bid won the tender, as in, if it was the first time a supplier had ever bid and the bid won.**

Flag 4. Bid is too close to budget, estimate or preferred solution

Flag	**Why we care**	**Type**	**Fields**	**Sample calculation**
Bid is too close to budget,	A bid value too close to a non-publicly released budget or	Threshold	*OCDS:* planning/bidNo; tender/id;	Add a binary flag (0,1) if the percentage distance

estimate or preferred solution	estimate value may signal that select bidders may have received additional information about the cost estimate or budget. This would amount to an unfair competitive advantage for those bidders.		awards/id; tender/value/amount *Non-OCDS:* tender/tenderers/bidValue*	between prices is less than X%. **We have used 1% for illustrative purposes.**

** In this example, we generated an additional field that is not in the current release of OCDS. The tender/tenderers/bidValue field represents the value of the bids proposed by individual tenderers.*

R Code:

```
31  for(g in seq(nrow(matched)))
32  {
33    if(is.na(matched$tender/value/amount[g])){next}
34    Disti <- abs((matched$tender/value/amount[g]-matched$tender/tenderers/bidValue[g])/
      matched$tender/tenderers/bidValue[g])
35    if(disti<0.01)
36    {
37      matched$flag26[matched$planning/bidNo==matched$planning/bidNo[g] <- 1
38    }
39  }
```

R Code explained:

- Line 31/ 39: Loop to iterates through each row (bid) in the dataset.
- Line 33: Add a provision to skip tenders that don't have an estimated price (tender/value/amount).
- Line 34: Calculate the absolute percentage distance between the estimated price and the bid price (tender/value/bidPrice) for a given bid and tender.
- **Line 35/ 37: Add a binary flag (0,1) if the percentage distance between prices is less than 1%.**

Flag 5: Only the winning bidder was eligible to have received the contract for this tender

Flag	**Why we care**	**Type**	**Fields**	**Sample calculation**

Only the winning bidder was eligible to have received the contract for this tender	When only the winning bidder was deemed responsive, particularly when there are additional disqualification irregularities present, this can be a sign that a certain bidder received additional information about the specifications and prerequisites for the tender, leading to an unfair competitive advantage.	Binary	*OCDS:* tender/id; awards/status *Non-OCDS:* ineligibleYN*	Add a binary flag (0,1) if there was only one eligible supplier and that same supplier won the contract for a given tender

***** *In this example, we generated an additional field that is not in the current release of OCDS. The tender.ineligibleYN field represents a binary indicator of whether or not a tenderer is eligible.*

R Code:

```
81  for(q in unique(nsing$tender/id))
82  {
83    elig <- data.frame(succ=nsing$awards/status[nsing$awards/status==q],eligs=nsing$ineligible_YN[nsing$awards/status==q])
84    if(nrow(elig[elig[,2]==”N”,])==1)
85    {
86      elig2 <- elig[elig[,2]==”N”,]
87      if(elig2[1,1]==”Y”
88    {
89        matched$flag12[matched$tender/id==q] <-1
90     }
91   }
92  }
```

R Code explained:

- Line 81/ 92: Loop through each individual tender
- Line 83: Create a small matrix that only shows two cells for each supplier that bid for the tender: whether or not they won (“awards/status”) and whether or not they were eligible to bid (“ineligible_YN”).
- Line 84/ 86: Add a provision that subsets the data if there is only one supplier who was eligible to have bid and identifies who it was.

- **Line 87/ 89: Add a binary flag (0,1) if there was only one eligible supplier and that same supplier won the contract for a given tender.**

Flag 6: Bids are an exact percentage apart

Flag	Why we care	Type	Fields	Sample calculation
Bids are an exact percentage apart	Irregularities in the correlation between bid prices such as identical spacing between bid values may indicate that bidders colluded during the tender process in an attempt to decrease competition.	Binary	*OCDS:* tender/id *Non-OCDS:* tender/tenderers/bid Value*	Adds a binary flag (0,1) if the percentage distance between a given bid pair is a whole number

** In this example, we generated an additional field that is not in the current release of OCDS. The tender/tenderers/bidValue field represents the value of the bids proposed by individual tenderers.*

R Code:

```
49  for(k in unique(nsing$tender/id))
50  {
51    teeny <- matched[matched$tender/id==k,]
52    for(b in seq(nrow(teeny),1))
53    {
54      hectic <- b+1
55      for(v in seq(hectic,nrow(teeny),1))
56      {
57        distper <- abs((teeny$tender/tenderers/bidValue[b]-
          teeny$tender/tenderers/bidValue[v]/teeny$tender/tenderers/bidValue[v])*100
58          if((distper%%1)==0{matched$flag61[matched$tender/id==k] <- 1}
59      }
60    }
61  }
```

R Code explained:

This flag uses multiple loops:

- Line 49/ 61: Loop through each individual tender (tender/id).
- Line 52/ 60: Once a tender is identified at the former loop, loop through each bid (tender/tenderers/bidValue) within the tender.
- Line 55/ 59: Once a bid is identified at the former loop, loops through all the *other* bids within the same tender.
- Line 57: Calculates the absolute percentage distance between all bid pairs within a given tender.
- **Line 58: Add a binary flag (0,1) if the percentage distance between a given bid pair is a whole number (i.e. if the remainder of the percentage divided by 1 is 0).**

IV: Mapping OCDS to red flags: it's off the charts!

Having explained our motivation for constructing an OCDS-centric solution, we move into revealing the real star of the show: our Red Flag Mapping Tool. This Tool synthesizes the innovative ideas we heard from expert voices across the field of integrity and translates them into a pragmatic tool practitioners can use to begin applying a red flag methodology to their own data. The mapping tool demonstrates in a very real sense how, once OCDS validated, country data can be mapped to specific red flag indicators for not just integrity purposes, but also other use cases such as value for money, competitiveness, and improved service provision. The tool also highlights existing data gaps, which can help countries develop publication plans to tackle data quality and availability challenges directly.

The full mapping schema is available here. Each row, or case, contains information about one red flag indicator. The format of the data table is copied below, with an an explanation of the data type in the second row and an example in the third row:

Phase	Associated Scheme(s)	Red Flag	Indicator Description	Possible: OCDS?	OCDS Field(s)	Other Data Needed	Possible: Ukraine?
Validated list	*Validated list*	*String*	*String*	*Binary*	*String*	*String*	*Binary*
Tender	Corruption; Bid rigging; Collusive bidding	Complaints from bidders	Complaints from bidders about the bid procedure, procuring entity, or other bidders can be one of the first signs of corruption	1	award/ documents/ complaint		0

1. Stage

Specifies one or more of five procurement stages, separated by a semicolon:

1. Planning
2. Tender
3. Award
4. Contract
5. Implementation

2. Associated Scheme(s)

Specifies one or more of 17 illicit schemes, separated by a semicolon. IACRC's Guide to Combatting Corruption and Fraud in Public Procurement provides robust definitions of each scheme.

1. Bid Rigging
2. Change Order Abuse
3. Collusion
4. Corruption
5. Excluding Qualified Bidders

6. Failure to Meet Contract Specs
7. False Statements or Claims
8. False, Inflated or Duplicate Invoices
9. Fictitious Contractor
10. Hidden Interests
11. Leaking of Bid Information
12. Manipulation of Bids
13. Product Substitution
14. Rigged specifications
15. Split Purchases
16. Unbalanced Bidding
17. Unjustified Sole Source Awards

3. Red Flag

Short description of the specific flag

4. Indicator Description

Detailed explanation and/or metricization of flag

5. Possible: OCDS?

Binary of the ability to calculate this flag using *only* fields included in the current OCDS schema (without additional data fields or sources), with 0 meaning “no,” and 1 meaning “yes”

6. OCDS Field(s)

Listing of the OCDS field(s) required to calculate each flag, separated by a semicolon

7. Other Data Needed

Listing of other data fields needed to calculate the flag, should the flag be incalculable within the current OCDS schema

8. Possible: Ukraine?

Binary of the ability to calculate this flag from the current Ukrainian OCDS data, with 0 meaning “no,” and 1 meaning “yes”

From this master list, we identified 36 red flag indicators that are possible to calculate within the current OCDS schema. The first column relates the flag to a specific stage of the procurement process. Although each flag pertains to its corresponding phase, the ability to calculate each flag may not come until later phases. For example, we may not be able to calculate tender flags such as “single bid received” until the tender phase has fully closed. The fact that tender-related data such as number of bidders are not available until after the close of the tender phase (the award phase) means, therefore, that we cannot calculate some tender phase flags in real time. The second column names the flag. The third column specifies which OCDS field or fields are necessary to calculate each flag.

Table 1: OCDS Flags

Phase	Red Flag	OCDS Field(s)
Planning	Key planning documents are not provided	planning/documents/procurementPlan; planning/documents/projectPlan
Tender	Non-public bid opening	tender/procurementMethod
Tender	Failure to adequately advertise the request for bids or proposals	tender/documents/tenderNotice; tender/tenderPeriod/startDate; tender/tenderPeriod/endDate
Tender	Short notice to bidders to submit expression of interest or prepare bids	tender/tenderPeriod/startDate; tender/tenderPeriod/endDate
Tender	Failing to read out bid prices and terms at bid opening	tender/id; tender/value/amount; tender/awardCriteria; tender/awardPeriod/startDate
Tender	Vague description of the supply terms	tender/documents/technicalSpecifications
Tender	Tender value is higher or lower than average for this item category	tender/value/amount; tender/items/id
Tender	Certain line items remain in recurring contracts that have never been called for in the past, and/or which will not be called for in the future	tender/documents/technicalSpecifications ; awards/items/description
Tender	Changes to bids after other bid prices are known	tender/amendment/changes/property; tender/value/amount
Tender	Agents charge excessive fees, usually expressed as a percentage of the contract value, or overcharge for the work performed (Billing Abnormalities)	contracts/items/unit/value/amount
Tender	Unreasonably high line item bids	tender/items/unit/value/amount
Tender	Unreasonably low line item bid	tender/items/unit/value/amount
Tender	Business similarities between bidders: Common addresses, personnel, phone numbers, etc.,	tender/tenderers/address/streetAddress; tender/tenderers/contactPoint/name; tender/tenderers/contactPoint/faxNumber
Tender	Single bid received	tender/numberOfTenderers
Tender	Fewer than the expected or normal number of bidders, based on prior similar contracts,	tender/numberOfTenderers; tender/items/id;

	submit bids	tender/procuringEntity/identifier/id
Tender	Perennial losing bidders give appearance of legitimate competition when they have no intention of actually winning	tender/tenderers/identifier/id; awards/suppliers/name
Tender	Any complaint	awards/documents/complaints
Award	Decision period for submitted bids excessively short	tender/awardPeriod/startDate; tender/awardPeriod/endDate
Award	Decision period for submitted bids excessively long or involved legal challenge	tender/awardPeriod/startDate; tender/awardPeriod/endDate
Award	Long, unexplained delays in contract negotiations or awards (ex: as bribe demands are negotiated)	awards/date; contracts/dateSigned
Award	The same companies always bid, the same companies always win and the same companies always lose	awards/suppliers/name; tender/tenderers/identifier/id
Award	Bidder that has never bid previously wins tender	awards/suppliers/name; tender/tenderers/identifier/id
Award	High number of contract awards to one bidder	awards/suppliers/name; awards/suppliers/identifier/id; tender/procuringEntity/identifier/id
Award	Supplier address is PO box with no address or phone number	awards/suppliers/address/streetAddress; awards/suppliers/contactPoint/telephone
Award	Business similarities between suppliers: Common addresses, personnel, phone numbers, etc.,	awards/suppliers/address/streetAddress; awards/suppliers/contactPoint/faxNumber ; awards/suppliers/contactPoint/name
Award	Supplier address is same as project official's	tender/procuringEntity/contactPoint/telephone; awards/suppliers/contactPoint/telephone; tender/procuringEntity/address/streetAddress; awards/suppliers/address/streetAddress
Award	Small initial purchase from supplier followed by much larger purchases (first purchase is to test whether it will be accepted)	tender/procuringEntity/identifier/id; awards/value/amount; awards/suppliers/name
Contract	Supplier receives multiple single-source/noncompetitive contracts from a single procuring entity during a defined time period	awards/suppliers/name; contracts/id; tender/procurementMethod; tender/procuringEntity/identifier/id
Contract	High number of contracts of the same type given to one supplier	awards/suppliers/name; tender/procurementMethod; contracts/items/id; contracts/id; tender/procuringEntity/identifier/id; tender/value/amount
Contract	Large difference between contract award and final contract amount	awards/value/amount; contracts/value/amount
Contract	Contract is not public	contracts/documents/contractNotice

Implementation	Approval of unnecessary change orders to increase the contract price after award	contracts/value/amount; contracts/implementation/transactions/amount
Implementation	Change orders issued after contract award extending the line item requirements	awards/amendment/changes/property
Implementation	Change orders issued after contract award, reducing or deleting item	awards/amendment/changes/property; awards/items/id; tender/items/id
Implementation	Payment of unjustified high prices relative to historical average	contracts/implementation/transactions/amount; tender/items/id; tender/procuringEntity/identifier/id
Implementation	Total payments to a contractor exceed total contract or purchase order amounts (Purchase of Unnecessary or Inappropriate Items)	contracts/value/amount; contracts/implementation/transactions/amount

A preliminary insight into the process of applying red flagging methodologies to actual data relates to the number of flags generated per phase, as summarized below. As evidenced by the counts, far more flags can be calculated in the tender and awards stages than in the contract, implementation, and planning phases. This insight is valuable because it supports our strategic planning of OCDS upgrades. For example, even though Table 2 shows us that only 1 flag pertains to the planning phase, theory tells us there are many opportunities for illicit behavior at that stage. As such, we could enable the calculation of more and better flags by restructuring or add new fields into the planning phase of the OCDS schema.

Table 2: OCDS flags by phase

Phase	Count
Planning	1
Tender	16
Award	10
Contract	4
Implementation	5

Of the 42 unique OCDS fields necessary to drive these calculations, 22 appear in just one calculation, 10 appear in 2 calculations, 6 appear in 3 calculations, and 4 appear in 4 or more calculations. The OCDS fields that appear in the greatest number of calculations appear below.

Table 3: Flags generated by each OCDS field

OCDS Field	Count
awards/suppliers/name*	7
tender/procuringEntity/identifier/id	6
tender/items/id	4

tender/value/amount	4
awards/suppliers/address/streetAddress	3
contracts/implementation/transactions/amount	3
contracts/value/amount	3
tender/awardPeriod/startDate	3
tender/procurementMethod	3
tender/tenderers/identifier/id	3

**Though supplier name is one way to identify suppliers, fields such as supplier ID are preferable because their inherent standardization decreases the difficulties associated with matching names which are entered similarly, but not identically. An even better option is unique IDs, such as those from a business registry.*

Given that the majority of flags fall under the tender and award phases, it is understandable that the most recurring fields involve just identifying basic information about the tenderers, suppliers, procuring entities. Other vital information includes tender, contract, and transaction amounts.

This is great news for countries just beginning the process of implementing anticorruption flagging into their data systems. By just tracking basic data about who is paying how much and to whom, countries can calculate the bulk of flags possible in the OCDS schema.

It should be noted that though our key field of interest, supplier name, appears in the calculation of 7 flags, in each of those cases, the field must be coupled with an additional new field or fields for calculation. This is true for many of fields. When looking at the true flag-calculating potential of each field, therefore, we must consider two factors: first, the overall popularity of that indicator in the calculation of new flags, as summarized in the above table; and second, its ability to independently drive the calculation of flags. That is, we must also look at the number of flags each indicator can generate without the help of any secondary indicator or indicators. This potential is summarized below. As you'll see, some of these flags did not appear on the above table, as they only generated 1 or 2 flags each.

Table 4: Unique flags generated by each OCDS field

OCDS Field	**Count**
tender/items/unit/value/amount	2
tender/documents/technicalSpecifications	1
tender/numberOfTenderers	1
tender/procurementMethod	1
awards/amendment/changes/property	1
awards/documents/complaints	1
contracts/documents/contractNotice	1
contracts/items/unit/value/amount	1

Here, we see that monitoring the line item value, which didn't even appear in Table 3, is the only field which can independently calculate two flags. Seven other fields can independently calculate one flag each. By combining information about the first factor, the overall popularity of the indicator as summarized in Table 3, and the second factor, the unique calculating potential as summarized in Table 4, we can structure our conversations with country-level data administrators about the overall usefulness of each data field in OCDS being collected. That is, we can look at the "return on investment" of collecting each data field, which can help countries to analyze which data to prioritize in their publication plans. Our hope is that this exercise can be a first step in learning how to work smarter, not harder, when it comes to applying integrity methodologies at the ground level.

V: What we learned

In mapping the OCDS schema to this set of 36 red flag indicators with the Ukrainian data, we found concrete opportunities to improve our methodology. Tweaking our methodology will allow us to generate a more robust, reliable, and accurate mapping of future countries' OCDS datasets.

1. OCDS Upgrade: additional fields needed

In addition to identifying and mapping the aforementioned 36 red flag indicators currently possible within the OCDS schema, we identified an additional 75 flags that could be calculated with minor additions to the OCDS schema. The calculation each of these 75 flags would necessitate the inclusion of one or two additional fields into the OCDS schema. Calculating all 75 flags would require adding a total of 37 new unique fields into the current OCDS schema. Of these 37 new fields, 26 would be necessary for the calculation of just one new flag each, 5 fields would appear in 2-4 new flags each, four fields appear in 5-7 flags each, and one field appears in a whopping 19 flags. The list of suggested new fields and their counts in additional flag calculations is below.

Table 5: Suggested new OCDS fields by flag-calculating potential

Additional Field	Description	Count
tender/tenderers/bidPrice	Number: Value of a bid	19
tender/tenderers/responsive	Binary: Was the tenderer responsive (qualified) to win the award?	7
tender/documents/illicitBehaviorDocumentation	Binary: Does there exist documentation of illicit behavior?	6
contracts/implementation/documents/invoices	Document: Invoices	5
tender/bidThreshold	Number: The competitive threshold of bids, as defined legally within each context	5
awards/suppliers/subcontractors	List: All subcontractors included in the award	4
tender/complaintType	Description: Type of each complaint received	4
awards/suppliers/approved	Binary: Does the supplier appear on an approved suppliers list?	3
tender/contractadvertising/startDate	Date: The date on which the contract advertising began	2
tender/publishingMethod	Description: The method by which the tender was published	2

It should be noted that though our key field of interest, bid price, appears in the calculation of 19 new flags, in 5 of those cases, the field must be coupled with an additional new field for calculation. In 4 of these 5 instances, it must be paired our second most important field listed above, tender/tenderers/responsive, and in one case, it must be paired with a timestamp of when the bid price was submitted. With that, we can see that tender/tenders/responsive only appears independently in 3 of 7 total new flag calculations; as mentioned, in the other 4 instances, it must be paired with bid price. This causes its flag-calculating potential to fall below new suggested fields, such as invoice documentation.

As discussed in the above section, we must simultaneously consider both the overall popularity of indicators in the calculation of new flags and their ability to independently drive the calculation of flags. By analyzing the first factor, as summarized in Table 5, and the second factor, as summarized in Table 6 below, we can begin to structure our conversations on OCDS upgrades around maximizing both overall procurement integrity and the overall usefulness of the data being collected.

Table 6: Suggested new OCDS fields by unique flag-calculating potential

Field	Count
tender/bidPrice	14
tender/documents/illicitBehaviorDocumentation	6
contracts/implementation/documents/invoices	5
tender/bidThreshold	5
tender/complaintType	4
awards/suppliers/approved	3
awards/suppliers/subcontractors	3
tender/tenderers/responsive	3
tender/contractadvertising/startDate	2
tender/publishingMethod	2

While the above table is a first step in understanding the value of each field, we want to emphasize that a simple count of uses of a field in flagging does not necessarily correlate with the value of an individual flag. Though certain fields may boast a relatively low flag calculating potential, they may be crucial aspects of the procurement process, and are therefore intrinsically valuable to monitor and report. For instance, while you can do a lot of math with bidPrice, a contract should never go to a non-responsive bidder. Though the flag-calculating potential of “bid price” is much higher than that of “responsive bidder,” the intrinsic importance of ensuring that only responsive bidders win tenders means that “responsive bidder” may be just as valuable as “bid price.”

As evidenced by this analysis, by thinking strategically about which new data types will drive the best possible integrity analyses, we can ensure we are spending our resources on collecting the right kinds of data. Now that we have done a primary analysis of the potential benefit of each

new data field, we can engage with the OCDS Upgrade process to discuss the feasibility, associated costs, and anticipated challenges of including these fields into the OCDS schema. Again, the question of "data for what, data for whom," remains at the forefront of our thinking.

2. Ukrainian mapping: data availability challenges

Working closely with the OCDS Help Desk, we carefully matched each Ukrainian OCDS field to the red flag indicators listed in Table 1. The goal of the exercise was to identify overlap between the fields necessary for the red flag calculations and the available Ukrainian data, and then calculate the "coverage" of each of these Ukrainian fields. "Coverage" here does not mean the percent of tenders or contracts that include a specific field. Rather "coverage" refers to the percentage of rows under a particular OCDS building block that are filled out. OCDS building blocks are the penultimate portion of the full indicator name. For example, the building block of "tender/tenderPeriod/startDate," is "tender period." "Tender period" becomes the unit of analysis of the coverage. The calculated coverage of approximately 88%, then, should be interpreted as, of the Ukrainian OCDS rows that specify tender period, 88% report the specific start date of that tender." This is different from claiming, for example, that 88% of all tenders in the system include a tender period start date. Understanding each field's coverage is a critical first step in understanding to what degree a red flag mapping methodology can be applied to a country's dataset.

The results of this Ukrainian mapping exercise are very encouraging. The coverage for each red flag indicator is calculated in the third column in Table 7 below. We use the term "maximum coverage" for each red flag because the calculation of many red flag indicators, as noted, depends on multiple OCDS data fields. In some of these instances, the coverage of one OCDS indicator is higher than another. Therefore, we take the minimum OCDS coverage value as our "maximum coverage" value, as this is the absolute highest coverage value possible if we assume perfect correlation of the availability of the "weakest" OCDS indicator (that with the lowest coverage) to the "strongest" OCDS indicator (that with the highest coverage). Consider the following example for clarity: for the flag "Decision Period for Submitted Bids Excessively Short," we need 2 OCDS indicators: award period start date, and award period end date. Award period start date has a coverage of about 66%, whereas award period end date has a slighter lower coverage of approximately 60%. Therefore, if we assume that every row that specifies an end date also specifies a start date, the absolute maximum coverage for this red flag indicator set is 60%.

Table 7: Red Flag indicator field coverage of Ukrainian OCDS data

Phase	Red Flag	Maximum Coverage (%)
Planning	Key planning documents are not provided	0
Tender	Non-public bid opening	100
Tender	Failure to adequately advertise the request for bids or proposals	0
Tender	Short notice to bidders to submit expression of interest or prepare bids	88
Tender	Failing to read out bid prices and terms at bid opening	66

Tender	Tender value is higher or lower than average for this item category	100
Tender	Certain line items remain in recurring contracts that have never been called for in the past, and/or which will not be called for in the future	0
Tender	Changes to bids after other bid prices are known	0
Tender	Agents charge excessive fees, usually expressed as a percentage of the contract value, or overcharge for the work performed (Billing Abnormalities)	0
Tender	Unreasonably high line item bids	0
Tender	Unreasonably low line item bid	0
Tender	Business similarities between bidders: Common addresses, personnel, phone numbers, etc.,	100
Tender	Single bid received	100
Tender	Fewer than the expected or normal number of bidders, based on prior similar contracts, submit bids	100
Tender	Perennial losing bidders give appearance of legitimate competition when they have no intention of actually winning	100
Tender	Any complaint	0
Award	Decision period for submitted bids excessively short	60
Award	Decision period for submitted bids excessively long or involved legal challenge	60
Award	Long, unexplained delays in contract negotiations or awards (ex: as bribe demands are negotiated)	66
Award	The same companies always bid, the same companies always win and the same companies always lose	100
Award	Bidder that has never bid previously wins tender	100
Award	High number of contract awards to one bidder	100
Award	Supplier address is PO box with no address or phone number	99
Award	Business similarities between suppliers: Common addresses, personnel, phone numbers, etc.,	100
Award	Supplier address is same as project official's	100
Tender	Small initial purchase from supplier followed by much larger purchases (first purchase is to test whether it will be accepted)	100
Contract	Supplier receives multiple single-source/noncompetitive contracts from a single procuring entity during a defined time period	100
Contract	High number of contracts of the same type given to one supplier	100
Contract	Large difference between contract award and final contract amount	68
Contract	Contract is not public	0
Implementation	Approval of unnecessary change orders to increase the contract price after award	0
Implementation	Change orders issued after contract award extending the line item requirements	0
Implementation	Change orders issued after contract award, reducing or deleting item	0
Implementation	Payment of unjustified high prices relative to historical average	0

Implementation	Total payments to a contractor exceed total contract or purchase order amounts (Purchase of Unnecessary or Inappropriate Items)	0

Even with this preliminary analysis, we can draw some interesting conclusions that could help the Ukrainian government make strategic decisions about its publication strategy. An excellent first step would be to consider average coverage by phase, as summarized below.

Table 8: Average field coverage by phase

Phase	Average Coverage (%)
Planning	0
Tender	53
Award	87
Contract	67
Implementation	0

While there is excellent coverage in the awards phase, coverage in the tender and contract phases is mixed, and there is no coverage in the planning and implementation phases. In order to maximize their ability to apply a red flag methodology, therefore, the Ukrainian ProZorro team should consider prioritizing publishing planning and implementation data and improving the quality of tender and contract data. It should be noted that this particular analysis utilized an outdated and incomplete version of the Ukrainian dataset, and is therefore not reflective of the current coverage of the ProZorro OCDS data. Since this dataset was published, the Ukrainians have made excellent progress in improving their data, specifically by including better planning and implementation data. Therefore, this mapping exercise should be thought of as a "proof of concept" of what is possible through applying a red flag mapping methodology to actual OCDS data, and not a reflection of the current state or quality of the current ProZorro data.

Our aim is that this mapping exercise and the preliminary analysis provided will be a solid starting points for more in depth conversations with partners about how to make strategic decisions about their data collection and publication. In future conversations, we hope to discuss the relative cost of collating and reporting each missing or undercovered data field in order to figure how to get the most "bang for the buck" out of their data systems. We are eager to continue this conversation with the ProZorro team as well as extract as much learning as possible from this pilot mapping exercise in order to improve on our methodology for the potential re-mapping of the Ukrainian OCDS dataset and the mapping of additional countries' OCDS datasets, such as those of Nepal and Mexico City (CDMX).

3. Ukrainian mapping: matching and calculation challenges

Even with the relatively high quality of the Ukrainian OCDS data and the high level of standardization that OCDS boasts, matching red flag indicators fields to specific OCDS fields did have specific challenges. One challenge was specifying the specific fields necessary for the calculation of each flag. Our methodology was to keep fields as generic as possible, assuming,

for example, that even countries with low quality data will at least publish a tenderer contact point name. What we found is that Ukraine's data sometimes includes similar but not identical fields. In this same instance, for example, the Ukrainian data contains "legal name" rather than "name," and tenderer contact point matches are therefore null. This discovery has helped us to deepen our understanding of the Ukrainian OCDS data, and also begin to consider what kinds of matching challenges we may face as we continue mapping new countries, all of which are likely to have their data field idiosyncrasies.

As a proactive approach to navigating these small but ultimately important semantic differences, we hope to construct a "translation" list which will map out alternative valid fields for every red flag indicator field listed. To extend the prior example, this could involve describing an equivalency in which "tender/tenderers/identifier/id," "tender/tenderers/identifier/legalName," or "tender/tenderers/name" are all as equally valid-and therefore proper substitutes-for any flag whose calculation requires the specification of "tender/procuringEntity/contactPoint/name." This step will involve considerable consultation with country-level data experts, as we want to ensure that there are not small differences between seemingly interchangeable fields that would affect the validity of red flag calculations. That is, for example, we want to make sure that tender/tenderers/identifier/name" and "tender/tenderers/identifier/legalName" actually refer to the exact same information in that given context.

A purely mathematical challenge involves flags whose calculations rely on "and/or" combinations of OCDS fields. Consider, for example, the flag "high number of contracts of the same type given to one supplier." For this flag, we need information about the supplier surely, but also information about contracts of the "same type." What does "same type" really mean? One way to define the term could be simply a contract by the same procuring entity, which could be tracked through a number of fields such as "tender/procuringEntity/identifier/id," "tender/procuringEntity/identifier/legalName," or "tender/procuringEntity/name." What if we define "same type," though, as contracts that list the same items? Then we would need fields such as "contracts/items/id" and maybe even more specific information from related fields like "contracts/items/description." A third option could be defining "same type" as awards of the tenders of the same relative size from the same Procuring Entity. In this case, we would need the aforementioned procuring entity information and also "tender/value/amount," which itself would need to be specified to define what the acceptable threshold level of variation in amount would be for tenders to still be considered "same relative size."

This extended example demonstrates how quickly seemingly simple flags turn into complicated exercises of combinations, manipulations, and permutations of clusters of related fields. It presents a weighty mathematical challenge as we attempt to drill to the heart of the issue: figuring out the minimum amount of information we need to calculate any given flag.

As well as proving a valuable exercise for our Ukrainian counterparts, this mapping activity has been beneficial for internal learning at the OCP. Through conducting this pilot mapping, we have learned how we can better support partners to define localized use cases for integrity, to publish more useful data for anti corruption purposes, and to actually use data for integrity monitoring.

VI: Now What?

Our initial dive into the field of red flagging has opened our eyes to a wide range of opportunities for collaborating with academics, practitioners, and governments around the world to identify context-sensitive solutions to tracking integrity indicators. The opportunities for growth and learning are huge, we have identified five key areas of interest we will prioritize in our integrity and red flagging work going forward:

1. Nepal

Our work in Nepal directly aligns with the methodology described in this Guidance. In fact, two of the main objectives of our S&L project are related to integrity. As noted in the project document, we aim to foster:

I. An enabling environment of trust and confidence ensured between the government and the general public by virtue of its openness in public procurement activities through an OCDS public procurement portal.
II. Measurable improvements seen in procurement outcomes (such as value for money, fairness, integrity and redress of citizens concerns) resulting from stakeholders' use of data.

The Government of Nepal, through the Public Procurement Monitoring Office (PPMO), with the help of the the local partner Young Innovations, has agreed to implement the public procurement reform -with OCDS implementation being its central element- with an overall objective of increasing trust in and the integrity of the public procurement system. As we progress in this collaboration, we aim to use this mapping tool to identify data gaps and potential monitoring indicators with partners in the country.

2. CDMX

When it comes to tracking indicators and specifically those that may relate to public integrity or corruption risk, Mexico City is just beginning this journey. The team there has committed to tracking key performance indicators (KPIs) that relate specifically to creating a more competitive business environment and strengthening public integrity. They are also proposing to work with civil society to track more complex indicators under these themes. At this time, it remains unclear which indicators will be inward or outward facing (internal versus public).

The city already plans to track performance indicators that align with several of the red flags that we have identified. These draft indicators relate to bidder complaints, single-source/direct award contracts, spending compared to budgeted amount, number of bidders, and the mix of new and longer-term bidders. To support the CDMX team in this important work, we will first collaborate closely to finalize and fully metricize these KPIs, hopefully in the near future. In quarter one of 2017, we hope to hold a learning and review session with core team to develop a detailed monitoring plan for these KPIs. To align the integrity work already completed with the CDMX S&L project, we will include specific integrity indicators and methodologies into this monitoring

plan. We will then work closely with the CDMX team to highlight the many benefits of integrity promotion in order to fully include the project in future integrity work.

3. Mapping new countries

A practical next step will be to publicly publish the OCDS to red flagging mapping methodology and the worked Ukrainian example to invite feedback on our work, which can help us revise and improve in the next mapping rounds. Once procurement officials worldwide see the practical application of our methodology, they may be incentivized not only to validate their own OCDS data, but also to release these data to be mapped against our red flag indicators.

4. Providing deeper guidance in future chapters

This Guidance is just the first piece in what we hope will flourish into a rich conversation on integrity and red flagging. It is our goal to continue engaging with researchers and practitioners across the field of integrity to deepen our understanding of the many complex challenges and opportunities that exist. Following our methodology of "building the field, not being the field," we hope to link together voices from across the world to promote knowledge sharing and the joint development of new tools. In specific terms, we hope to delve into the following topics in the next round of the Guidance:

- Defining threshold values
- Triangulating risk indicators
- Constructing risk indices
- Contextualizing risk indicators to increase the accuracy of flagging across disparate geographic, temporal, sectoral, and cultural realities

5. Corruption Risk Dashboard

A final, outward facing application of these methodologies will be the Corruption Risk Dashboard that DG is currently constructing. This dashboard will contain 10 to 15 red flag indicators that would ultimately enable governments to conduct real-time monitoring of individual contracts for corruption, fraud, bid rigging and collusion. This tool, which will be built on top of existing open source OCDS tools created by DG and used primarily by government functionaries and knowledgeable users, would enable visualization and analysis of our research on red flags, and the indicators referenced in this Guidance document. The tool will enable technicians within government, civil society, the media, and the public to understand what the concrete implementation of red flagging indicators looks like in practice. It could also spark the development of shared tools and additional iterations by a variety of users based on OCDS.

Focusing initially on monitoring indicators that are OCDS-compliant, the Corruption Risk Dashboard will include the following features:

- An overview dashboard showing the percentage of contracts that generate each of the 10 to 15 flags
- A high-risk contracts table showing the contracts with the most flags by corruption type
- Individual indicator pages showing key metrics for each indicator

In the future, the Corruption Risk Dashboard could be integrated with DG's Contract Explorer, a related visualization tool currently under development. The Contract Explorer allows users to visualize individual contracts at all phases of the procurement process. Both tools will be merged with DG's M&E Dashboard, another visualization platform that allows procuring entities to take a global look at their procurement ecosystem in order to analyze overall efficiency, competitiveness, and value for money.

DG will test the initial dashboard using data from the Vietnamese Public Procurement Agency, or another data set to be agreed upon jointly. Recognizing differences in the quality of available data, varying legal requirements, and structural particularities that influence the procurement process, DG would seek to fine-tune indicators to suit the data set and contextual factors. Ultimately, DG hopes to identify a discrete set of contracts that could be researched by authorities for potential illicit behavior.

6. Final thoughts

It has been a privilege to collaborate closely with top integrity experts across the world to construct this initial Guidance. Through our methodological conversations with researchers and implementers and the development of a pragmatic mapping tool with DG and the Helpdesk, we have just begun to appreciate the fantastic complexity of red flagging. This work serves not only as a tool for partners across the world to utilize in their research and work, but also as a mechanism for internal learning at the OCP. In constructing this Guidance, we have identified concrete opportunities to cultivate our understanding of how to use data to achieve all four use cases identified. Always eager to improve on ourselves, we have already begun consulting feedback on this piece in order to strengthen the quality of our next integrity-related projects. We wholeheartedly welcome your comments, and encourage all interested parties to contact us at info@open-contracting.org with any and all questions, critiques, and/or outpourings of undying admiration. We are thrilled to continue learning about this dynamic and challenging field, and are eager to include your voice in what promises to be a rich global conversation.

VII: Annex 1: research and guides

- Luciana Cingolani, Mihály Fazekas, Roberto Martinez Barranco Kukutschka, and Bence Tóth: Towards a comprehensive mapping of information on public procurement tendering and its actors across Europe
- Mihály Fazekas: Lack of electoral accountability and public procurement corruption
- Mihály Fazekas, Luciana Cingolani, and Bence Tóth: A comprehensive review of objective corruption proxies in public procurement: risky actors, transactions, and vehicles of rent extraction
- Mihály Fazekas and Elizabeth Dávid-Barrett: Corruption Risks in UK Public Procurement and New AntiCorruption Tools
- Mihály Fazekas and István János Tóth: From corruption to state capture: A new analytical framework with empirical applications from Hungary
- Mihály Fazekas, István János Tóth, and Lawrence Peter King: Anatomy of grand corruption: A composite corruption risk index based on objective data
- International Anti-Corruption Research Center: Guide to Combating Corruption & Fraud in Development Projects
- Ian Makgill: Why good procurement data does more than fight corruption
- Mara Mendes: Who has won the contract? - Identifying the bidders of public procurement processes
- Open Contracting Partnership: Four example use cases
- Dmitry Palamarchuk: Methodology for Assessing Risk Factors in Public Procurement
- Bence Tóth, Mihály Fazekas, Ágnes Czibik, and István János Tóth: Toolkit for detecting collusive bidding in public procurement
- István János Tóth and Miklós Hajdu: Competitive Intensity and Corruption Risks in the Hungarian Public Procurement 2009-2015

VIII: Annex 2: Existing Red Flag platforms

1. **Indonesia: Corruption Watch**

Indonesian platform that analyses national procurement data and posts its findings publicly, which is proving to be a powerful tool for tracking irregularities and ensuring that publicly accessible data translates into public understanding of government spending.

2. **Hungary: Red Flags**

Hungarian platform that draws data daily from the Tenders Electronic Daily (TED) and automatically flags suspicious behavior. Registered users can utilize the site's API to export notice and organization data in JSON format.

3. **Poland, Romania, and Hungary: Tender Tracking**

A suite of platforms developed by the Government Transparency Institute and Corruption Risk Center Budapest, thanks to funding by the Open Society Institute, that calculates the Corruption Risk Index (CRI) of individual tenders.

4. **Vietnam: M&E Platform (Under Development)**

Vietnamese platform developed by Development Gateway that pulls data from the country's eGP system and flags suspicious behavior. Development Gateway is currently working on a generic version of this tool that can be applied to any OCDS dataset. At the time of publishing (October 2016), neither tool is public.

About the authors

Development Gateway (DG)

DG is an early thought leader and implementer of open contracting principles and the Open Contracting Data Standard, with activities in Nepal, Vietnam, the Philippines, and the United States. Recently, DG has collaborated with the World Bank and Government of Vietnam on an open contracting and procurement analytics program that includes developing and implementing a procurement monitoring and evaluation framework and dashboard for the Public Procurement Agency; the lessons from that have been vital for this study. DG and the Open Contracting Partnership are also conducting open contracting scoping studies in 5 West African countries.

Open Contracting Partnership (OCP)

The OCP works across sectors and along the whole process of government contracting to use the power of open data to save governments money and time, deliver better goods and services for citizens, prevent corruption, and to create a better business environment for all. The OCP is the proud developer of the OCDS, a global non-proprietary standard structured to reflect the complete contracting cycle. The standard enables users and partners around the world to publish shareable, reusable, machine readable data, to join that data with their own information, and to build tools to analyze or share that data.