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Early & Quick Function Points - Case Study

Ben Netherland
Cobec Consulting
bnetherland@cobec.com

Introduction & Agenda

As software estimators, many of us have been asked to provide an estimate early in the program lifecycle, when requirements are vague or are defined at a high level. This lack of definition can make using traditional function points difficult. The Early and Quick Function Point (E&QFP) methodology, developed by the Italian Consulting Firm DPO in 1996, is an excellent way to address this challenge in software size estimation.

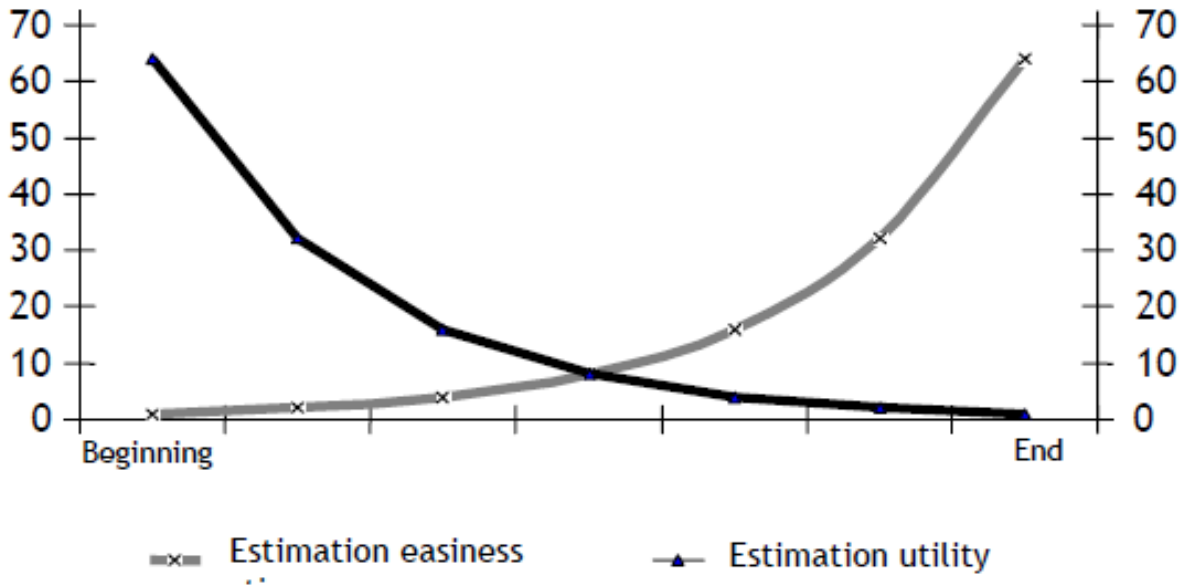
In this presentation, the E&QFP methodology will be reviewed in depth. A discussion of how to apply E&QFP will follow, using sanitized requirements from government programs. An Excel-based E&QFP tool will be used during the session to facilitate and illustrate the concepts.

Motivation for Early and Quick Function Points

- IFPUG Function Points are best suited for cases where design details have been worked out.
  - At that point, the number of DETs, RETs, and FTRs will be firmed up, and complexities for the traditional IFPUG Base Functional Components (EI,EO,EQ,ILF, EIF) can be determined.
- Unfortunately, Estimators are often tasked to estimate early in the Program life-cycle – Often with only Systems level requirements complete, and occasionally with Systems Level requirements still incomplete.

The Estimation Paradox

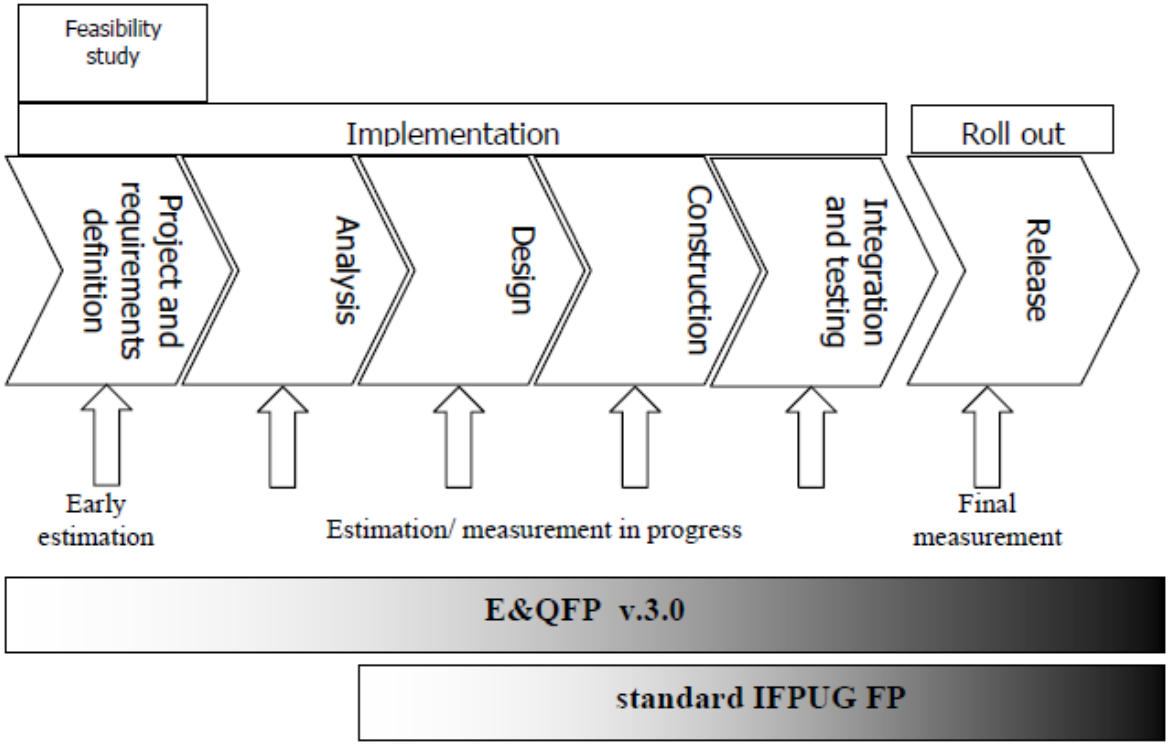
- Estimation is most useful to users when it is the most difficult to complete:



Source: *Reference Manual release 1.2 of IFPUG E&QFP method release 3.0,* DPO srl, 2007, Figure 1

E&QFP vs. IFPUG Timeframes

- The below graphic shows the partially overlapping project phases that IFPUG and E&QFP can be used on. As you can see, E&QFP has more "range":



Source: *Reference Manual release 1.2 of IFPUG E&QFP method release 3.0,* DPO srl, 2007, Figure 6

Early and Quick Function Background

- Early and Quick Function Points (E&QFP) were developed to address the early program blind spot for IFPUG Function Points.
- In the E&Q FP frame work, IFPUG functional categories are a subset of E&Q FP.
- E&QFP use the same transactions and logical files as IFPUG when estimating detailed requirements. However, additional layers of functionality are used to estimate broad, high-level requirements.
- Process is the same as with IFPUG FP: Establish type of count, counting scope, boundary, etc.

E&QFP Transactions

- Early and Quick Transactions fit into five tiers, or "aggregation levels".
- 2nd through 4th tiers serve as building blocks for the tier above
- From least to most complex, they are:
  - 1st Level: IFPUG "Base Functional Component" (BFC) = EI,EO, or EQ
  - 2nd Level: "Unclassified Elementary Process" (UEP) - Unsure of how many RETs/DETs/FTRs there are.
  - 3rd Level: "Typical Process" (TP) = 4-6 UEPs – base unit is a CRUD [Create, Read, Update, and Delete of a logical file]
  - 4th Level: "Generic Process" (GP) = 6-20 UEPs
  - 5th Level: "Macro Process" (MP) = 2-10 GPs – can be a large system segment or a small scale application

E&QFP Logical Files

- Early and Quick Logical Files fit into 3 tiers or "aggregation levels":
  - 1st Level: IFPUG "Base Functional Component" (BFC) = ILF or EIF
  - 2nd Level: "Unclassified Logical File" (ULF) - Unsure of how many RETs/DETs/FTRs there are.
  - 3rd Level: "General Data Group" (GDG) = 2-13 ULFs

E&QFP Scoring Table

Aggregation Level of Functional Component	requirements level of detail	type of functional component	Function Type	min - minimum	ml - most likely	max - maximum	type of functional component	Function Type	min - minimum	ml - most likely	max - maximum
[1] - IFPUG Base Functional Component (BFC)	it is possible to use complete information for standard counting	EI	EIL - EI low	3,0	3,0	3,0	ILF	ILFL - low	7,0	7,0	7,0
			EIA - EI average	4,0	4,0	4,0		ILFA - average	10,0	10,0	10,0
			EIH - EI high	6,0	6,0	6,0		ILFH - high	15,0	15,0	15,0
		EQ	EQL - EQ low	3,0	3,0	3,0	EIF	EIFL - low	5,0	5,0	5,0
			EQA - EQ average	4,0	4,0	4,0		EIFA - average	7,0	7,0	7,0
			EQH - EQ high	6,0	6,0	6,0		EIFH - high	10,0	10,0	10,0
		EO	EOL - EO low	4,0	4,0	4,0					
			EOA - EO average	5,0	5,0	5,0					
			EOH - EO high	7,0	7,0	7,0					
[2] - Unclassified Base Functional Component (UBFC)	it is possible to identify accurately IFPUG BFC types but not their complexity	UEP (Unclassified Elementary Process)	GEI - Generic EI	4,0	4,2	4,4	ULF (Unclassified Logical File)	GILF- Generic ILF	7,4	7,7	8,1
			GEQ - Generic EQ	3,7	3,9	4,1		GEIF - Generic EIF	5,2	5,4	5,7
			GEO - Generic EO	4,9	5,2	5,4					
	it is possible to identify accurately IFPUG BFC but not their types and complexity		UGO - Unspecified Generic Output (EQ/EO)	4,1	4,6	5,0					
			UGP Unspecified Generic Process (EI/EQ/EO)	4,0	4,4	4,8		UGDG - Unspecified Generic Data Group (ILF/EIF)	6,4	7,1	7,8
[3] - Group of UBFC (GUBFC)	it is not possible to identify accurately individual UBFCs, or even the exact number of UBFCs componing a particular software object	TP Typical Process	TPS - small (CRUD)	14,1	16,5	19,0	GDG General Data Group				
			TPM - medium (CRUD + List)	17,9	21,1	24,3					
			TPL - large (CRUD + List + Report)	22,3	26,3	30,2					
		GP General Process	GPS - small 6–10 UEP's	26,4	35,2	44,0		GDGS - small 2–4 ULF	15,0	21,4	27,8
			GPM - medium 11–15 UEP's	42,9	57,2	71,5		GDGM - medium 5–8 ULF	32,4	46,3	60,2
			GPL - large 16-20 UEP's	59,4	79,2	98,9		GDGL - large 9-13 ULF	54,8	78,3	101,8
[4] - Group of GPs	sw requirements at a low granularity level (first decomposition of a large application)	MP Macro Process	MPS - small 2-4 generic GP's	111,5	171,5	231,5					
			MPM - medium 5-7 generic GP's	185,8	285,9	385,9					
			MPL - large 8-10 generic GP's	297,3	457,4	617,4					

Source: *Reference Manual release 1.2 of IFPUG E&QFP method release 3.0,* DPO srl, 2007, Appendix A

Case Study - E&Q FP

- 43 requirements were selected from 2 related programs
- The requirements fit in to a variety of categories: Data Communications, Security, Simulation, etc.
- Each requirement was sized using a functional component from the E&Q FP palette
- First we examine why each requirement is hard to size using traditional IFPUG function points, then we detail how the requirement would be sized using E&Q FP

E&Q FP Excel Tool

- An Excel tool is used in this demo
  - Provides a way to take into account pre-existing functionality (reused code, open source software, COTS)
  - By referencing the Pivot Table, the user can see how much functionality is contained in various groupings the user defines
- The set of requirements used in the Excel tool, along with the accompanying analysis, is provided for reference in the next 3 slides
- <Open Excel tool>

E&Q FP Case Study

Category	Rqmt Text	Issue	Diagnosis
Certification	The system shall allow service certification without loss of service.	No idea of what service certification implies. May be more than one elementary process.	GPS (certification)
Data Communications	The system shall detect and report errors in data communications messages.	Checking for different types of errors involves different types of processing logic. Uncertain how many error types there are.	TP-Low (Detect errors)
Data Communications	While processing the Design Workload in the Full Configuration, the system shall detect conditions that affect any function within an average time of 1 minute.	Sounds like it is not a validation, but different elementary processes checking an unknown number of conditions	TPM (Detect conditions that have a ripple effect)
Data Communications	The system monitor and control services shall record metadata associated with messages exchanged between tower facilities and external systems.	How many DETs/RETs does the metadata involve?	GEI (record message metadata)
Database	The system shall manage NDA designations.	"Manage" probably implies the Create, Read, Update, Delete (CRUD) of designations. Call this a Typical Process to manage an implied logical file.	TPM (Manage NDA designations)
Database	The Training System shall allow the operator to develop a library of PDMs and PCMs for permanent use on a per sector basis.	The number of PDMs and PCMs appears purposefully open-ended. It would seem that a file for PDMs and one for PCMs would be maintained. Not sure if there is just one type (RET) for each.	GEI (create library of PDMs), GEQ (query library of PDMs), GEI (edit library of PDMs), GEI (create library of PCMs), GEQ (query library of PCMs), GEI (edit library of PCMs), GILF (PDM file), GILF (PCM file)
Diagnostics	The maintenance function shall provide on-line software and hardware diagnostic tools for remote problem determination and resolution support by Maintenance and Support personnel	Believe this would be different than the diagnostic tools necessary to certify the DCGS service.	GPS (on-line software and hardware diagnostic tools)
GUI	When in manual mode, the SYSTEM shall allow the controller to select locally adapted pre-defined information into all fields that are capable of being edited.	Unclear how many fields can be populated by pre-defined information.	GILF (locally adapted pre-defined information), GEI (Edit the GILF), GEQ (Query the GILF)
GUI	The SYSTEM shall allow the controller to review, edit, delete and accept the proposed departure clearance prior to a departure clearance request message being received from the aircraft.	4 elementary processes are listed. This is equivalent to the Typical Process-Low	TPL (Review, Edit, Delete, Accept of proposed clearances)
GUI	The SYSTEM shall have the ability to View, Edit, Send, Dump or Cancel a departure clearance.	5 elementary processes are listed. This is equivalent to the Typical Process-Medium	TPM (View, Edit, Send, Cancel, Dump clearances)
GUI	The scenario development tool shall be modified to allow the creation of data communication related events and messages.	Completely open-ended requirement - unsure how many events are possible to create.	GPS (creation of CPDLC-related events)
GUI	The system shall provide programmable shortcuts for sequences of keystrokes.	although the shortcut duplicates an existing function, the user is maintaining a logical file by creating the shortcut. It is unclear how many fields will be involved in the logical file, though.	TPS (create, read, update, or delete of a shortcut)
GUI	The system shall provide audio coding by dimension of intensity, pitch, and rhythm, for required levels of criticality.	This appears to be a requirement that changes how information is displayed depending on criticality. This would require processing to determine what to do - unclear what is being checked, though	GEO (vary GUI to show criticality)
Metrics	Automation Processing shall generate performance data reports for a specific set of monitored system parameters to support hardware and software performance analysis per the requirements of the Automation System.	the number of parameters and number of reports are unclear	TPS (performance data reports for monitored DCGS parameters)
Reliability	Automation Processing shall take automatic reconfiguration action per the requirements of the Automation System when a system interface error condition is detected. Reconfiguration actions that involve reconfiguration between system sites are excluded from this requirement.	potentially multiple errors that could happen for each interface. "Reconfiguration action" is undefined.	GPS (automatic reconfiguration action after interface errors)
Reliability	The system shall provide continued redundancy while hardware maintenance is performed.	Assume this functionality is the same for each type of hardware. Each piece of hardware (processor, receiver, etc.) would be viewed as different file type.	GEI (swap in redundant HW)
Reliability	The system shall provide continued redundancy for data communications functions while software maintenance is performed.	Assume this functionality is the same for each type of software. Each piece of software would be viewed as different file type.	GEI (swap in redundant SW)

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E&Q FP Case Study, Continued

Category	Rqmt Text	Issue	Diagnosis
Security	For authentication to a cryptographic module, the system shall employ authentication methods that meet the requirements of FIPS 140-2 Level 1, unless policy and/or legacy design do not support the use of this form of cryptography.	This is more than just a simple retrieval of information, but can be considered 1 elementary process. Not sure the number of DETs or even the number of FTRs referenced. Can be debated whether primary intent is to present information (EO) or change behavior of system (EI).	UGP (authentication)
Security	The system shall protect against or limit the effects of denial of service attacks.	What does protection against D-O-S attacks involve? Unclear how many EPs there are.	GPS (Denial-of-Service protection)
Security	The system shall monitor and control communications at the external boundary of the system through gateways, proxies, routers, firewall, guards, and encrypted tunnels in accordance with NIST 800-53 Revision 3 controls.	What does monitoring and controlling involve? Unclear how many EPs are involved.	GPS (Denial-of-Service protection)
Security	The system shall implement malicious code protection that includes a capability for automatic updates unless policy and/or legacy system design do not support use of such tools.	Imagine there would be an elementary process for every kind of Malicious code attack, but unclear of what is involved	GPS (Malicious code protection)
Security	Automation Processing shall monitor for system security related events per the requirements of the Automation System.	the number and complexity of "security related events" is unclear. Monitoring would seem to imply the user is provided with information when something bad happens.	GEO (Monitor security related events)
Security	For pre-shared key authentication, the system shall (i) support secure out-of-band key distribution (ii) establish user control of the pre-shared key, and (iii) map the authenticated identity to the endpoint.	Sounds like 3 different functions: distributing the key (1 Logical file?), establish user control of the pre-shared key (not sure what this means) , update a file	EO (generate/distribute key), UGP (establish user control of the pre-shared key), EI (map the authenticated identity to the endpoint)
Security	For authentication to a cryptographic module, the system shall employ authentication methods that meet the requirements of FIPS 140-2 Level 1, unless policy and/or legacy design do not support the use of this form of cryptography.	unsure how much interaction is involved in authentication & how many DETs	UGP (Authentication to a cryptographic module)
Security	The system shall implement malicious code protection that includes a capability for automatic updates unless policy and/or legacy system design do not support use of such tools.	Sounds like 2 functions: One to enable automatic updates (EI), and the updates themselves (GEI) - not sure how many files/DETs are updated	enable automatic updates (EI), automatic updates (GEI)
Security	The system shall provide automated tools to scan for vulnerabilities including, spam and spyware detection unless policy and/or legacy system design do not support such tools.	Each type of scan could be considered an independent function	GPS (Automated vulnerability scans)
Simulation	The Training System shall simulate Specialist entries within a training exercise.	Not sure how many entries will be simulated, and what is involved in the entries.	TPM (Manage NDA designations)
Simulation	The Training System shall simulate operationally available uplink and downlink messages.	A very large number of messages are available. Could call this a General Process (GP)	GPL (Simulate uplink and downlink messages)
Simulation	The Training System shall simulate system and subsystem failures and recovery for each facility independently within each exercise via scripted events.	Unclear how many system/subsystem failures there are. Do you consider the failure and the recovery separate processes?	GPM (simulate system/subsystem failure & recovery)
Simulation	The system Training System shall simulate network and radio site(s) failures and recovery independently within each exercise via scripted events.	Unclear how many network and site failures there are. Do you consider the failure and the recovery separate processes?	GPM (simulate system/subsystem failure & recovery)
Simulation	The Training System shall simulate intra-facility communications.	What is involved in intra-facility communications?	GPM (simulate intra-facility CPDLC operations)
Simulation	The Training System shall simulate inter-facility operations.	What is involved in inter-facility communications?	GPM (simulate inter-facility CPDLC operations)
Simulation	With operator action, the Training System shall simulate operationally available responses to uplink messages.	Processing logic is involved in providing the correct response message. There is an indeterminate number of messages, but only one elementary process.	GEO (provide appropriate response messages during training sessions)
Simulation	The Training System shall simulate error messages displayable on the controller position.	Processing logic is involved in providing the correct error message. There is an indeterminate number of stimulus messages, but only one elementary process.	GEO (provide error messages during training sessions)
Simulation	The Training System shall provide simulated input that replicates external communication interfaces.	Completely open-ended requirement - unsure how many interfaces, or what is being simulated	GPS (creation of simulated external CPDLC interfaces)

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E&Q FP Case Study, Continued

Category	Rqmt Text	Issue	Diagnosis
System Admin	The system shall provide audit reduction and report generation tools that support after-the-fact investigations of security incidents without altering original audit records.	Unsure of how many types of reports there may. Unclear of what audit reduction tools do, and therefore the number of elementary processes.	GPM (lump all elementary processes in to one function)
System Admin	The system shall ensure that the actions of individual information system users can be uniquely traced to those users unless policy and/or legacy design do not support the use of this feature.	Sounds like an additional log file; and the ability to query, edit, and set up what gets logged. The set up function is of an undetermined size. Log function sounds like it can be enabled disabled.	ILF-Low (log file), EQ-Low, EI-Low (edit file), EI-Low (enable/disable logging), GEI (setup logging), ILF-Low (log settings file)
System Admin	For those system elements merged into the Automation baseline, the support system shall provide an integrated environment for system software, adaptation and firmware configuration control, adaptation generation and integration, and data backup and restoration for both operational and support software.	Most of these are taken of in other requirements, except for Firmware configuration control.	TPS (Firmware configuration control = Create, Read, Update, Delete firmware configuration records)
System Admin	The system shall provide on-line data communications logon data to external systems.	Not clear which data is provided, if there is procssing involved, and whether it is push or pull	UGP (provide on-line Data Communications logon data to external systems)
System Admin	The system shall be configurable to enforce the most restrictive set of rights/privileges or accesses needed by users (or processes acting on behalf of users) for the performance of specified tasks, unless policy and/or legacy design do not support specific user restriction.	number of rights/privileges/accesses needed by users is unclear	GEI (Set rights/privileges or accesses needed by users)
System Admin	The system shall provide automated mechanisms to facilitate the review of user activities, unless policy and/or legacy design do not support automated review features.	unclear how many DETs are in user activities	GEQ (review user activities)
System Admin	The support system shall include automated tools for generating, collecting, and analyzing system error, failure, status, and processing trace files.	the file types sound like they were all generated by the Operating System. Would need to analyze them, but not sure what is involved. 1 process for each file type.	GPS (Analyze system error, failure, status, and processing trace files)
Training	The Training System shall be modified to support Technical Operations Facilities Maintenance and Support personnel training to monitor, control, diagnose, analyze, and maintain those elements of the system that reside within <a larger system>.	Lot's of verbs are used that are very vague. Additionally, it's unclear how many DETs are involved in these actions.	GEQ (monitor DCGS elements), GEI (Control DCGS elements), GEO (Diagnose DCGS elements), GEI (Analyze DCGS elements), GEI (Maintain DCGS elements)

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E&QFP Points to Remember

- **When should you use E&Q FP? If you answer, "yes" to any of the following, consider using E&Q FP:**
  - **Is it difficult to identify DETs/RETs?**
  - **Difficult to identify logical files?**
  - **Unsure of how to classify transactions?**
  - **Unsure of how many transactions/logical files are implied by a requirement?**
- **If "Yes", use tiered approach to assigning function points spelled out in Summary table.**
- **Remember, E&Q FP is a superset of traditional function points.**
- **As a result, your count can be refined in to a more traditional function point count as the requirements are fleshed out.**

References

- "E&QFP Early and Quick Function Point for IFPUG method, Release 3.0, Reference Manual 1.2". DPO srl. 2007. http://www.dpo.it/eqfp/Downloads/EQ&FP-IFPUG-30-RM-12-EN-P.pdf