

# Quality: Attitudes and Experience Within the Irish Software Industry

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**Abstract.** The Irish software industry is facing a new challenge. Prior to this, Ireland had emerged as one of the leading software exporters in the world. Then came the downturn in the global economy, the burst of the ‘dot com’ bubble and now Ireland faces competition in the form of developing third world economies. The Irish software industry will struggle to compete with the vast, skilled but cheap labour force that these economies can offer in abundance. Is there any other field in which the Irish software industry can compete? Quality in Ireland had traditionally only been applied to the manufacturing industry. However, since the continued development of the Irish software industry, have the Irish software community taken software quality seriously enough? This paper presents the results of research conducted with members of the Irish software community to gauge their attitudes and opinions towards software quality.

## 1 Introduction

The Irish software industry plays a vital role in the Irish economy. According to reports over the past number of years the Information and Communication Technology (ICT) sector in Ireland employs an estimated 92,000 people within 1,300 companies, with a combined estimated turnover of €52 billion for the year 2003 [1], [2], [3]. Focusing exclusively on the software industry in Ireland, it is estimated that 23,930 people were employed in 2003, a drop of 14% from the previous year. Revenue for the industry in 2003 was estimated around €14.9 billion, a 7% increase on the previous year [4]. The statistics presented here vary to a degree from report to report. However, these statistics highlight the continued importance of the ICT sector to the Irish economy. Despite the downturn in the global economy optimism is still high within the Irish software community that recent success can be continued and improved upon.

### 1.1 Success Factors for the Irish Software Industry

The Irish software industry has enjoyed the benefits of lucrative outsourcing and foreign direct investment (FDI), particularly from large multi-national corporations.

Currently, seven of the top ten ICT companies have a base in Ireland: IBM, Intel, HP, Dell, Oracle, Lotus and Microsoft. Worldwide FDI suffered a slump in 2002, though this was not evident in Ireland. FDI to Ireland in 2002 was recorded at €26 billion. This is over two and a half times the amount recorded for 2001 [5]. So what are the reasons behind the Irish software industry's success and growth? There are several factors responsible for the success of the ICT sector in Ireland over the past 20 years. These can be divided into ICT and non-ICT specific factors:

#### ICT Specific Factors

- Growth in global trade and the expansion of the US economy
- The growth of FDI globally in the 1990s
- Education and technological innovation
- Upgrading of Ireland's telecommunications infrastructure

#### Non-ICT specific Factors

- Reductions in taxation (corporation tax of 12.5%) and wage moderation
- Labour supply did not limit growth potential
- English speaking workforce
- Deployment of EU structural and cohesion funds to Ireland [6], [7], [8]

### **1.2 Concerns for the Irish Software Industry**

In the last number of years the characteristics that have made Ireland attractive to FDI have been diminishing. With the recent downturn in the global economy, this poses a recognizable problem. Since the 'dot com' bubble burst there has been a reduction in the number of school leavers pursuing college degrees with a technological background, resulting in the possibility of future labor shortages in the ICT sector. There is a distinct worry that there will be a shortfall of supply over demand for ICT graduates to fill jobs currently available to them [9].

The emergence of developing economies such as India and China as major players on the world's technological stage has given the Irish software community cause for concern. These nations and others like them can provide an abundant, well-educated workforce for their ICT sectors. Estimates predict a workforce of almost 17 million available to the ICT sector in India by 2008 [10]. More importantly, this workforce can be delivered at a much lower cost. There also appears to be a higher focus on quality and quality processes within Indian organizations as they seek to surpass their own domestic, continental and western competitors in their bid to secure lucrative foreign investment deals.

### **1.3 Potential Solutions**

In order for the Irish software industry to prosper, the Irish government must continue to lead by example. Ireland's existing financial policies are a big incentive for foreign companies looking to set up a European base. "With one of the lowest corporation tax rates in the European Union, Ireland has seen its economic growth consistently outpace that of its neighbors" [11]. The Irish government needs to continue its positive

economic strategy and further exploit the potential that the ICT sector can bring to the Irish economy.

The potential shortfall of skilled IT graduates in Ireland may eventually be overturned as confidence returns to the ICT sector. Until then, this shortfall could be made up by an influx of skilled foreign workers, particularly from the newly joined member states of the EU.

Possible pay cuts in order to match competitors do not seem plausible in a country where the cost of living is already one of the highest in Europe. Even if it were possible, the cuts would have to be sizable in order to rival Ireland's newly developing competitors. Some hope for the Irish software industry in this regard is the projected rise in wages in India. However, should the balance be met between the Indian and Irish wage costs; other economies such as China still exist to take over the advantage.

One possibility is for the Irish software community to embrace the desire to improve their software processes in the way that Indian companies appear to have. If the Irish software industry could do this and do it right, they would be able to demonstrate mature, repeatable and traceable processes. This could prove the decisive factor for attracting untapped FDI potential, while retaining and developing their existing FDI.

## **2 Research Overview**

The information presented in this paper is the result of research carried out with members of the Irish software community. The aim of this research was to gauge the attitudes and experience of the Irish software community towards quality and quality processes. Given the concerns facing the Irish software industry, the authors wished to explore how or if the Irish software community had catered for quality. A "state of the nation" was proposed whereby the authors would conduct research into these attitudes and opinions and form conclusions and recommendations based on the analyzed data received.

### **2.1 Research Methods**

As this research was intended to discover opinions and experiences, it was decided that interviews would be used as the primary research method. Data from an online questionnaire provided the researcher with a second and separate quantitative bank of data to be analyzed.

#### **2.1.1 Interviews**

Interviews bring the researcher closer to the topic, offer flexibility and can be adapted to suit particular situations. They allow the researcher the opportunity to ask complex questions and provide quality data for the researcher to analyze. Interviews were semi-structured in nature allowing the researcher to pursue any emerging trends. A mixture of open-ended and closed questions were used, depending on the type of information the researcher wished to elicit. Voice recording equipment and note taking, were used to record the interviews.

Interview questions were based around the five perceptions of quality as presented by Garvin [12]. Given that there can be a variety of different ways to view

quality, by basing the interview questions around Garvin’s views on quality, it was intended to discover the different attitudes and opinions of each respondent towards each perspective.

Personal contacts secured many interviews, while other companies upon being informed of the research were also willing to cooperate. In total, 53 interviews were conducted with members of the Irish software community. It was hoped to gain as many perspectives as possible regarding quality in the Irish software industry. As such a variety of personnel were interviewed ranging from CEO’s to software engineers. Once transcribed, interview data was coded and hand analyzed for emerging trends.

### 2.1.2 Online Questionnaire

Data from an online questionnaire was made available to the authors for the purpose of their research. This questionnaire sought to examine quality model adoption rates within the Irish software industry. The questionnaire provided a mix of qualitative and quantitative based questions, allowing respondents to tick a box or in some cases offer a few short words for an answer. Background information about the respondents’ organizations was collected. Data relating to organizations focus on quality, as well as data regarding respondent’s’ experience with a variety of quality models was also gathered.

The raw data from this questionnaire was input into a statistical analysis software tool, which was used to produce tables and graphs to aid the authors in their analysis of the data.

## 3 Research Findings

### 3.1 Background of the Irish Software Community

The aim of this research was to gauge the attitudes and experiences of the Irish software community towards quality. The pie chart below (Fig. 1.) presents the information received in a graphical context. Only one interviewee had no formal third level education, but was working in the industry for 20 years. Several interviewees had achieved postgraduate awards in various disciplines.

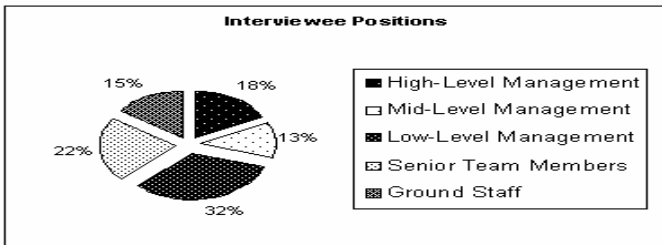


Fig. 1. Employee level of the respondents

### 3.2 Quality Definitions

Interviewees were asked, “How do you define quality?” When analyzed, these definitions were categorized into 4 areas. In order of importance, these were: customer oriented, meeting requirements, reliability / efficiency and process oriented. Over half gave a definition resembling “A system that reliably satisfies the customers needs”. But what does satisfying a customer mean? Further analysis revealed that satisfying a customer can be achieved through one or all of the following; meeting customer needs or requirements, ensuring good product performance and value for money.

### 3.3 Customers of the Irish Software Industry

Eighty four percent of interviewee’s customers are external i.e. outside their organization. The majority of customers fall into the category of IT service users. The main industries catered for are telecommunications, medical, governmental, automotive and construction / engineering.

Customers are shown to have varying attitudes and knowledge regarding the software process within their supplier organizations. Fifty one percent of interviewees said that their customers do not know nor do they wish to know what software processes are in place: “*As long as they get a good product, on time and within budget they are happy*”. Those customers that did care, were either involved in the medical industry and as such were under strict guidelines on quality, or had experience themselves with software quality models.

When asked regarding the main cause of customer complaints, requirement issues were highlighted. Incorrect, changing or misunderstanding requirements were estimated to cause 75% of customer complaints. The remaining 25% of complaints were alleged customer misunderstandings regarding how the product works.

### 3.4 Software Development Problems

The primary cause of organization’s software development problems was issues with requirements. Poor requirements capture or changing requirements caused interviewees the most problems, with one developer saying, “*trying to nail things down and get things done has always been the biggest problem*”. Interviewees were also aware of the difficulty in getting their customers to specify their exact requirements stating, “*It is very hard to pin down specific user requirements*”. Changes can also occur because sometimes the customers themselves do not really know what they want until they see a product in front of them. “*If the customer doesn’t know what they want this can be very frustrating*” to developers attempting to anticipate rather than cater for customer needs or wants. The later a requirement change is made, the more expensive and time consuming it can be for an organization to implement.

Incorrect estimates were also considered a major problem. Management figures were seen to play a part in this problem by imposing unrealistic deadlines and/ or budgetary constraints on development teams. According to one interviewee “*They (management) would promise the customer that it would be done in two weeks, when we needed to months to do it*”. Managing management’s expectations is a big concern with estimations, but not the only one. In some organizations this can result in “*a trade off between quality and functionality, sometimes shortcuts have to be taken and*

*sometimes functionality has to be curbed*". Management has a different view on this. One top-level manager in particular bemoans his inability to receive a project plan from his development teams. However this manager believes this is down to the nature of software development itself: *"Every developer will tell you what we're doing is so innovative"*. When developing a new product or using a new method, though they are perhaps not in uncharted territory, they are navigating with new tools. As a result, developers are unwilling to specify how long it will take them to get to their destination, because they are unsure of the answer themselves.

Documentation was the third major software development problem highlighted by interviewees. Having an excessive documentation load can waste time, which developers actually need to spend developing products. According to one developer, an organization's *"heavy handed approach to documentation and procedures"* can waste *"valuable development time and company money, especially if the change involves something small, such as changing a heading"*. However, having too little documentation can lead to variation in practice and having the right amount of documentation will only work if everyone knows how to use it properly and consistently. *"Variations in working practices"* can cause organizations major headaches. Documentation is a very complex issue for organizations and each organization must determine for themselves what is best for them.

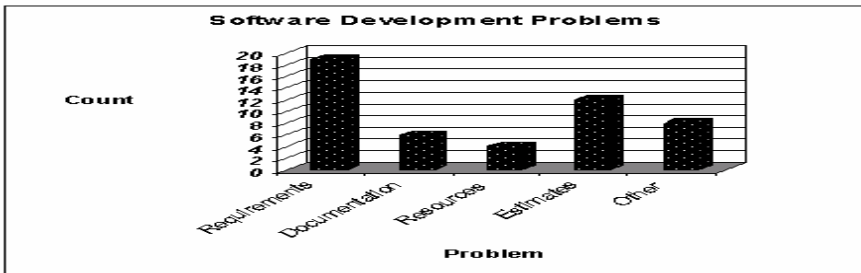


Fig. 2. Main software development problems as reported by the interviewees

### 3.5 Software Processes: The Good, the Bad and the Confusing

Each interviewee stated that having a good software process positively impacts product quality, *"the more efficiently and effectively a process may be completed, the higher the product quality"*. When asked to give an example of a good software process within their organization 34% of interviewees highlighted their development process as one to be proud of. This was mainly put down to the experience of the individuals running it. One interviewee stated the development process was good because *"it is engrained within the organization, well documented, key deliverables at every stage and risk management is covered"*. Twenty three percent of interviewees highlighted their requirements process as their organization's best example of a good software process. The reason for this was experience, not just of the people involved, but also the experience of the process itself, *"everybody knows why we are doing it, the importance of doing it and we've refined it. It works for us but it took us a while to get there"*.

An issue with requirements again reared its head, this time as organization's primary example of a bad software process. Thirty seven percent of interviewees highlighted their requirements process as a bad software process. The main reasons for requirements causing problems were; having multiple people involved in sign off, reported skills shortages in gathering requirements, not enough accurate documentation for requirements and requirements needing constant revision. Other examples of bad software processes within organizations include; testing, documentation, estimation and the development process.

A confusing development in this research was requirements being highlighted as the second most popular choice for a good software process within organizations. Given the problems associated with requirements i.e. it was, according to interviewees, the main cause of software development problems and the most popular choice for a bad software process. How then could it be held up as the second most example of a good software process? Upon further examination it was revealed that 33% of those that gave requirements as their "good software process" also listed requirements as their main software development problem! A further 33% had estimates as their software development problem; of these, each one stated estimates were a problem, particularly when requirements change. In total this means that either directly or indirectly, 66% of interviewees that highlighted requirements as their "good software process" had issues with requirements during software development.

### 3.6 Software Quality Models

Fifty two percent of interviewees stated that their organization used a recognized quality model. The most common model used by interviewee's organizations was the ISO series of standards. Tick IT and then CMM follow ISO in popularity here. Thirty seven percent of organizations used none, while 11% of organizations used an internal model. Those not using any model primarily listed cost and overhead as their reasons for not having one. However another reason given was "*at the moment we are not too concerned about having a standard process model. Customers don't ask about it, they don't seem to be aware about it*". This information is supported by the results from the online questionnaire in which 49% of respondents listed "*too costly or difficult to implement*" as their primary reason for not implementing a quality model. For those with a quality model, it was found that in the majority of cases, market forces were the impetus behind the model's implementation. A customer requirement was also an important factor here. One interviewee from an organization with customers in the United States stated, "*they (our customers) don't have clear visibility at times into our process... so they regard ISO registration as being a key indicator that our quality is up to scratch*".

Respondents to the online questionnaire were asked how often they get customer enquiries as to their certification if any with quality models. The vast majority (61%) of organizations were asked for certification between 0-20 percent of the time. Not surprising when one considers the lack of customer interest in software processes in the first place, but a worrying trend nonetheless, that suggests that customers do not know enough about software quality models to ask about them or insist on their use.

## 4 Conclusions and Discussion

This paper has presented the results of research conducted within the Irish software industry. An overview of attitudes, opinions and experience of the Irish software community towards software quality, processes and software models has been presented, but what can be learned from this, not only from an Irish but also from a European perspective?

### 4.1 Advice for Software Organizations

Software organizations and in particular Small to Medium Enterprises (SME's) generally cannot afford to make mistakes. Without a larger parent to absorb costs and without aid from external organizations, how can small indigenous software companies set about improving their software development process [13]? One customer lost to an SME could potentially put it out of business. So what can SME's do to help themselves? From this research it is evident that requirements are a major issue for software organizations. The requirements process needs to be prioritized, this is particularly pertinent for SME's. There is a clear need for a well defined requirements document, customer and management sign off on such a document and customer involvement in the whole development process right from the beginning. Having customers involved from the start of a project keeps them aware of what is going on but also gives them a better idea of how it will all turn out. This gives customers the opportunity to correct any requirements issues from a very early stage resulting in less trouble had these issues not been spotted until later in the development process.

Incorrect estimates were identified as a serious problem. Estimating how long a project will take or how much it will cost can be a difficult thing. Developers and management must learn from their experiences, retain knowledge from each project completed and carry this forward to the next endeavor. Some estimation problems can be traced back to issues with requirements, so SME's need to ensure that their requirements process is up to scratch or it is bound to have a negative effect on estimates. Communication channels must be kept open between developers and management and each group must be aware of the others situation.

Documentation can help or be a hindrance for any organization. There is no quick fix. Some organizations need heavy documentation, some organizations want heavy documentation. Other organizations want flexibility, through little or no documentation. Whichever the case, all organizations must ensure that all employees using documentation know how to use it right.

### 4.2 Attitudes Towards Quality

There is a definite disregard within some sections of the Irish software community towards quality. This appears to be down to the ignorance of individuals to the possible benefits of software process improvement techniques. One interviewee of a multi national company with bases in Ireland, India and elsewhere pointed out "the Indian divisions are CMM certified to get more project work"! The Irish division was not CMM certified nor was it pursuing it. Was this because the Irish division does not want more work? Those working in the Irish software industry are not the only ones



who show a disregard and lack of knowledge towards software quality. Customers also appear to be in the dark when it comes to processes or process quality. This is reflected in their attitude towards software processes and their lack of desire to know if their supplier organization is at least accredited or certified in a quality model or standard. If the Irish and European software industries are to compete with their Indian and Chinese counterparts, change is required. The industry itself and those that use software products in their day-to-day business must realize the positive benefits that software process improvement can bring to organizations.

Companies appear to be focusing on quick fixes, one problem at a time. These problems include requirements, documentation and estimation. Each of these can be a serious problem for organizations if not managed correctly. However standardizing the organization's processes or even following a quality model or tailored quality model could not only solve these problems, but bring unforeseen return on investment (ROI) benefits to these organizations [14]. Structured process or quality models do not guarantee any ROI, but they can provide an organization with a solid platform to build on.

What can be done to change this? The answer lies in two parts. Firstly management of software organizations need to be made aware of the benefits and pitfalls that structured software process improvement can bring to an organization. They need to know that models can be tailored for use, how to tailor the models and how to get their staff on board as well. Secondly, once in place, management should treat the quality model, or structured processes as a marketing tool, educating customers with regards to their "top quality procedures". Once customers are aware of a process to improve quality, it is likely that they would insist on this as a requirement on all of their suppliers. The more customers ask, the more pressure software organizations will be under to provide.

This could very much be a case of the chicken and the egg. Who goes first, do management start improving their process? Why should they if their customers are not that interested in it? Should customers start asking? Why would they? They do not know about it. Education can play a pivotal role here. Ninety seven percent of those interviewed from the Irish software industry had a third level education. Third level institutions across Ireland have the opportunity and the motive to reach out to future employees of the industry. Were 97% of future employees to be educated in software processes and see their benefits, they would take this with them to the workplace where they would be in a position to positively affect the future of the Irish software industry.

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