An Empirical Modelling Approach To Software System Development in Finance: Applications and Prospects

By

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In Memory Of My Father

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Declarations

This thesis is presented in accordance with the regulations for the degree of Doctor of Philosophy. It has been composed by myself and has not been submitted in any previous application for any degree. The work in this thesis has been undertaken by myself except where otherwise stated.

The perspective on the integration of financial systems in this thesis has been published in [BM99]. The various aspects of building a web-based environment for virtual collaboration appeared in [BM00]. The timetabling model was considered in [BWMRR00]. The integration of e-commerce and ERP applications was researched in [Maa99]. The EM and VR models of the monopoly dealer simulation were introduced in [MBG01]. The financial analysis in the Ho case study can be found in [AH01].

Abstract

The financial industry is witnessing major changes. The financial enterprise is undergoing major business process renewal accompanied with the introduction of new technologies including electronic commerce; the financial market is shifting from an old to a new trading model that introduces major structural changes to the market and new roles for market participants; investment offers access to ever larger repositories of financial information and a wider choice of financial instruments to fulfill rising needs and expectations. In all these developments, there is a central role for human intelligence that can potentially influence the pattern of change and direct appropriate decisions in adapting to change. There is also a vital need for computer-based technology to support this human activity.

The relation between human and computer activities in classical models for computer-based support is characterised by rigidity and framed patterns of interaction. The emphasis in such models is on automation, not only in respect of routine trading operations, but even of the role of market participants. An alternative culture is emerging through the use of advanced technologies incorporating databases, spreadsheets, virtual reality, multi-media and AI. There is an urgent need for a framework in which to unify the classical culture, in which mathematical financial modelling has a central place, with the emerging culture, where there is greater emphasis upon human interaction and experiential aspects of computer use. This thesis addresses the problem of developing software that takes into account the human factor, the integration of the social and technical aspects, human insight, the experiential and situated aspects, different viewpoints of analysis, a holistic rather than an abstract view of the domain of study, cognitive rather than operational activities, and group social interaction. The ultimate aspiration for this work is to transform the computer as it is used in finance from an advanced calculator to an ' instrument of mind' .

Meeting the challenges of software support for finance is not only a matter of deployment, but also of software system development (SSD): this motivates our focus on the potential applications and prospects for an Empirical Modelling (EM) approach to SSD in finance. EM technology is a suite of principles, techniques, notations, and tools. EM is a form of situated modelling that involves the construction of artefacts that stand in a special relationship to the modeller' s understanding and the situation. The modelling activity is rooted in observation and experiment, and exploits the key concepts of observables, dependencies and agency. The thesis extends the major findings of Sun (1999), in respect of the essential character of SSD, and its contextual and social aspects, by considering its particular application to the finance domain.

The principles and qualities of EM as an approach to SSD are first introduced and illustrated with reference to a review of relevant existing models. The suitability of EM as a framework for SSD in finance is then discussed with reference to case studies drawn from the finance domain (the financial enterprise, the financial market, and investment). In particular, EM contributes: principles for software integration and virtual collaboration in the financial enterprise; a novel modelling approach adapting to the new trading model in the financial market; computer-based support for distributed financial engineering; and principles for a closer integration of the software system development and financial research development activities. This contribution is framed in a Situated Integration Model, a Human Information Behaviour Model, an Open Financial Market Model, a framework for distributed financial engineering, and a situated account of the financial research development cycle.

Abbreviations

AI – Artificial Intelligence

EM – Empirical Modelling

CRM – Customer Relationship Management

CAPM – Capital Asset Pricing Model

APT – Arbitrage Pricing Theory

OOP – Object Oriented Programming

XML – Extensible Markup Language

ERP – Enterprise Resource Planning

P/E – Price to Earnings ratio

ISM – Interactive Situation Model

EMH – Efficient Market Hypothesis

OLS – Ordinary Least Square Regression

EMF – Empirical Modelling Framework

VR – Virtual Reality

DEM – Distributed Empirical Modelling

ISM – Interactive Situation Model

CD – Cognitive Dimensions

IA – Information Artefact

SOM – Self Organized Maps

SSD – Software System Development

RE – Requirement Engineering

SPORE – Situated Process of Requirement Engineering

DSS – Decision Support System

GDSS – Group Decision Support System

HCI – Human Computer Interaction

VR – Virtual Reality

ODM –Open Development Model

BPM – Business Process Modelling

BPR - Business Process Re-engineering

SE – Software Engineering

OOSE – Object Oriented Software Engineering

NPV – Net Present Value

IRR – Internal Rate of Returns

DOT – Distributed Object Technology

GO – Generic Observable

Jam – Java Maintainer Machine

API – Application Interface