Model-driven Engineering for the social enterprise

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Outline

- The emerging social enterprise (John G interpretation anyway…)
- Example domains and data
- Requirements for next-generation social enterprise systems
- Engineering next-generation social enterprise systems
  - Modelling
  - Generating
- Some of our representative current example projects
- Future work
"Old-style" Enterprise Systems

- Mainly internally focused (even SOA & cloud-based!)
- Significant external data, services – but limited sources / sinks
- Enterprise to enterprise
- Transactional – B2B
Emerging Social Media Systems

- Incorporate variety of social vs corporate data
- (Somewhat) limited cross-system sharing
- Increasing use in corporate domains
- Trend to integrated access
- P2P
Emerging Social Enterprise Systems

- To the user – where does enterprise vs social media begin / end?
- Ubiquitous enterprise and social media
- Increasing IoT/device info
- P2B
(Potential) Domains of Use

- Probably just about anything 😊, but increasingly…
- Retail – crowdsourced requirements, design, usage, reviews of products
- Financial services – micro-finance, tailored packages, on-demand services
- Government services – transport, infrastructure esp demand-based supply – personal, group, demographic data etc
- eHealth – wearable data, personalised solutions eg fitness, dietary, treatment
- Education – learning analytics merging LMS, OLM, group interaction, behavioural data
Sources of “social” enterprise data

- Enterprise databases (don’t forget these are still very rich!)
- eGovernment data sources
- Cloud data sources – yours and theirs
- Social media
- Crowdsourcing
- Internet of Things
  - Environment e.g. building, transport, infrastructure
  - Groups of people e.g. rooms, devices, video, voice
  - Personal data e.g. wearables etc
Key requirements – and challenges!

- Source (and sink) data from very diverse places
- Integrate disparate data sources
- Model complex applications
- Model and apply various data analytics
- Visualise complex information
- Realize and scale complex applications
- Maintain privacy and security
  - Where is the boundary between self / friends / enterprise / community …
Overview of MDE concept

- **Domain meta-model(s)** (Platform independent model)
  - Use to model with
  - [Visual] representation(s) of domain model(s)
  - Combine with “platform” info
  - Reverse engineering models

- **Software platform meta-models, patterns, templates**

- **Platform-specific model(s)**
  - Combine with “platform” info
  - Code/config generation

- **APIs, hand-written code, manual configs**

- **Code, configurations**
  - Code/config generation

- **Reverse engineering models**
- Model disparate data sources – structured, semi-structured, discrete, continuous, number/text/image/sound/video/…

- Source data from disparate sources – enterprise systems (services), devices, social media, wide variety of formats; some limitations for privacy etc

- Integrate / wrangle / cleanse / transform / store data

- Apply various analytical techniques to discover information / knowledge – aggregate, disaggregate, data mine, ML, feedback loops, …

- Visualise data and information to support decisioning (by multiple people)

- Model non-functional issues: security, privacy, reliability, interfaces, …
- Generate scripts, code to cleanse, wrangle, integrate data to produce large data sets for social enterprise data

- Generate data analytics code and/or 3rd party code configurations to apply to large data sets

- Generate apps, configurations for mobile, web and increasingly IoT-based social enterprise interfaces, including decisioning support via rich information visualisations

- Generate configurations, scripts, code to produce (highly) scalable solutions
Some of our current projects

- Various examples from our recent work addressing (parts!) of the problem:
  - AURIN, ITS - data sourcing, integration & visualisation
  - Mobile Trauma Tool – eHealth
  - CONVERT – by-example data transformation & visualisation generation
  - Blue box – domain expert modelling support
  - Horus HPC – GPU-ising applications to scale
  - Yellow box – scalable compute platform
  - MDSE@R – run-time security modelling and enforcement
Examples of “social enterprise” applications
Example #1 - Information Aggregation & Visualisation

- Household Travel Survey data -> AURIN system
- Various states with different Survey instruments and categorisation
- Harmonise into a canonical DB
- Project includes data wrangling, mapping, and visual analytics

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Use Specific Mappings before transfer

Canonical Database

DB Server

Diagram showing data flow and integration process.
Sample Visualisations of Harmonised Data

Swinburne
Example #2: Big Data Visualisation for Traffic Management

- Vicroads Collects traffic data (SCATS) - Enterprise
- Traveller GPS collects travel data – personal
- Twitter data - social
- Data is transferred to Swinburne’s local DB daily

- Project:
  - Collect & integrate data
  - Visualisation of collected data
  - Users can interact with visualisations to see different aspects of the data and help traffic management – personal and utility

- Extension: PAVVET w NDSU & Great Plains Travel Research Centre – capture road quality data & vis
Sample Visualisations Traffic Data

Congestion in Melbourne CBD
12:15PM

Congestion in Melbourne CBD
12:45PM
Example #3 - MTR – Mobile Trauma and Resuscitation tool

- Mobile trauma tool (w Alfred Hospitals and US Navy)
- Data from various medical devices
- Visualise & decide
- Now – towards Personal health management:
  - Personal data monitoring – exercise, diet, various body and environment measures
  - How use to influence behaviour?
  - How learn to improve treatments etc??
How support specification, generation?
Example #1 - CONVERT - By-example data mapping & InfoVis

Figurative Map of successive losses in men of the French army in Russian Campaign 1812 ~ 1813
Example #2 – Visual Care Plan Modelling Language

Care Plans:
Obesity Management

Personal Health Management

Glucose Measure Appointment
Starting time: 27/06/2007 13:30:00
Duration: 0 minutes
Enter Glucose Sugar:
5.6 mmol/L

Status:
- Completed
- Could Not Complete
- Not Attempted

Comments:
I ate a salad for lunch along with a fruit smoothie.
Example #3 – “Blue box” – DSVLs for subject matter experts

- Specifying data analytics solutions for subject matter experts

- Set of DSVLs to model aspects of complex domains:
  - Workflow in target domain
  - Disparate data sources and data formats
  - Integrated data sets
  - Re-usable data analytics abstractions expressed in domain expert concepts
  - Data visualisation specifications for decisioning
  - Generates solution to run on yellow box (or other) compute platform
Early example – Statistics Design Language Tool (SDLTool)
Example #4 - Horus HPC – GPU-ising scientific software

- Approach and tool for re-engineering HPC applications
- Set of DSVLs to model
  - Data
  - High-level domain specific metaphors (including formulae)
  - Sequential algorithms
  - Successively specify more detailed parallel computation solutions, down to C and GPU kernel code
  - Code generators and reverse-engineering tools
  - Deployment model to run code on Grid, GPU, Cloud
  - Web-based IDE, cloud-based generation and deployment
Horus HPC example parallel computation specification

C = A X B , C_{i,j} = \text{Sum}( A_{i,k} \times B_{k,j} )
Web-based development tool

Swinburne
Example #5 – “Yellow box” – Scalable compute platform

- Scalable compute platform for large data analytics problem domains
- With NICTA, DSTO, Austin Hospitals, Hawthorn Football Club, Mailguard
- Specify in set of DSVLs:
  - Deployment platform capabilities
  - Data acquisition, processing, usage workflow
  - Set of compute jobs
  - “Black box” compute components i.e. reusable parts of solution space
  - Data integration
Yellow box Platform Architecture (current)

- Platform Monitoring
- Platform UI
- Scheduler
- Distributed Systems Kernel
- Executor
- Slaves

- Ceph
- Ubuntu

Custom web interface: collectd + Riemann + Graphite

- Aurora
- Mesos

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Example #6 - MDSE@R - Modelling and Generating Security

- System Description Models
- Security Specification Models
- Live System Interceptors Documentation
- Live Security Specification Document
- Security Enforcement Point
- Security Testing

Roles:
- System Engineer
- Security Engineer

Steps:
1. Develop System Description Models
2. Create System Container
3. Develop Security Specification Models
4. Interact between System Engineer and Security Engineer
5. Develop Live System Interceptors Documentation
7. Develop Security Services
8. Security Testing
9. Security Enforcement Point
10. Feedback loop
DSVLs supporting modelling & generation
Key challenges to address

- How do we model and integrate complex, heterogeneous information sources (CONVERt generalisation)

- How do we enable domain experts to specify and generate their evolving social enterprise solutions (Blue box)

- How do we generate highly scalable computations (Horus HPC, Yellow box)

- How do we scale data analytics required, especially black-box solutions (yellow box)

- How do we specify and generate effective information visualisations (COVERt, Horus HPC, )

- How do we maintain security and privacy (MDSE@R) for multi-tenant solutions with emergent users, requirements and deployment environments
Future work

- Domain expert modelling using domain-specific metaphors – Blue box, SDL++
- Diverse information sourcing and integration – purple box (sensor networks, IoT - Smart Home), CONVERT++
- Scaling of black-box solutions (yellow box) and bespoke solutions (Horus HPC)
- Better understanding of what “privacy” means esp in IoT world
- Adaptive security, especially for highly dynamic environments
- Where does personal end, social begin / social end, enterprise begin?
The social enterprise brings new challenges and opportunities

Access vast quantity and quality of information

Learn behaviours, influencers, warning signs, counter-examples like could never do before

Personal / social / enterprise / government / society lines blurred

Security of information

Privacy

Just because you can build it – does it mean you should?


