

★ Modern businesses must react quickly to changes in the marketplace if they are to remain competitive. Flexibility measurements can play a large part in improving organisational structures, and Professor Jivka Ovtcharova, Coordinator of the X-Change project says their impact can reach even further

# Flexibility management in the factory of the future

In the last quarter of the 20th century companies reacted to the desire for flexibility by shifting various paradigms and strategies. This process began with Computer Integrated Manufacturing (CIM) and was quickly followed by Total Quality Management (TQM) and Business Re-engineering. It then continued right through to Supply Chain Management (SCM) and Holistic Production Systems (HPS). These shifts have not been based on concrete flexibility measurements and assessments. Instead, they stem from companies basic need to maintain a level of commercial competitiveness as they strive to differentiate themselves from their rivals and respond to market trends. The X-Change project, established in September 2005 with seven European partners from both industry and academia, aims to develop a flexible measurement tool capable of responding to our ever-changing business environment.

The recent radical changes in levels of competition, technology and customer expectations are creating an increasingly uncertain environment, an environment in which production managers need a new kind of decision support. They need methods and tools to assist them in making decisions about planning, monitoring and changing a production system. The X-Change project responds to these trends by developing several innovative, live, 'near realtime' flexibility measurement methods as part of a flexibility evaluation toolbox with wide applicability range. The project's long-term goal is to cover the entire lifespan of production systems by adopting a holistic approach focused on addressing business and production processes in a multi-level structure.

The organisational models and strategies that have been developed do not allow for

direct comparison on the basis of flexibility operating figures. Thus, important flexibility statements or benchmarks on the shop floor, line or network level are very limited. Furthermore, companies have to integrate a rising number of products and product varieties, this means that predicting the break-even point, turnover or sales figures becomes ever more difficult [1]. As a result, the success of a company depends more and more on the ability to recognise internal and external influences as early as possible and

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then react to the resulting changes with an adaptation of their organisational structures, and eventually their production systems.

Despite the enormous importance of flexibility measurements, the problems outlined above remain unsolved. There are a number of reasons for this. Firstly, flexibility is a multi-dimensional factor (variety, costs, time), and therefore cannot be easily expressed by direct indicators. Secondly, in order to assign an important role to flexibility, companies must find a way to quantitatively measure flexibility. If flexibility has not been properly defined in quantitative terms it cannot be properly considered in the decision making process [2]. Thirdly, most of the existing flexibility evaluation methods require specific data inputs, which are often not easy to either identify or record.

In fact there are a large number of approaches regarding the measuring and

rating of flexibility, but they need to be modified to suit the particular purpose or specific situation of the companies using them. Failure to do this can leave people sceptical about these systems potential and thus less likely to adopt them [3]. As a consequence, no concrete considerations or solutions aiming to integrate flexibility measurements into change management – with the goal of significantly accelerating change processes – currently exist.

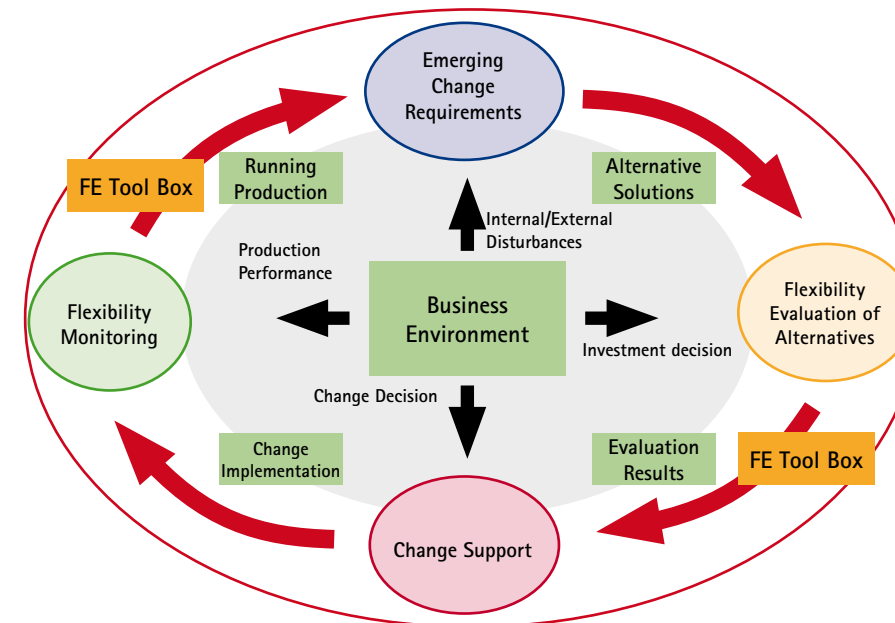
The integration of quantitatively

identified flexibility indicators into the business lifecycle and change management is a crucial challenge. Indeed, it is likely to be a key future factor in attempting to improve both the effectiveness and competitiveness of industrial enterprises.

Looking specifically at this context, the X-Change project aims to develop and integrate flexibility measurement methods to support change management processes within manufacturing systems.

The objectives of the X-Change project can be summarised as:

- The development of several innovative, live, 'near-realtime' flexibility measurement methods as part of a flexibility evaluation toolbox with a wide applicability range
- The integration of the results of the flexibility measures, the flexibility indicators, into existing cross-



### Improved flexibility management could bring a range of benefits

organisational and organisation-internal change management (business) processes

- The realisation of a flexibility evaluation toolbox into an open-interface X-Change lifecycle platform able to facilitate lifecycle and change management in production systems and extended enterprises

X-Change is thus threefold in its scope. It is about developing innovative flexibility measurement methods that can be used in different production environments in a multilevel structure (e.g. from shop floor to top floor). Furthermore, it integrates the results of the flexibility calculation – the flexibility indicators – into either existing change management processes or newly specified change processes. Eventually it combines both aspects within an overall, open-interface lifecycle platform that enables a broad, general distribution of the results.

Within X-Change, the idea of a flexibility evaluation toolbox will be used. Instead of providing a single flexibility evaluation measure, X-Change will provide production engineers with the opportunity to select from a set of reliable flexibility measures. Furthermore, these methods will be integrated into either organisation-internal or cross-organisational change processes. Attention has to be paid to the preparation of the internal change properties of cross-organisational processes which will eventually include two steps: reduction of the representation to the relevant change

process information and definition of the process wrappers. Eventually the X-Change Lifecycle platform will narrow the gap between flexibility assessments on the one hand and change management processes on the other. The development of a novel approach that provides both the methods and the realisation will allow companies and stakeholders to benefit fully from the results of this project.

The flexibility evaluation platform being developed within the X-Change project will eventually permit companies to detect flexibility weaknesses in their production systems, ranging from machine to network level. Moreover, it will allow the performance of benchmarking tests between production systems of an industrial branch. It is planned that these tests will include not only existing production systems but also planned systems. Thus, there will be a level of decision support that enables all persons responsible, ranging from production planner to higher management, to compare different application scenarios and consequently guarantee a higher degree of decision security.

In today's highly complex, highly competitive commercial environment flexibility is a key requirement for companies of all sizes, whether they be small-scale enterprises or corporate behemoths. In such a situation flexibility measurement tools take on a greater importance than ever before, creating a need that we at the X-Change project are determined to fulfill. ★

### At a Glance

**About the project:**  
The X-Change project was founded by the European Commission under the Sixth Framework Programme. The project started in September 2005

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Funded by the European Union FP6-2004-IST-NMP-2

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