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Empowering the telecoms world

Flexible, customizable, effective learning solutions for the global telecoms industry:

- 5G Technology
- Essential Technologies
- LTE/4G
- UMTS & HSPA
- GSM & GPRS
- IMS & SIP
- Radio Engineering
- ORAN
- Professional Mobile Radio
- Telecoms Business

Classroom | Live Virtual Classroom | On-Demand Online

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Contents

Introduction to Wray Castle…… 2
Training Delivery Formats…… 3
Customised Online Academy…… 4
Certificate & Diploma in Telecoms…… 5
Essential Technologies…… 6
5G Technology…… 9
LTE/4G…… 11
IP Engineering…… 14
Radio Engineering…… 16
Network Virtualisation…… 17
IMS & SIP Training Courses…… 18
Rail Engineering…… 19
Professional Mobile Radio (PMR)…… 20
GSM, UMTS & HSPA…… 21
Telecoms Business…… 23

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Introduction to Wray Castle

Empowering the Telecoms World

We empower the global telecoms world by providing the specialised knowledge, skills, and competencies required by organisations to build, manage, optimise, and operate cutting-edge telecommunications networks.

Proven **learning interventions** help organisations increase online learning completion rates by **70%**

Trusted by the global telecoms industry since 1958, we've helped upskill over 300,000 industry professionals from over 85 countries worldwide. Our learners come from many major mobile and fixed operators, vendors, regulators, consultants, rail operators, energy suppliers and government organisations.

Our Expertise

Our team of highly experienced specialist course developers and instructors come with decades of experience from within the industry and as specialist technical trainers.

"By 2030: Skills shortage of 4.3 million workers in TMT Sector and unrealized output of $449.70 billion." **The Global Talent Crunch, Korn Ferry**

We support learners at all stages of their career from new entrants looking for a thorough grounding in industry to experienced engineers looking to enhance their knowledge of the latest network technologies.

Our courses cover all the major global communications technologies including:

- 5G Technology
- Essential Technologies
- LTE/4G
- UMTS & HSPA
- GSM & GPRS
- IMS & SIP
- Radio Engineering
- ORAN
- Professional Mobile Radio
- Telecoms Business

"…effortless delivery, reminded me how hard it is to do training really well. I found your enthusiasm for the subject infectious." **Vodafone**

"A very good course. This has given me a solid foundation in the telecommunication industry allowing me to be more effective in my new role." **Huawei**

"One of the best pieces of instruction I have received in over 20 years of military experience." **MOD**

Ofcom making communications work for everyone · BT · Telefónica · ATKINS · NetworkRail · vodafone · GCHQ

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Training Delivery Formats

Our blended training approach is adaptable and customizable, resulting in an engaging, effective learning experience.

1. Instructor-led Face-to-Face Training Courses:

Our classroom courses by true subject matter experts, uses a range of learning techniques to bring your programme to life including exercises, demonstrations, and role-playing.

- Train at your premises or at a premier venue globally
- Live training with on-the-spot feedback
- Ideally suited for delivering complex or detailed information to groups

2. Instructor-led Virtual Live Training Courses:

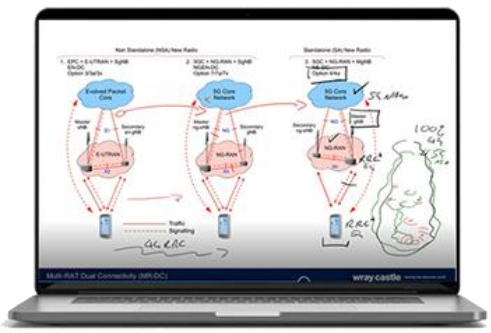
Live online classes reach participants globally with the same interactive learning experience as classroom training. Our trainers have delivered thousands of hours of live virtual training are skilled at utilising a range of techniques to ensure learners remain engaged throughout.

- Train staff across multiple locations, minimise downtime and travel costs
- Live training featuring engaging collaboration techniques.

3. Self-Paced Online Training Courses

Learn online, anytime, with our self-study courses. Our self-paced on-demand distance learning courses include an extensive blend of core reading materials and video resources, scenario-based assignments, a dedicated Instructor all in a modern, intuitive and secure cross-device Virtual Learning Environment.

Each course includes:



- **Illustrated Course Books** - featuring leading edge knowledge from subject matter experts.
- **Videos** - Detailed videos expand on the subject and discuss topics in greater depth.
- **Tutor Support** – Tutors are available to answer any questions throughout your studies.
- **Formative Assessment** - Modules include regular quizzes to support learning by testing your knowledge of the subject matter.
- **Digital Certification** - Successfully complete the end of module tests to earn Digital Badges to demonstrate the depth of your knowledge.

4. Tech Talks

Our growing collection of 2-3 hour technology briefings provide knowledge on the key technologies and the factors influencing strategic decisions in the telecoms sector.

5. Digital Course Books

Our diverse course portfolio is tailored to the needs of today's network engineers, our books include custom technical diagrams created by our subject matter experts.

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Customised Online Academy

Our customised Online Learning Academies are designed and customised for each client, meaning that every Academy is unique. Our proven platform combined with our Gold Standard training material effectively enables knowledge transfer and upskills staff across an organisation. We empower industry giants to fill their skills gap and develop, retain and attract the industries best talent and ensure they stay at the leading edge of the industry.

Each Academy help address the skills gap and delivers effective integrated training programmes that truly engage employees in their own development, whether its new starters, identified talent or experienced engineers. We help organisations empower employees to reach their potential and delivers a true return on your training investment.

Each customised Academy features:

- Robust, secure, feature heavy learning platform
- Flexible, blended learning formats to maximise employee engagement and learning across an organisation
- The widest range of specialist telecoms technology and business training courses.
- Best in class training content delivered by subject matter experts
- Regular and ad hoc learner analytics enable organisations to monitor employee progress, plan learning interventions and reward your top learners

Flexible Training Formats		**On-Demand Online Content**	
Executive Briefings	✓	Training Videos	✓
Self-Paced Online Learning	✓	English Delivery	✓
Access to Public Live Virtual Training	✓	Human Verified English Subtitles	✓
Customised Live Training Courses	✓	Other Language Subtitles	Option
Learner Platform		Course Books/Notes	✓
Scalable Enterprise Platform	✓	Tutor Support	✓
Fast Roll Out/Customization	✓	Self-Assessment Tests	✓
24/7 Access	✓	Certification Badges	✓
Computer/Tablet/Smartphone	✓	**L&D Admin Platform**	
Host Clients Content	✓	Learner Management	✓
Salesforce Security Rating - Excellent	✓	Ad Hoc Reporting	✓

Trial Academy Offer

Want to learn more?

If you'd like more information on Wray Castle's Online Academy solution. Contact us to discuss a limited seat trial Academy so you can see for yourself how the Academy can help you organisation execute your training projects and start to address the skills gap. Email us on info@wraycastle.com.

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Certificate & Diploma in Telecoms

Become a certified expert in Cellular Radio Engineering, Core Network Engineering, LTE or 5G Engineering with our Certificate and Diploma level training programmes. We have combined some of our most popular training courses to build guided learning pathways enabling you to demonstrate your expertise and competence in your chosen field.

Certified Training Programme Format

Certificate programme students' study the three foundation courses plus two specialist courses. The Diploma level programme allowing you to widen your knowledge base, by selecting an additional two courses from a portfolio of over 15 leading Wray Castle courses.

What specialisms are available?

- **Cellular Radio Engineering** (Specialist Courses: LTE Air Interface, 5G Air Interface)
- **Core Network Engineering** (Specialist Courses: LTE EPC, 5G Architecture and Protocols)
- **LTE Engineering** (Specialist Courses: LTE Air Interface, LTE EPC)
- **5G Engineering** (Specialist Courses: 5G Air Interface, 5G Architecture and Protocols)

Who would benefit?

Our Certificate and Diploma programmes have been designed for anyone working within the telecoms industry from new starters looking to build their technical knowledge from the ground up to more experienced managers and engineers looking to formalise and expand their knowledge base.

What sets our certified training programmes apart?

- **Focused Learning Pathways** – enable you to become an expert in your chosen field.
- **Flexible Learning** – study at a time, location and pace of your choice.
- **Full Tutor Support** – from industry experts with decades of experience.
- **Extended Learning** – Diploma students' study 3 additional courses.
- **24 months access** – access to the all the training materials for 2 years.
- **Regular Testing and Digital Badges** – allow you to demonstrate your knowledge.
- **End of Programme Certificate** – students successfully completing the programme are issued with a certificate complete with a grade transcript.

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Essential Technologies

Introduction to Telecoms

Instructor-Led – 2 Days
Self-Study Online – 22 Hours

An essential foundation in the core technologies used in fixed, mobile and IP-based telecoms networks. The fundamentals of networking technologies are discussed. Next generation networking based on an all-IP environment is included.

Course Modules:

- Telecom Services in the Modern World
- The PSTN and ISDN
- Transmission Networks
- Mobile Cellular Networks
- IP Packet Networks
- Fixed and Wireless Broadband Access Technologies
- VoIP, NGNs and the IMS

Telecoms Fundamentals

Instructor-Led – 3 Days
Self-Study Online – 32 Hours

The historical background to telecommunications is described and the technologies, abbreviations and techniques that are employed are explained.

Course Modules:

- Defining Telecoms and the Nature of Information
- A Historical Background to the Telecom Network
- Digital Fixed Telecom Networks
- Data Networks
- Mobile Networks & Wi-Fi
- Broadband and Emerging Networks

Telecoms – as an Industry & Business

Instructor-Led – 1 Day
Self-Study Online – 11 Hours

This course explores the overall make-up of the industry and the business dynamics; the types of organisations involved and their roles and relationships; the service propositions; and main customer segments.

Course Modules:

- Telecoms Industry and Business Dynamics
- The Technology Explained and Evaluated
- Telecoms Industry and Market Update

Telecoms - Today & Tomorrow

Instructor-Led – 1 Day

This workshop provides delegates with a clear understanding of the technologies available for use within communications networks. It considers how technologies have evolved and then considers fixed-line and mobile voice and data networks. The full range of broadband technologies is introduced both for fixed and mobile access.

Course Modules:

- Telecommunication Concepts and Technologies
- Telecommunication Networks and Services
- Evolution of Networks, Technologies and Services

2G to 5G Mobile Technologies

Instructor-Led – 2 Days
Self-Study Online – 22 Hours

This course provides a technical overview of the main cellular technologies GSM, UMTS, LTE and 5G. It provides a view of the most important aspects of cellular communication technologies and how the principles are applied within the different generations as networks evolve from providing basic GSM services, through to supporting an increasingly complex set of connection requirements and services.

Course Modules:

- Principles of Mobile Cellular Networks
- 2G Mobile Networks
- 3G Mobile Networks
- 4G Mobile Networks
- 5G Mobile Networks

eSIM Engineering

Instructor-Led – 2 Days
Self-Study Online – 22 Hours

This course is a detailed technical description of eSIM technology and the new remote SIM provisioning specifications from GSMA covering M2M and Consumer applications.

Course Modules:

- Introduction to eSIM
- GSMA Consumer eSIM Specification
- GSMA M2M eSIM Specification
- GSMA Consumer eSIM Specification Enhancements
- The Future of eSIM

Next Generation Transmission

Instructor-Led – 3 Days

This course reviews traditional approaches to transport services such as SDH and WDM and also discusses in detail alternative approaches including Carrier Ethernet and Pseudo Wire services that may be deployed in backhaul and core network applications.

Course Modules:

- Options for Layer 2 Virtual Circuits
- Carrier Based Ethernet & Transmission Systems
- Pseudo Wires
- Synchronous Digital Hierarchy (SDH)
- Packet & Frames over SDH
- Wavelength Division Multiplexing (WDM)
- Optical Transport Network
- Automatic Switched Optical Network (ASON)
- Generalized Multi-Protocol Label Switching (GMPLS)

Mobile Intelligent Networks (CAMEL)

Instructor-Led – 2 Days

An introduction to IN concepts specifically those associated with IN Capability Set 1 (IN-CS1). The course covers the interworking between CAMEL and mobile networks, including the circuit-switched packet-switched domains and the SMS service.

Course Modules:

- Telecommunication Systems and Services
- Intelligent Networks
- Service Creation and Implementation
- GSM System Overview
- CAMEL Phase 1
- CAMEL Phase 2
- CAMEL Phase 3

SS7 Engineering

Instructor-Led – 3 Days

SS7 is a key element in the control plane of fixed and mobile networks and in Intelligent Network scenarios. It facilitates communication between SS7 hosted 'applications' enabling end-to-end service delivery. This course provides a comprehensive description of SS7 protocols, functions and procedures.

Course Modules:

- Introduction to Telecommunications Signalling
- SS7 Signalling Networks
- MTP – SMH
- Call Control and the ISDN User Part
- Signalling Connection Control Part (SCCP)
- Transaction Capabilities
- SS7 Applications

Machine to Machine (M2M)

Instructor-Led – 2 Days

Designed for those involved in the planning, design, implementation, operations and management of M2M networks. This course is built in accordance with ETSI/3GPP, OMA and the IOT- A and so is primarily aimed at cellular implementations of M2M.

Course Modules:

- Introduction to M2M
- M2M Applications
- M2M Standardization
- M2M Protocols & Networking Technologies
- M2M Security
- Cellular M2M
- M2M Challenges & Issues
- M2M Ecosystem & Market

Wi-Fi Engineering Overview

Instructor-Led – 2 Days

This course presents an overview of the 802.11 family of wireless LAN technologies that are more commonly known as Wi-Fi.

Course Modules:

- Wireless LAN Technologies and Standards
- 802.11 PHY
- MAC Frame Structures
- MAC Procedures
- Security
- Wi-Fi Troubleshooting

Wi-Fi and Cellular Convergence

Instructor-Led – 1 Day

The course introduces the various forms of WiFi currently in use and looks in detail at the structure, operation and functionality of WiFi connections.

Course Modules:

- Wireless LAN Technologies & Standards
- 802.11 PHY
- MAC Frame Structures
- MAC Procedures
- Security
- Wi-Fi Troubleshooting

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5G Technology

5G - A Business Perspective

Instructor-Led – 2 Days

The course focusses on the commercial aspects of 5G and the capabilities it brings to telcos, new and emerging players in the communications industry, as well as adjacent industries

Course Modules:

- The Telecoms Environment
- 5G as a Key Business Enabler for Ongoing Connectivity
- 5G – A Framework for Cost Control
- Connected Innovation – A New Universe for Connectivity
- New Use Cases

5G Strategy 5G Technologies, Services & Markets

Instructor-Led – 1 Days

This is a non-technical introduction to the 5G system, its capabilities, structure and operation, as well as its position as a development of previous technologies. The course also covers the place that 5G holds in the telecoms market, and how that is developing.

Course Modules:

- What is 5G?
- How Does 5G Work?
- What Does a 5G Network Look Like?
- How is the 5G Market Developing?

5G Engineering Overview

Instructor-Led – 1 Day
Self-Study Online – 11 Hours

This course is a technical overview of 5G. The course includes the design goals and development schedule for 5G, and the principles and architecture of the 5G air interface, radio access network and core network.

Course Modules:

- Introduction to 5G
- 5G Air Interface
- 5G Network Architecture

5G Engineering

Instructor-Led – 2 Days
Self-Study Online – 22 Hours

This technical introduction to 5G includes the design goals and development schedule for 5G, the principles, design and implementation of the 5G air interface, radio access network and core network, and the operation of the 5G system.

Course Modules:

- Introduction to 5G
- Principles of the 5G New Radio
- 5G Air Interface
- 5G Network Architecture
- 5G Procedures
- Releases 16 and 17

5G Architecture & Protocols Overview

Instructor-Led – 1 Days
Self-Study Online – 11 Hours

This 5G Architecture and Protocols Overview is a technical introduction to the 5G network. The course includes the design goals and development schedule for 5G, the principles, design and implementation of the core and radio access networks of 5G.

Course Modules:

- Introduction to the 5G Network
- Radio Access Network Architecture
- 5G Core Network Architecture
- 5G Procedures

5G Architecture & Protocols

Instructor-Led – 2 Days
Self-Study Online – 22 Hours

A technical description of the core and radio access networks of 5G. It covers the architecture and interfaces used by 5G, the protocols used for signalling and data transport, the provision of services over a 5G network, and the procedures for signalling and operation.

Course Modules:

- Introduction to 5G
- Radio Access Network Architecture
- Core Network Architecture
- Data Transport
- 5G Protocols
- 5G Procedures
- Releases 16 and 17

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5G Infrastructure & Operation

Instructor-Led – 2 Days

The 5G Infrastructure and Operation course is designed for those that require a detailed introduction to the 5G Network.

Course Modules:

- Introduction to 5G
- Principles of the 5G New Radio
- 5G Air Interface
- Radio Access Network Architecture
- Core Network Architecture
- Data Transport
- 5G Protocols
- 5G Procedures
- Releases 16 and 17

5G Service Based Architecture & Core Network

Instructor-Led – 2 Days
Self-Study Online – 22 Hours

This course examines the 5G Core and SBA supporting protocols and technologies, as well as a thorough examination of the Service Based Interface (SBI) and Service.

Course Modules:

- 5G introduction and Deployment Options
- PDU Connectivity Services and PDU Sessions
- HTTP/2
- Service Based Interface (SBI)
- Procedures
- 5G Access Security and SBA Domain Security

5G Radio Access Networks

Instructor-Led – 2 Days
Self-Study Online – 22 Hours

Exploring the key features of a 5G network before delving into the finer detail of the 5G New Radio. The 5G RAN is described in terms of network architecture, base station characteristics, spectrum usage and multiple antenna configurations.

Course Modules:

- Introduction to 5G
- The Next Generation Radio Access Network
- Signalling Protocols & Procedures in the NG-RAN
- Signalling Procedures in the
- Releases 16 and 17

5G Air Interface

Instructor-Led – 2 Days
Self-Study Online – 22 Hours

A detailed technical description of the air interface for the 5G New Radio. It covers the principles of mm wave and multiple antenna communications, the architecture of the AI's physical layer, the higher layer air interface protocols, and the signalling procedures for 5G devices.

Course Modules:

- Introduction to 5G
- Principles of the 5G NR
- Introduction to the Physical Layer
- Physical Layer Implementation and Procedures
- Higher Layer Protocols
- Signalling Procedures
- Releases 16 and 17

5G Cell Planning

Instructor-Led – 2 Days
Self-Study Online – 22 Hours

This course will guide you through the variables that impact both coverage and capacity and provides practical worked examples for a variety of scenarios.

Course Modules:

- Fundamentals of the 5G Air Interface
- Link Budget Estimation
- Coverage Estimation
- Capacity Estimation
- RSRP, RSRQ and SINR
- Parameter Setting

5G Network Slicing

Instructor-Led – 1 Days

This 5G Network Slicing course examines 5G network slicing and those topics that impact and drive slice strategy

Course Modules:

- Introduction to 5G, Use Cases and Connectivity
- 5G Slicing
- Slice Development and Deployment

5G Security

Instructor-Led – 1 Days
Self-Study Online – 11 Hours

The 5G Security course provides a comprehensive grounding in this expanded set of security requirements and mechanisms used in 5G.

Course Modules:

- 5G Architecture and the Service Based Interface
- 5G Security Architecture and Authentication and Key Agreement
- Security and the Service Based Interface (including SEPP*)

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LTE/4G

LTE Technologies, Services & Markets

Instructor-Led – 1 Days

A non-technical introduction and overview of the complete LTE system, known as the Evolved Packet System (EPS), including the system capabilities, general structure and operation as well as its position as a development of current systems. The course also covers the place LTE holds in the telecoms market and how this is developing.

Course Modules:

- What is LTE?
- How Does LTE Work?
- How is an LTE Network Built?
- Who Are LTE's Target Users?
- How is the LTE Market Developing?
- LTE Evolution

LTE Engineering

Instructor-Led – 2 Days
Self-Study Online – 22 Hours

A technical introduction and overview of LTE and LTE-Advanced, including the air interface, radio access network, core network and other key associated technologies.

Course Modules:

- Introduction to LTE
- OFDMA Physical Layer
- Access Stratum Protocols
- LTE UEs and Access Networks
- LTE Core Networks
- LTE Operation
- LTE Release 9 and Beyond

LTE Backhaul

Instructor-Led – 1 Day

A detailed technical description of the technologies available to be used to support the backhaul requirements of next generation 4G LTE access networks.

Course Modules:

- Mobile Backhaul Requirements
- Layer 1 Options
- Layer 2 Options
- Layer 3 Options
- Typical Backhaul Scenarios

LTE Evolved Packet Core

Instructor-Led – 3 Days
Self-Study Online – 32 Hours

A detailed technical description of the Evolved Packet Core (EPC) for LTE systems. This includes EPC architecture and interfaces, service provision concepts, application of IP technologies, overall protocol architectures and (optionally) a review of IMS functionality.

Course Modules:

- LTE Overview
- Evolved Packet Core
- Data Transport in the EPC
- Major Protocols
- EPC Operations
- Release 9 and Beyond

LTE End-to-End Signalling

Instructor-Led – 2 Days
Self-Study Online – 22 Hours

This course is designed to provide an end-to-end view of the whole set of signalling messages that support some of the most fundamental LTE network operations, such as: initial attach, PDN Connectivity, EPS Bearer setup, bearer resource allocation, handover and detach.

Course Modules:

- Signalling Protocols
- Initial Attach Procedures
- Idle Mode Procedures
- Connected Mode Procedures
- Detach Procedures

LTE SON & Small Cell Deployment

Instructor-Led – 1 Days

This course discusses the concept of a Self-Organizing Network (SON) with a look at the key features and procedures that enable self-configuration in a SON. This course will also examine the issues surrounding femtocell deployment with a discussion around potential interference issues and techniques for controlling uplink and downlink interference.

Course Modules:

- Planning Small Cells
- Self-Organizing Networks (SON)

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LTE Radio Access Networks

Instructor-Led – 2 Days

A detailed technical description of the RAN for LTE systems. This includes E-UTRAN structure, configuration, deployment options, security functions, core network interactions and bearer procedures.

Course Modules:

- Introduction to LTE
- LTE Evolved Universal Terrestrial RAN
- S1 Interface Messages and Procedures
- X2 Interface Messages and Procedures
- E-UTRAN Support for LTE Procedures

LTE Air Interface

Instructor-Led – 3 Days
Self-Study Online – 32 Hours

A detailed description of the air interface for LTE radio access. This includes OFDMA principles, access and non-access stratum protocols, channel structures, connectivity and mobility management procedures along with radio link control functions.

Course Modules:

- LTE Overview
- OFDM Principles
- Physical Layer Structure
- Layer 2 Protocols
- Radio Resource Control
- LTE-Advanced
- Lower Layer Procedures

Cell Planning for LTE Networks

Instructor-Led – 2 Days

An introduction to the changes required in the techniques, skill sets and tools for planning LTE networks. This includes link budgets, mixed traffic dimensioning, coverage considerations and tool configuration parameters. All aspects are reinforced through classroom exercises and planning-tool illustrations.

Course Modules:

- LTE Planning Considerations
- Coverage Planning and Link Budgets
- Traffic Characterization
- LTE Cell Parameters
- Frequency Planning
- Planning for VoLTE
- LTE Performance Simulations
- The LTE Planning Process

LTE RAN Signalling

Instructor-Led – 1 Days

Engineers involved with equipment design, operation, optimization or monitoring of the LTE Radio Access Network.

Course Modules:

- LTE Signalling Protocols and Interfaces
- S1 Interface Messages and Procedures
- X2 Interface Messages and Procedures

LTE RAN Capacity Planning

Instructor-Led – 3 Days

This course equips engineers with the necessary information to predict and plan capacity requirements in LTE RAN architectures.

Course Modules:

- Introduction to LTE
- User Plane Connectivity
- Control Plane Connectivity
- Radio Link Dimensioning
- Backhaul Capacity Planning
- LTE Evolved Universal Terrestrial Radio Access Networks

LTE Optimisation

Instructor-Led – 2 Days

An introduction to the principles and techniques that relate to the parameters available in the LTE Radio Access Network (RAN). This includes cell configuration, idle mode parameters and connected mode parameters. All elements are reinforced through classroom exercises and tool demonstrations.

Course Modules:

- Radio Characteristics and Metrics
- LTE Air Interface Parameters
- Frequency Planning
- Idle Mode Parameters
- Connected Mode Parameters

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LTE Quality of Service

Instructor-Led – 1 Days
Self-Study Online – 11 Hours

This course concentrates on the two main areas of an LTE network in which Quality of Service (QoS) is applied – the End-to-End EPS Bearer and the underlying Transport Network Layer (TNL). The main QoS concepts are explored as are details of the interworking between LTE QoS and the QoS schemes employed in other network types, such as UMTS, GPRS and the IMS.

Course Modules:

- LTE Connectivity Overview
- EPS Bearer QoS
- Transport Network Layer QoS
- End-to-End QoS

LTE Voice - VoLTE

Instructor-Led – 2 Days
Self-Study Online – 22 Hours

This course provides a detailed technical description of the currently specified methods of offering a VoIP service using LTE and the IP Multimedia Subsystem.

Course Modules:

- Introduction to LTE
- IMS Overview
- VoLTE
- VoLTE Service Centralization and Continuity
- Additional VoLTE Services

LTE Billing & Charging

Instructor-Led – 0.5 Days
Self-Study Online – 6 Hours

A technical overview of the billing and charging architecture defined for 4G LTE networks, including a review of LTE bearer, traffic flow and QoS concepts.

Course Modules:

- LTE Billing and Charging

LTE Security

Instructor-Led – 0.5 Days
Self-Study Online – 6 Hours

This course provides a detailed overview of the security environment developed for LTE networks, including the LTE Authentication and Key Agreement (AKA) procedures and the provisions for Non-Access Stratum, Access Stratum, Access Network and Core Network security.

Course Modules:

- Introduction to LTE
- IMS Overview
- VoLTE
- VoLTE Service Centralization and Continuity
- Additional VoLTE Services

LTE Mission Critical Communications

Instructor-Led – 2 Days

LTE Mission Critical Communications training course is aimed at those who are working with the emergency services or government agencies wishing to become familiar with the technology planned replace TETRA.

Course Modules:

- Requirements of a Mission Critical Network
- Introduction to LTE
- The LTE Radio Interface
- Multimedia Broadcast/Multicast Service
- The IP Multimedia Subsystem (IMS)
- Group Communication System Enablers for LTE (GCSE_LTE)
- Mission Critical Push to Talk (MCPTT)
- Mission Critical Video (MCVideo)
- Mission Critical Data (MCData)
- LTE and LMR Interworking

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IP Engineering

IP Engineering

Instructor-Led – 2 Days

This course delivers a detailed overview of IP networks, an understanding of Engineering techniques, as well as applications, protocols and switching methods, it enables delegates to work confidently in the IP environment.

Course Modules:

- IP Networks Overview
- IP Network Services
- Service Provider Architectures
- Engineering for IP Application

IP Workshop

Instructor-Led – 5 Days

The IP is the key transmission and switching technology for almost all communication network types and a core skill for telecoms and IT engineers. Theoretical knowledge of how IP networks perform and hands-on experience of how to configure network devices and troubleshoot problems is offered through this intensive five-day course.

Course Modules:

- LAN Technologies
- Introduction to Cisco Equipment and IOS
- Routing & Routing Protocols
- Controlling IP Resources – Access Lists & NAT
- Wide Area Networks
- Layer 2 Switching & VLANs
- Wireless LAN
- Overview of the Cisco Exam Process

IP Backbone Traffic Engineering

Instructor-Led – 2 Days

This is a detailed course examining the complexities of IP Backbone traffic engineering techniques. ATM and MPLS are explored as well as looking to the future of traffic engineering.

Course Modules:

- Traffic Engineering Introduction
- Layer 3 Traffic Engineering
- ATM Traffic Engineering
- MPLS Traffic Engineering
- Introduction to Pseudo Wires
- Introduction to Generalized MPLS

IP Addressing and Internet Protocols Principles

Instructor-Led – 1 Day

A course designed to give the new IP engineer a grounding in IPv4 Addressing whilst also exploring the typical routing protocols and essential components that will be encountered.

Course Modules:

- Router Fundamentals
- IP Addressing
- Internet Protocol Operation

Internetworking, Ethernet LANs & VLANs Principles

Instructor-Led – 1 Day

This course is an excellent introduction to the workings of IP networking. An important part of any network is the local LAN connection; this course breaks open the LAN, and looks at the Ethernet technology, Switching and Virtualised LANs or VLANs.

Course Modules:

- Internetworking Fundamentals
- Ethernet LANs
- Ethernet Physical Layer
- Spanning Tree Protocol
- Virtual Local Area Networks (VLANs)
- Ethernet Support Protocols
- Introduction to Ethernet VPNs and WANs
- Power over Ethernet (PoE)

MPLS VPNs & Traffic Engineering

Instructor-Led – 2 Days

A practical look at Multi-Protocol Label Switching (MPLS) from the simple Label Switched Path through to Virtual Private Network (VPN) connections and finally looking at MPLS Traffic Engineering.

Course Modules:

- Introduction to MPLS
- Technology and Packet Forwarding
- MPLS Virtual Private Networks

TCP/IP

Instructor-Led – 2 Days

Knowledge of TCP/IP and its operation has become a fundamental requirement for anyone involved in IP networks. This detailed and exciting course takes delegates through TCP/IP principles, applications and protocols, enabling them to work confidently in this changing environment.

Course Modules:

- Internet Architecture
- The Physical & Link Layer Interfaces
- Multi-Protocol Label Switching (MPLS)
- The Internet Layer Protocols
- IP Version 6
- The Transport Layer Protocols
- Management Protocols

IPv6 Overview: Enabling the Internet of Things

Instructor-Led – 1 Day

This one-day course based on real-life deployments provides a brief look at IPv6 and in particular how this will apply to telecommunications markets from the User Equipment up through the Service Providers networks and out into the internet.

Course Modules:

- The Need for IPv6
- IPv6 Packet Structure and Addressing
- IPv6 Functionality
- Adoption and Development

AAA Diameter

Instructor-Led – 2 Days

The course will also delve into the deployment of Diameter as seen by modern telecoms in particular. After looking at Diameter in detail the course will review how it is being implemented into 3GPP's IMS and LTE network architectures.

Course Modules:

- Introduction to RADIUS and Diameter
- Diameter Transports
- The Diameter Base Protocol and Entities
- Investigating Diameter Base Protocol
- Diameter Operations and Extensibility
- Diameter Accounting Protocol
- Diameter Security
- Diameter in IMS
- Diameter in the Evolved Packet Core

IPv6 Enabling the Internet of Things

Instructor-Led – 3 Days

This course provides a detailed look at IPv6 and in particular how this will apply to telecommunications markets from the User Equipment up through the Service Providers networks and out into the internet.

Course Modules:

- The Need for IPv6
- IPv6 Packet Structure
- IPv6 Addressing
- IPv6 Address Assignment
- IPv6 Functionality
- Transition & Deployment
- Adoption & Development

Routing Protocol Principles

Instructor-Led – 2 Days

An IP course that looks at providing a grounding in two principal routing protocols namely Open Shortest Path First (OSPF) and Border Gateway Protocol (BGP).

Course Modules:

- What is IP Routing
- Open Shortest Path First (OSPF)
- Border Gateway Protocol (BGP)

Quality of Service (QoS)

Instructor-Led – 2 Days

This detailed course provides network engineers with an in-depth study that covers all the principal aspects of IP QoS in part through theory but also by means of at least 9 practical exercises.

Course Modules:

- IP Quality of Service
- Quality of Service Mechanisms

Broadband Access Technologies

Instructor-Led – 1 Day

This course introduces delegates to the broadband technologies and access methods that are available to fixed- and mobile-network operators.

Course Modules:

- The Broadband Market
- Wireline Broadband
- Wireless Broadband
- The Future of Broadband

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Radio Engineering

Introduction to Radio

Instructor-Led – 1 Day

This course provides an understanding of how radio spectrum is managed, the systems that use spectrum and an overview of the technical matters relating to the design of radio systems.

Course Modules:

- A Need for Radio
- Frequency & Bandwidth
- Modulation
- Radio Spectrum
- Antennas & Transmission Lines
- Propagation
- Radio Coverage
- Radio Interference
- Analogue & Digital Systems

Radio Principles

Instructor-Led – 3 Days

This course provides an in-depth understanding of the principles on which radio technologies are built, taking a logical and detailed path through the various aspects of the theory, and practice, of radio communications.

Course Modules:

- Waveform Fundamentals & Baseband Signals
- Electromagnetism & Radio Signal Measurements
- Analogue Modulation
- Digital Modulation
- Duplexing & Multiplexing
- Transmitter & Receiver Design
- Transmission Lines
- Antennas
- Propagation
- Principles of Cellular Coverage
- Radio Systems
- Regulation & Safety

Radio System Design

Instructor-Led – 3 Days

The course covers the essential information and practical skills needed to begin designing mobile and fixed radio systems.

Course Modules:

- Spectrum Management
- Radio Systems
- Propagation Mechanisms & Modelling
- Path Profiling
- Fixed Radio Link Power Budgets
- Fixed Radio Links – Fade Margins & Diversity Systems
- Frequency Reuse & Planning for Land Mobile Radio Systems
- Propagation Models and Link Budgets for Land Mobile Radio Systems
- Capacity Planning
- Radio Site Engineering – Radio Interference & its effects

Principles of Radio Site Engineering

Instructor-Led – 2 Days

This course is intended for those involved in radio site acquisition, planning and build, who do not have a strong radio background. The training focuses on the practical issues of site build.

Course Modules:

- Radio Theory & Propagation
- Antennas and Feeders
- Cellular Coverage Areas
- Radio Interference Problems and Solutions
- Site Engineering Requirements

Radio Network Surveys

Instructor-Led – 2 Days

The course is focused on the practical issues of performing surveys. The equipment and software used on this course includes the Rohde & Schwarz TSMA radio scanner, ROMES and NESTOR software as well as the QualiPoc, handheld survey tool.

Course Modules:

- Cellular Radio Principles
- GSM Radio Networks
- UMTS Radio Networks
- LTE Radio Networks
- 5G Networks
- Wi-Fi Radio Networks
- Radio Measurements
- Idle Mode Activity for Mobile Devices
- Connected Mode Activities for Mobile Devices
- Tools for Radio Surveys
- Guidance for Radio Network Surveys

Open Radio Access Networks (ORAN)

Instructor-Led – 0.5 Day
Self-Study Online – 6 Hours

This course provides an introduction to O-RAN, exploring the purpose, features, architecture, operation and deployment options.

Course Modules:

- Radio Access Networks
- 3GPP RAN Architecture for 5G
- O-RAN, O-RAN Operations & Maintenance
- Whitebox Basestations

Microwave Link Planning

Instructor-Led – 3 Days

The course covers all of the essential aspects of planning point-to-point microwave link systems, from conception to commissioning.

Course Modules:

- Fixed Link Radio Technology
- Availability, Performance and Reliability Objectives
- Spectrum Management
- Feeders and Antennas
- Path Profiling
- Power Budgets
- Fading
- Diversity Systems
- Frequency Assignment & Interference Management

IP Microwave and E Band Planning

Instructor-Led – 0.5 Days

The course looks at how vendors and network planners are addressing the issues associated with upgrading from legacy microwave technologies (PDH/SDH) to full IP.

Course Modules:

- Ethernet Radio
- Spectrum and Regulation
- Technological Developments in Fixed Link radio
- Planning IP and E-Band Radio Links
- Timing and Synchronization

Network Virtualisation

Software Defined Networking (SDN)

Instructor-Led – 1 Day

This course delivered a solid base understand of SDN, network virtualisation and the deployment considerations associated with SDN, including network, software and IT engineers, as well as managers and consultants.

Course Modules:

- SDN Drivers for Change
- Introducing SDN Architecture
- SDN Deployment
- Case Study – Google
- SDN Operation Southbound
- SDN In Transport Networks
- Case Study – Mininet

Network Functions Virtualisation (NFV) Engineering

Instructor-Led – 2 Days

This course provides a detailed understanding of NFV and the deployment considerations associated with NFV; including network, software and IT engineers, as well as managers and consultants.

Course Modules:

- Drivers for Change
- NFV Functional Architecture
- NFV Infrastructure (NFVI)
- NFV Management and Orchestration (MANO)
- Software Defined
- Networks (SDN) and NFV
- NFV ETSI Proof of Concept Projects

Cloud Computing

Instructor-Led – 1 Day

A technical introduction to the techniques and protocols that underpin cloud computing services, including an examination of the types of cloud that can be created and the variety of 'X as a service' facilities that clouds can make available.

Course Modules:

- What is 'The Cloud'?
- Cloud Architecture and Technologies
- Types of Cloud Service
- Pros and Cons of Cloud Computing

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IMS & SIP Training Courses

IP Multimedia Subsystem (IMS)

Instructor-Led – 2 Days

This course provides an understanding of the IP Multimedia Subsystem's (IMS) role in Next Generation Networking. It provides a detailed description of the IMS architecture including security, charging and Policy and Charging Control (PCC).

Course Modules:

- Introduction to the IMS
- IMS Architecture and Functional Elements
- Security and Charging
- Policy and Charging Control
- SIP Procedures in IMS
- IMS Applications

Session Initiation Protocol (SIP)

Instructor-Led – 1 Day

This course provides an understanding of the Session Initiation Protocol (SIP), Session Description Protocol (SDP) and the Real-time Transport Protocol (RTP) and their roles in establishing multimedia communications over an IP-based network.

Course Modules:

- Introduction to SIP and Related Protocols
- SIP Architecture and Operation

SIP Trunking

Instructor-Led – 0.5 Days

This half-day course uses real business cases throughout to discuss the lead up to the employment of SIP Trunking.

Course Modules:

- Overview of SIP Trunking
- Technical Standards
- Design Considerations

SIGTRAN

Instructor-Led – 2 Days

The drive towards all-IP networking necessitates the transport of SS7 protocols over an IP domain. This course provides a thorough explanation of how this is achieved using the SIGTRAN 'toolkit'.

Course Modules:

- Signalling Transport (SIGTRAN) Overview
- Stream Control Transmission Protocol (SCTP)
- SIGTRAN Common Elements
- MTP2 Peer-to-Peer Adaptation (M2PA)
- MTP2 User Adaptation (M2UA)
- MTP3 User Adaptation (M3UA)
- SCCP User Adaptation (SUA)

Softswitching & VoIP

Instructor-Led – 2 Days

Covering Voice over IP (VoIP) services in fixed and mobile, Next Generation Networks (NGNs) and all IP-based networks, the course also includes VoIP concepts, supporting architectures, interworking with circuit-switched networks together with QoS issues.

Course Modules:

- Voice over IP (VoIP)
- Voice Quality
- SIP Architecture and Operation
- Operational Issues
- Softswitching

NGN Voice Protocols

Instructor-Led – 3 Days

This course is intended for experienced telecoms engineers that wish to understand the workings of the protocols that are commonly used within Next Generation Networks (NGNs).

Course Modules:

- Introduction to Next Generation Networks
- Real Time Voice Protocols
- IMS Architecture and Network Elements
- SIP Procedures in IMS
- Softswitching

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Rail Engineering

GSM-R Engineering Overview

Instructor-Led – 2 Days
Self-Study Online – 22 Hours

Those in or entering technical roles within the GSM-R industry who require a broad overview of the services, features and technology of GSM-R.

Course Modules:

- Introduction to GSM and GSM-R Networks
- GSM Network Architecture
- GPRS Network Architecture
- GSM-R Network Architecture
- GSM-R Services
- GSM-R Identities
- GSM-R Coverage
- Network Access
- GSM-R Procedures
- European Train Control System

GSM-R for Rail Engineers

Instructor-Led – 1 Day
Self-Study Online – 11 Hours

This detailed course provides network engineers with an in-depth study that covers all principles of GSM-R networks and operation.

Course Modules:

- Introduction to GSM and GSM-R Networks
- GSM-R Network Architecture
- GSM-R Identities
- GSM-R Functionality
- GSM-R Coverage

ERTMS/ETCS Overview

Instructor-Led – 1 Day
Self-Study Online – 11 Hours

This one-day course is aimed at non-technical project managers that require an overview of ERTMS/ETCS.

Course Modules:

- ERTMS Standards and Legislation
- Basic System Description
- System Architecture
- ERTMS Operating Modes

ERTMS/ETCS for Radio Engineers

Instructor-Led – 3 Days
Self-Study Online – 22 Hours

This three-day course is aimed at radio engineers who need a detailed understanding of the operation of the ETCS.

Course Modules:

- ERTMS Standards and Legislation
- Basic System Description
- System Architecture
- ERTMS Operating Modes
- ERTMS/ETCS Protocols
- Circuit Switched Signalling
- Circuit Switched Connections
- GPRS for ETCS
- The GPRS Air Interface
- GPRS Procedures
- Transmission through the Network
- Radio Network Optimization

FRMCS – Future Railway Mobile Communications System

Instructor-Led – 2 Days
Self-Study Online – 22 Hours

This FRMCS course looks at the documents published by the UIC to gain an understanding of the requirements of a future communications system.

Course Modules:

- FRMCS – An Introduction
- FRMCS Requirements
- Spectrum Issues
- On-board System Architecture
- 4G –LTE
- 5G
- The IP Multimedia Subsystem (IMS)
- Mission Critical Push to Talk (MCPTT)
- Mission Critical Video (MCVIDEO)
- Mission Critical Data (MCDATA)

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Professional Mobile Radio (PMR)

TETRA System Overview

Instructor-Led – 2 Days

All aspects of a TETRA system are described. The course introduces trunking principles, service aspects, network planning and architecture. Technical details about the radio interface are also examined.

Course Modules:

- Trunked Radio
- TETRA Services
- Network Components
- Network Architecture & Functionality
- Air Interface
- Radio Procedures
- Security Aspects
- Direct Mode Operation

TETRA System Design

Instructor-Led – 2 Days

The course will equip delegates with the knowledge to plan and configure TETRA networks.

Course Modules:

- Channel Structure & Configuration
- Burst structure & Configuration
- Radio Performance
- UHF & VHF Propagation Principles
- Frequency Reuse & Planning Techniques
- Propagation Models & Link Budgets
- Cell Dimensioning & Positioning
- Capacity Planning
- Radio Procedures
- Security Aspects

TETRA Security

Instructor-Led – 1 Day

Providing TETRA system engineers with the information required to plan and configure the security services available on TETRA networks.

Course Modules:

- Introduction to Encryption
- Encryption – Adding Functional Keys
- Adding Transposition
- Strength Through Combination
- AES Overview
- Security Associations
- Authentication
- Integrity
- Key Management & Distribution
- IPSec and End-to-End

TETRA Direct Mode Operation

Instructor-Led – 1 Day

The course will enable those working in TETRA systems administration, design and specification to plan and configure TETRA Direct Mode.

Course Modules:

- Introduction to Direct Mode Specifications, Services and Functions
- Frequency Management
- DMO Air Interface Protocol Stack
- Air Interface Procedures
- Direct Mode Layer 3
- Direct Mode Layer 2
- Direct Mode Repeater & Gateway
- Direct Mode Security
- Radio Engineering Aspects of DMO

TETRA Air Interface

Instructor-Led – 2 Days

This course provides a detailed description of the key aspects of the radio link between a TETRA mobile and a TETRA base station.

Course Modules:

- Introduction to TETRA
- TETRA Radio & Modulation
- Physical & Logical Channels
- The MAC Layer
- Logical Link Control (LLC)
- The Network Layer
- Direct Mode Operation

DMR System Design

Instructor-Led – 1 Day

The topics covered in this course will enable those working in radio system design, specification and optimization to plan and configure DMR networks.

Course Modules:

- Introduction to DMR
- Air Interface – Structure and Configuration
- Numbering & Dialling
- UHF & VHF Propagation Principles
- Frequency Reuse & Planning Techniques
- Propagation Models & Link Budgets
- Cell Dimensioning & Positioning
- Capacity Planning
- Channel Access Procedures
- Tier 3 Radio Procedures
- Radio Performance & Engineering Aspects of Direct Mode

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GSM, UMTS & HSPA

UMTS System Overview

Instructor-Led – 2 Days

UMTS is a complex technology that is described thousands of pages of technical specifications. We have distilled this into high-level focused course that will significantly shorten the learning curve.

Course Modules:

- Evolution to 3G
- UMTS Services
- UMTS Architecture
- UTRAN
- Core Network and Interworking
- CDMA Principles
- Power Control and Handover
- Air Interface
- Procedures

HSPA Principles & Application

Instructor-Led – 1 Day

This course provides a clear and logically organized explanation of both HSDPA and the E-DCH for both HSPA and the introduction to HSPA+ capabilities.

Course Modules:

- Enhanced Uplink and Downlink Packet Delivery
- HSDPA Protocols Overview
- HSDPA Implementation
- Enhanced Uplink Protocols Overview
- Enhanced Uplink Implementation

UMTS Core Network

Instructor-Led – 3 Days

This course provides a clear and logically organized tour of the 3GPP UMTS circuit-switched and packet-switched core network domains.

Course Modules:

- Network Architecture
- UMTS Services &Toolkits
- Evolution of the Core Network
- Protocols in the Circuit Switched Core Network
- Protocols in the Packet Switched Core Network
- Other Functions in the Core Network
- Signalling Procedures

Cell Planning for UMTS Networks

Instructor-Led – 2 Days

This course is designed for experienced GSM cell planners and highlights the differences required in technique and tools for planning a WCDMA network.

Course Modules:

- UMTS Planning Philosophy
- UMTS Air Interface
- Considerations for CDMA
- Coverage Predictions
- Traffic Analysis
- Predictions and Simulations
- Co-Siting Considerations

UMTS Air Interface

Instructor-Led – 1 Day

This course provides a comprehensive technical overview of the structure and operation of the UMTS air interface protocol stack.

Course Modules:

- UMTS Planning Philosophy
- UMTS Air Interface
- Considerations for CDMA
- Coverage Predictions
- Traffic Analysis
- Predictions and Simulations
- Co-Siting Considerations

GSM System Overview

Instructor-Led – 2 Days

Describes the services, structure and operation of a GSM network.

Course Modules:

- GSM & its Services
- Domains, Identities & Areas
- Radio Access Network
- Cell Coverage & Capacity
- Core Networks and Interconnects
- GPRS

GSM Air Interface

Instructor-Led – 2 Days

Covering the services, structure and operation of a GSM mobile network.

Course Modules:

- Architectural Review
- Layer 1 Characteristics
- Layer 2 & 3 Signalling
- Idle Mode Procedures
- Circuit-Switched Signalling
- Dedicated Mode Procedures
- GPRS Signalling

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Telecoms Business

Strategy in Business

Instructor-Led – 1 Day

This programme looks at each component of strategy in turn, with the decision-making process at the heart of a much more extensive set of activities need to maximise the impact of good strategy.

Course Modules:

- Understanding Strategy, Industry and Business Dynamics
- Analysing the Market; Developing Strategy & Competitive Advantage, Strategy Execution, KPIS & OKRs
- Key Performance Enablers

Business Finance – For Non-Financial Managers

Instructor-Led – 1 Day

This programme provides a comprehensive foundation in business finance – covering all the major areas needed to be a fully-functioning member of the mid-senior management team.

Course Modules:

- The Financial Cycle and Reporting
- KPIs, Ratios and Financial Analysis
- Financial Control, Budgets and Evaluating Initiatives / Projects

Leadership in Business

Instructor-Led – 1 Day

This programme builds a solid understanding of leadership and culture in business, giving current and aspiring leaders the confidence and tools needed to better engage, guide, develop, coach, organise, assess, and most critically, empower their people, teams and departments.

Course Modules:

- Leadership in Business / Organisations
- Developing Effective Teams
- Influence & Communication
- Supporting & Deploying Effective People – Culture and Innovation

Evaluating & Optimising the Business Models

Instructor-Led – 1 Day

We deconstruct the business model in order to fully understand its component parts before looking at how those parts can be optimally configured / reconfigured in order to maximise value creation and competitive advantage.

Course Modules:

- Definitions and Components of a Business Model
- Business Models – Options, Assessment and Development

Developing & Communicating Compelling Customer Propositions

Instructor-Led – 1 Day

It covers all the key elements needed to develop a sustainable business model that is tightly aligned with customer requirements, gets the right information in front of the right customers in an engaging and compelling way, and supports the overall strategy by delivering sustainable competitive advantage.

Course Modules:

- Creating Compelling Customer Propositions
- Communicating Compelling Customer Propositions
- Sales and Business Development

Optimising Operations &Transformation

Instructor-Led – 1 Day

This programme explores change within businesses / organisations – whether it is a case of optimising operations, or full-on transformation, we hit the key barriers and enablers for change, before exploring the change process and the role of the leader and key stakeholders.

Course Modules:

- Optimising Operations and Transformation