

Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

The Role of Intelligent Machines on the Future Battlefield,
Circa 2030.

A thesis presented in partial fulfilment of the
requirements for the degree of
Master of Arts
in
Defence and Strategic Studies
at Massey University, Palmerston North,
New Zealand.

Ben Robert Morton

2009

Abstract

The application of Intelligent Machine (IM) technology to the battlefield in future has the potential to revolutionise warfare. Converging trends and incentives are propelling this technology towards military applications at an ever increasing rate. This thesis examines the state of IM employment on the battlefield at the year 2030.

The methodology employed in undertaking this thesis is the Extrapolation method. It has been utilised to extrapolate a range of technological, social, geo-strategic and military trends, in order to determine the state of affairs regarding intelligent machines at the subject year 2030.

Chapter One examines what proportion of modern military ground forces will consist of IMs at the subject year. It assesses factors both driving and obstructing the development and employment of IM technology, and compares these against environmental developments with respect to time.

Chapter Two addresses the likely roles in which IMs will be employed on the battlefield. These include present day military functions, as well as possible new roles enabled by specific characteristics of IMs. The chapter also assesses the potential forms that these IMs may take.

Chapter Three focuses on the level of autonomy to be granted to battlefield IMs. It analyses the risks and benefits of autonomous control, and also the

advantages and disadvantages of the alternative of teleoperation. The level of autonomy will be a defining factor of the IM presence on the battlefield.

Chapter Four investigates the potential organisational architectures that may be employed in organising, commanding and controlling IMs. Specifically, centralised, decentralised, and swarm organisation are examined. The advantages and disadvantages of each, as well as necessary enablers are considered in turn.

The conclusion provides an aggregated picture of the IM battlefield presence at the year 2030. It surmises the predicted proportion, roles, the level of autonomy, and organisational architecture of IM technology on the battlefield at the subject year of 2030.

Acknowledgements

I would like to thank everyone who helped see me through to the conclusion of this thesis, with their knowledge, advice, encouragement and patience. I thank Dr Piers Reid (CBE) for helping me stay on track and yet allowing me the freedom to pursue my own ideas. Thanks too to Majors Doug Mallet and Stu Davies of the Australian Army, Major Vern Bennett and Warrant Officer Brian Chalmers of the New Zealand Army, Maxim Zimir of Rafael, Phil Strong of the Defence Technology Agency, Professors Guvinder Virk and Donald Bailey of Massey University, and Bryan Dorn for readily lending me their particular knowledge and expertise.

I give thanks to the New Zealand Army, for assisting in funding this research and giving me the time and opportunity to undertake it. Finally, thanks to Eden Currey for blazing the Defence Studies Masters thesis trail for me, and my fiancé Alex for cracking the whip.

Table of Contents

Abstract	3
Acknowledgements	5
Table of Contents	6
Pictures and Figures:	7
Acronyms	8
<u>Introduction</u>	11
<u>Research Methodology</u>	14
<u>Chapter One: What Proportion – What part of a modern Military’s force will likely be made up of Intelligent Machines by the year 2030?</u>	19
Section One: Drivers – Why Intelligent Machines?	20
Section Two: Obstacles - Factors constraining the development and adoption of battlefield IMs.	46
Section Three: Timeline – IMs and the world, now until 2030.	80
<u>Chapter Two: Role and Form – Tasks and Shapes of IMs on the Battlefield</u>	112
Section One: Which Roles – How IMs may be employed on the Future Battlefield.	113
Section Two: The Product – Physical characteristics of Battlefield IMs.	129
<u>Chapter Three: How Autonomous – Risks and Benefits of Autonomous IMs, and a Comparison with Teleoperation.</u>	145
<u>Chapter Four: What Organisational Architecture – Methodologies of Utilisation, Command and Control of IMs.</u>	163
<u>Conclusion</u>	179
Bibliography	187

List of Figures

Figure 1:	Capability Curve for Emerging Technology	62
Figure 2:	Nurture Period for Capability Development (Musket and Rifle)	63
Figure 3:	Nurture Period for Capability Development (Manned and Unmanned Systems)	64
Figure 4:	The C4 System	163
Figure 5:	Chain of command	163
Figure 6:	Centralised control	168
Figure 7:	Decentralised control	170
Figure 8:	The Swarm	172

List of Pictures

The Goliath tracked mine	22
iRobot Packbot	23
The S-Tank	25
M1A2 Abrams Tank: The true specialist	129
The HUMM WV: Jack of all trades, Master of none	130
BigDog	139
Dragon Runner	139
RHex	140

Acronyms

AI	Artificial Intelligence
AO	Area of Operations
APC	Armoured Personnel Carriers
ARV	Armed Robotic Vehicle
BCI	Brain Computer Interface
BIT	Built-in Test
BOS	Battlefield Operating System
C2	Command and Control
C3	Command, Control and Communications
CCD	Charge-Coupled Device
CIED	Counter Improvised Explosive Device
CIWS	Close-in Weapon System
COP	Common Operating Picture
CSAR	Combat Search and Rescue
CSS	Combat Service Support
DARPA	Defence Advanced Research Programs Agency
DEWS	Directed Energy Weapon System
DOD	Department of Defence
EM	Electromagnetic
EOD	Explosive Ordnance Disposal
EW	Electronic Warfare
FCS	Future Combat Systems
GBAD	Ground Based Air Defence
GPS	Global Positioning Satellite
HF	High Frequency
HRI	Human-Robot Interface
IFV	Infantry Fighting Vehicles
IM	Intelligent Machine
IO	Information Operations
IR	Infra-Red
IRA	Irish Republican Army
ISR	Intelligence, Surveillance and Reconnaissance
KIA	Killed in Action
LOAC	Laws of Armed Conflict
MANET	Mobile Ad hoc Network
MIPS	Million Instructions per Second
MNC	Multinational Corporation
MRAP	Mine Resistant Ambush Protected
NBC	Nuclear, Chemical, Biological
OODA	Observe, Orientate, Decide, Act
OS	Offensive Support
PDA	Personal Digital Assistant
PMC	Private Military Contractor
RFID	Radio Frequency Identification
RMA	Revolution in Military Affairs
ROE	Rules of Engagement
SA	Situational Awareness
SAM	Surface to Air Missile

SWORDS

TI

UAV

UGV

VHF

WIA

Special Weapons Observation Reconnaissance
Detection System

Thermal Imaging

Uninhabited Aerial Vehicle

Uninhabited Ground Vehicle

Very High Frequency

Wounded in Action