자율운항선박 운영을 고려한 VTS 관제시스템의 사이버보안 만족도 조사: 부산항 VTSO 사례연구

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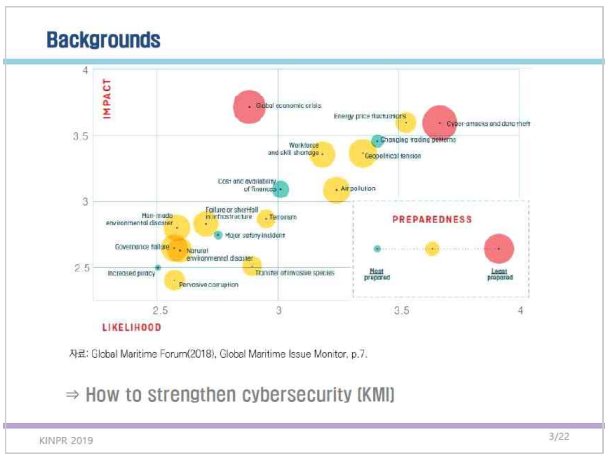
요 약 : 우리나라는 국제해사기구에서 제시한 자율수준 3단계의 자율운항선박 기술개발 사업을 추진 중에 있으며, 자율운항선박 및 원격운항센터의 사이버보안에 관한 기술개발이 핵심과제로 포함되어 있다. 국제해사기구는 현존선의 대한 사이버 위협에 대한 조치로 제98차 해사안전위원회에서 '해상 사이버 위험관리 지침(Guidelines on maritime cyber risk management)'을 채택 및 승인하였다. 자율운항선박이 디지털 센서의 거대시스템임을 고려할 때 기술개발 완료시 해상에서 기존 선박과 자율운항선박의 공동 운항을 고려하여 해상교통관제체계(VTS)에 대한 사이버보안 측면을 고려 할 필요가 있다. 이 논문에서는 부산항 VTS 관제사(VTSO)를 대상으로 하여 자율운항선박 운영을 고려한 VTS 관제시스템의 사이버보안 만족도를 조사하였다. VTSO를 대상으로 한 사이버보안 만족도 조사 및 분석방법은 IPA(Importance Performance Analysis) 매트릭스를 적용하였다.

핵심용어 : 자율운항선박, 사이버보안, VTS, VTSO, IPA 분석기법



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What is the cyber security ?

- **Cybersecurity can be defined as**
  the collection of *tools, policies, security concepts, security safeguards, guidelines, risk management approaches, actions, training, best practices, assurance and technologies* that can be used to protect the cyber environment and organisation and user's assets(Source: Overview of cybersecurity, ITU-T X.1205, 2008).
  USER's ASSETS Include connected computing devices, personnel, infrastructure, applications, services, telecommunications systems, and the totality of transmitted and/or stored information in the cyber environment.

- **Cyber-Security and Cyber-Safety risks**
  CUBERSECURITY RISKs Potential for *intentional disruption* compromise, or exploitation of a computer network or control system by non-authorized personnel(Source: Guidelines for addressing cyber risks at maritime transportation security act(MTSA) regulated facilities, USCG 2016).
  CUBERSAFETY RISKs Potential for *accidental disruption* of a computer network of control system by an owner, operator, other actor, or as an unintended consequence of a mishap within a connected cyber system.

What is the cyber security ?

- **Cybersecurity attributes**
  CONFIDENTIALITY The control of access and prevention of unauthorised access to ship data, which might be sensitive in isolation or in aggregate(Source: Code of practice – Cyber security for ships, UK Department for Transport 2017).

  POSSESSION & CONTROL The design, implementation, operation and maintenance of ship systems and associated processes so as to prevent unautohrised control, manipulation or interference.

  INTEGRITY Maintaining the consistency, coherence and configuration of information and systems, and preventing unauthorised changes to them. A loss of system integrity could occur through physical changes to a system, such as the unauthorised connection of a Wi-Fi access point to a secure network, or through a fault such as the corruption of a database or file due to media storage errors.

  AUTHENTICITY Ensuring that inputs to, and outputs from, ship systems, the state of the systems and any associated processes and ship data, are genuine and have not been tampered with or modified. Authenticity issues could related to data such as a forged security certificate or to hardware such as a cloned device.

What is the cyber security ?

- **Cybersecurity attributes**
  AVAILABILITY Ensuring that the asset information, systems, and associated processes are consistently accessible and usable in an appropriate and timely fashion(Source: Code of practice – Cyber security for ships, UK Department for Transport 2017).

  UTILITY That asset information and systems remain usable and useful across the lifecycle of the ship asset. An example of loss of utility would be a situation where a ship system has been changed or upgraded and the file format of historic data is no longer intelligible to the system.

  SAFETY The design, implementation, operation and maintenance of ship systems and related processes so as to prevent the creation of harmful states which may lead to injury or loss of life, or unintentional physical or environmental damage. A safety issue could arise through malware causing a failure or display or communication ship systems alarm states.

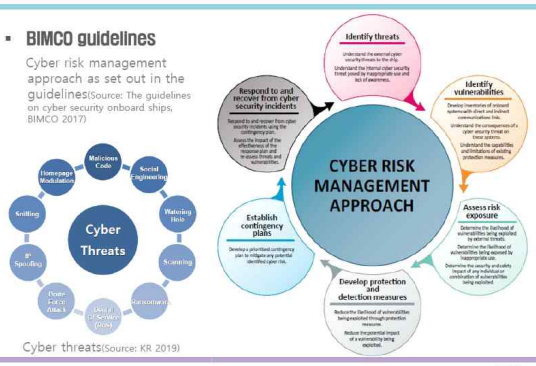
  RESILIENCE The ability of the asset information and systems to transform, renew and recover in a timely way in response to adverse events. In the event that an outage occurs, it should be possible to recover a normal operating state, or acceptable business continuity state, in a timely manner.

Cybersecurity related standards & guidance

Cybersecurity related guidelines(Source: KR 2019)

Cybersecurity related standards & guidance

- **BIMCO guidelines**
  Cyber risk management approach as set out in the guidelines(Source: The guidelines on cyber security onboard ships, BIMCO 2017)



Cyber threats(Source: KR 2019)

How to identify vulnerability & Assess risk ?

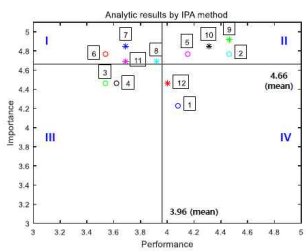
연구영역	응답자(명)	비율
정책	15	11.8%
해운	20	15.7%
해사	33	26.0%
정보통신	24	18.9%
보안관리	6	4.7%
기타	29	22.8%
합계	127	100%

(표 3-29) 상대적 중요도 평가항목

대항목 (가중치)	구 분	내 용	점수 (%)	순위 (Rank)
A (36.3%)	관리적 보안 (Administrative Security)	A-1. 인식제고 및 교육	12.8	1
		A-2. 이동 미디어(USB 등) 통제	9.6	4
		A-3. H/W 및 S/W 업그레이드	8.1	6
		A-4. 비상계획 수립	4.9	11
B (37.7%)	기술적 보안 (Technical Security)	B-1. 네트워크 접근제어	12.2	2
		B-2. 사이버 공격 탐지 및 차단	12.0	3
		B-3. 원격/ 무선 접근제어	6.6	10
		B-4. 데이터 백업 및 복구	6.9	9
C (28.1%)	물리적 보안 (Physical Security)	C-1. 보안구역 통제	8.8	5
		C-2. 정보 및 S/W 반출금지	7.0	7
		C-3. 장비의 가용성/ 무결성 보장	6.9	8
		C-4. 데이터 및 라이센스 폐기	4.2	12

How to assess importance & satisfaction ?

Analytic results of importance & satisfaction by IPA method



- **IPA results**
  I – Threats (6, 7, 8, 11),
  II – Opportunities (2, 5, 9, 10)
  III – Weaknesses (3, 4)
  IV – Strengths (1, 12)

⇒ Need to concentrate on Section-I (6,7,8,11)